comes under the mobile communi-
cation system.

2. Types

There are various kinds of
communication nets such as public
communication net, police communi-
cation net, railway communication
net, weather communication net, etc,
according to the purpose of the

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communication nets such as public communication net, police communication net, railway communication net, weather communication net, etc, according to the purpose of the communication facilities. Communication facilities may also be divided

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into different classifications, such as wire telephone net, wireless telephone net, and facsimile transmission net, etc. These communication nets are exceedingly complex. Some are duplications while others are interlinked. But as a rule, each is independently organized.

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etc. These communication nets

are exceedingly complex. Some

are duplications while others are

interlinked. But as a rule,

each is independently organized.

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Section 2 Wire Telephone Apparatus

Part ONE: Definition of Wire telephone Apparatus.

Wire telephone equipment consists of various apparatus which change the sound waves generated by a talker into electric vibration, transmit the vibrations through wires to distant points and reproduce the fundamental tones as original sound waves.

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the sound waves generated by a talker into electric vibration, transmit the vibrations through wires to distant points and reproduce the fundamental tones as original sound waves.

The apparatus consists of telephones, wires, switchboards,

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safety devices, wire distributing panels, testing equipment, and apparatus for ~~source of~~ electric power generation. Besides these, there are special apparatus such as telephone repeaters, carrier telephone ~~apparatus~~ equipment, simultaneous address telephone equipment and privacy system

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powers. Besides these, there are special apparatus such as telephone repeaters, carrier telephone ~~apparatus~~ equipment, simultaneous address telephone equipment and privacy system apparatus.

Part TWO: Telephone Set

A telephone set consists of a

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transmitter, receiver and signalling apparatus. The transmitter and receiver are the most important parts of telephone equipment.

(1) Transmitter. A telephone is an instrument which carries voices a long distance in the form of electric currents, and after the

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parts of ~~my~~ telephone equipment.

(1) Transmitter. A telephone is an instrument which carries voices a long distance in the form of electric currents, and after the currents reach the destination, it changes them back into voices. The function of a transmitter is to

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Attached p 34

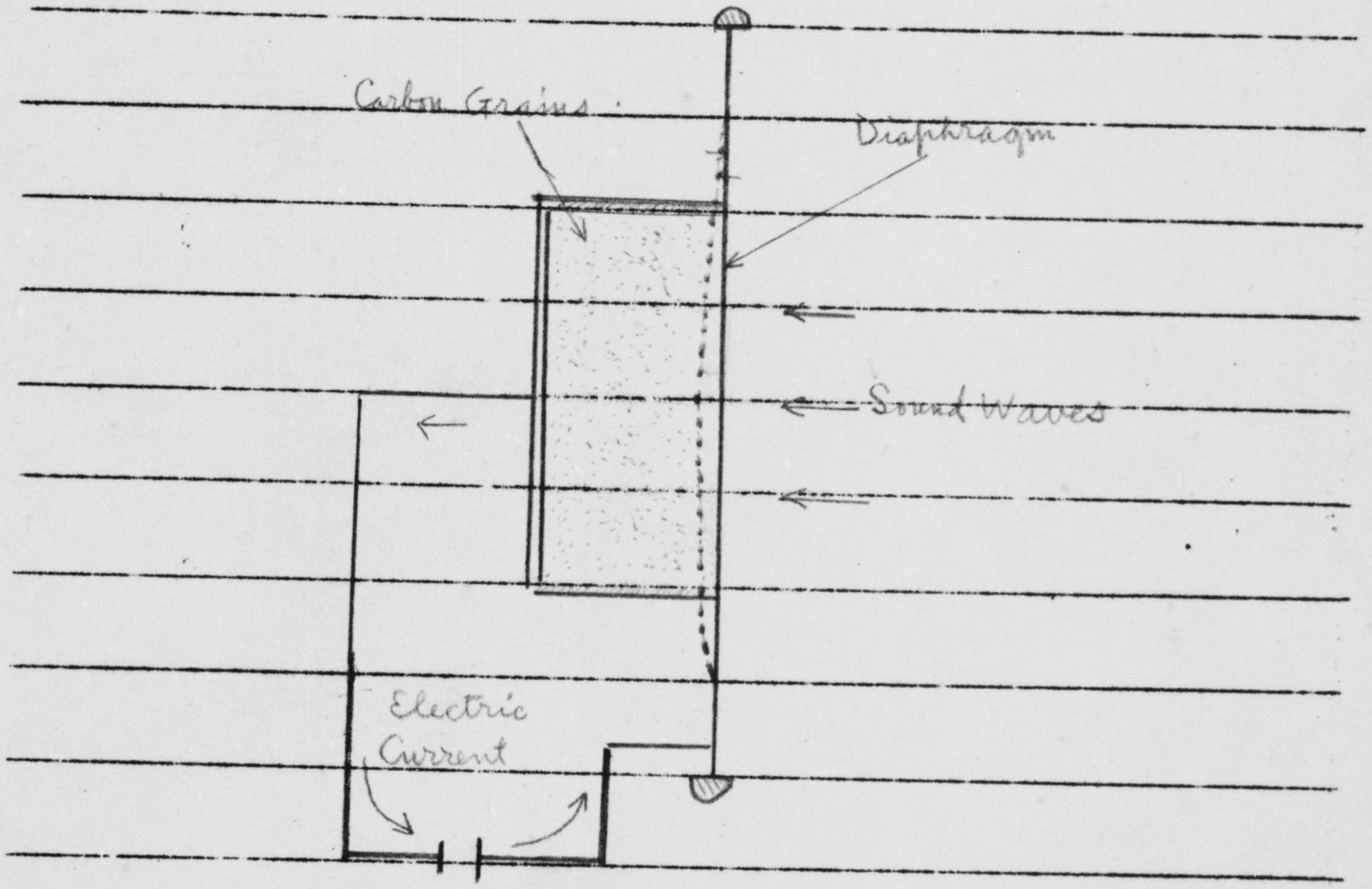

Fig 33

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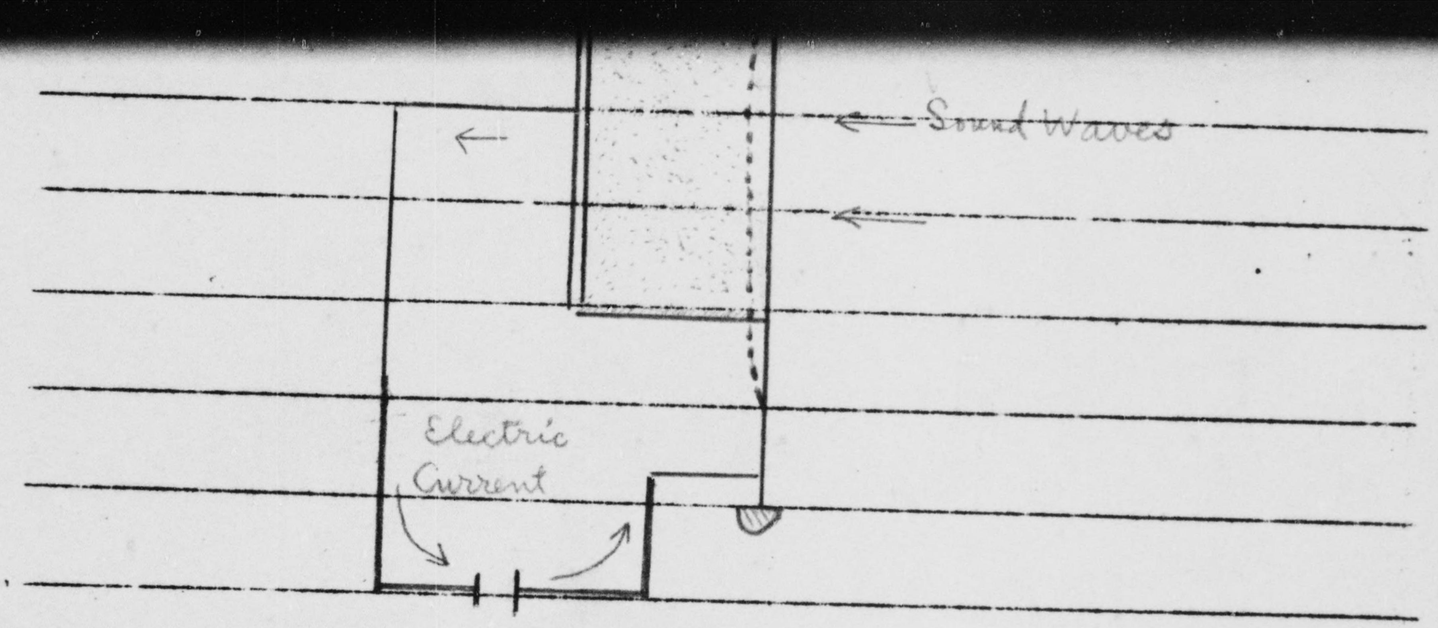

Fig 33

Theory of Transmitter

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change human voices into electric currents.

For this the transmitter is equipped with a diaphragm which vibrates according to the sound of our voices. To change voices into electric currents, the box behind the diaphragm is filled with carbon

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equipped with a diaphragm which vibrates according to the sound of our voices. To change voices into electric currents, the box behind the diaphragm is filled with carbon grains (Fig 33). Since carbon is a good conductor of electricity, when a battery is attached to both sides

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of the carbon box, electric current begins to flow through the carbon grains. However, the strength of flow of the electric current varies according to how the box is filled. That is to say, if the box should be filled loosely, there is less adherence between the grains of

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flow of the electric current varies

according to how the box is filled.

That is to say, if the box should

be filled loosely, there is less

adherence between the grains of

carbon and thus greater resistance,

consequently, the passage of electric

current is made difficult. On the

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other hand, tightly packed grains offer little resistence and provide excellent passage of electric current. In other words, the ratio of the electric current which passes through the carbon is in proportion to the pressure applied to the carbon grains.

Accordingly, when one

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other words, the ratio of the electric current which passes through the carbon is in proportion to the pressure applied to the carbon grains.

Accordingly, when one speaks into the transmitter after a battery is connected to the box containing the carbon grains behind

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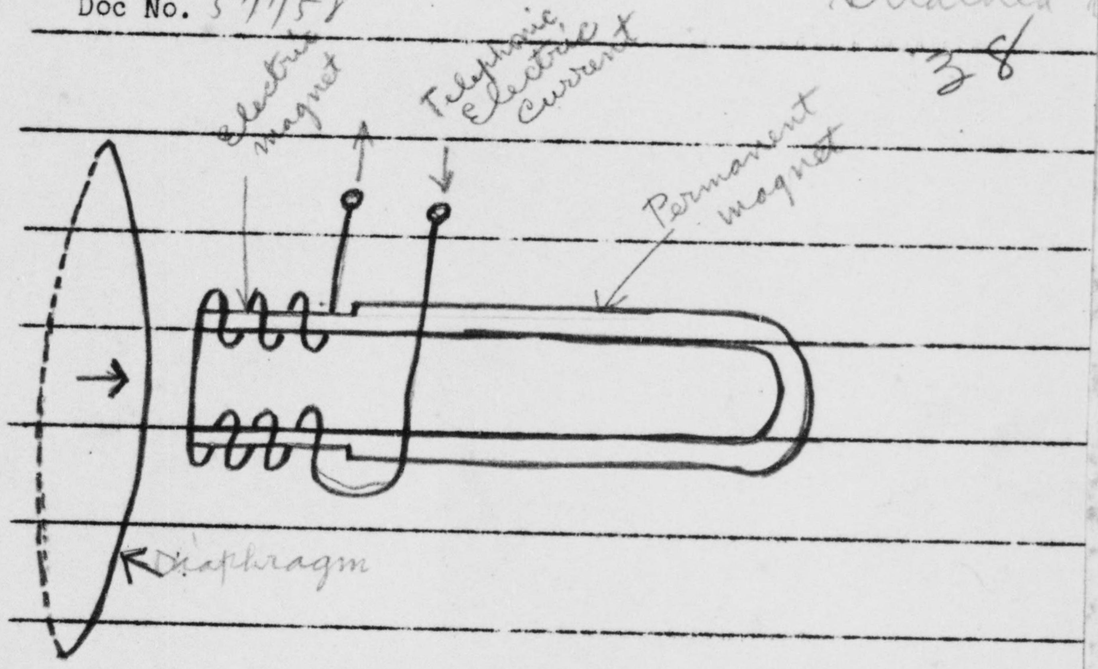
Attached to 38



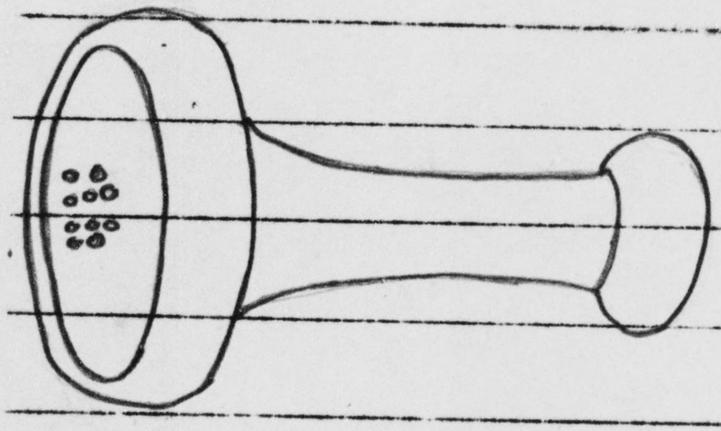


Fig 34

When telephone current passes through the electro-magnet, the diaphragm

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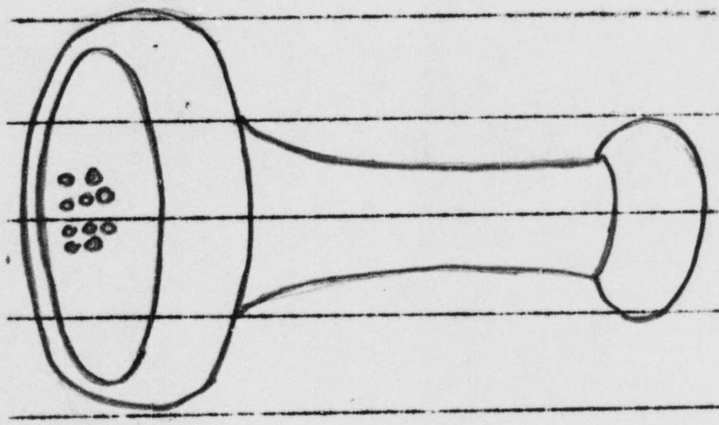

Fig 34

When telephone current passes through the electro-magnet, the diaphragm vibrates and produces audible sounds.

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the diaphragm and electric current is permitted to flow, the diaphragm vibrates. With each vibration, pressure is applied or released from the carbon grains. The flow of the electric current also becomes stronger or weaker with each vibration.

(2) Receiver

pressure is applied or released from the carbon grains. The flow of the electric current also becomes stronger or weaker with each vibration.

(2) Receiver

A receiver is an instrument which reverts the telephonic current sent from the transmitter back into

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sound and sends the sound as

voice into the ear. But it is still

the diaphragm of the receiver which

produces the sound, and in order to

produce vibration of the diaphragm

with electric current, an electromagnet

is used. As is shown in Fig.

34, a piece of wrought iron is

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produces the sound, and in order to produce vibration of the diaphragm with electric current, an electromagnet is used. As is shown in Fig. 34, a piece of wrought iron is attached to each end of the two poles of the horseshoe-shaped permanent magnet. A coil is

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wound around the wrought iron, and a diaphragm is placed in front of the two ends of the wrought iron. Drawn by the force of the permanent magnet, the diaphragm is usually in a curved form. However, when electric current is sent through the coil, the wrought iron becomes an

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Drawn by the force of the permanent magnet, the diaphragm is usually in a curved form. However, when electric current is sent through the coil, the wrought iron becomes an electromagnet, and the combination of its force with the magnetic force of the permanent magnet alters the

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force that has been pulling the diaphragm. When the electric current which is constantly being changed by the transmitter flows through the coil, the diaphragm vibrates to and fro, aided by the force which pulls it and produces an audible sound.

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changed by the transmitter flows through the coil, the diaphragm vibrates to and fro, aided by the force which pulls it and produces an audible sound.

(3) Signalling Apparatus.

The signalling apparatus consists of a magnetic dynamo and electric

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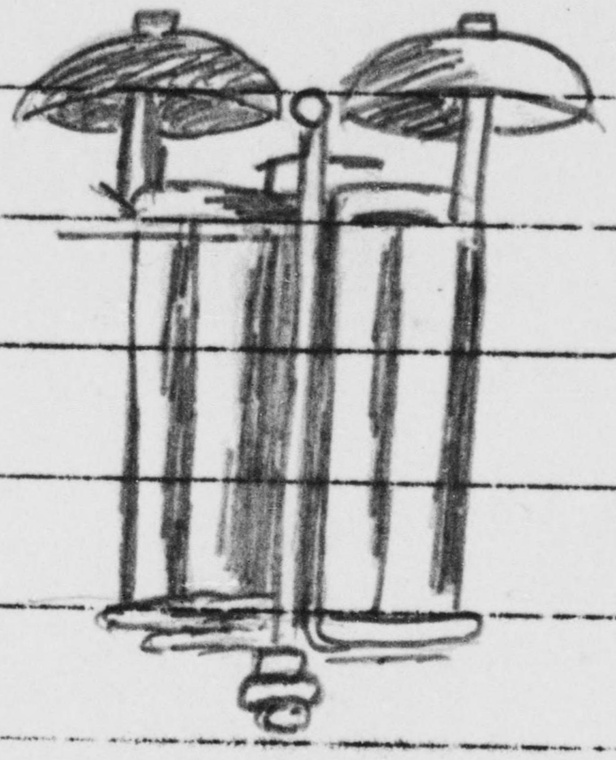

Fig 35 Signalling Apparatus

bells and is a device which calls the correspondent or signals that one is being called (Fig 35).

(4) Classification of Telephone Set.

A telephone set is either a magnetic system or a common battery system. The difference

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(4) Classification of Telephone

Set.

A telephone set is either a

magnetic system or a common

battery system. The difference

lies in whether each subscriber is

equipped locally with a transmitting

battery or whether the batteries of all

the subscribers within the subscriber

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(4) Classification of Telephone

Set.

A telephone set is either a

magnetic system or a common

battery system. The difference

lies in whether each subscriber is

equipped locally with a transmitting

battery or whether the batteries of all

the subscribers within the subscriber

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area are installed at the telephone office and used jointly (Fig 36). (By subscriber area is meant telephone sets which receive calls through the same switchboard or telephone office).

The magnetic system telephone is equipped with the above mentioned

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sets which receive calls through the same switchboard or telephone office).

The magnetic system telephone is equipped with the above mentioned signalling apparatus, but in the common battery system telephone, the call sign is automatically

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transmitted to the telephone office

when the receiver is taken off the hook.

Needless to say it is also equipped

with an electric bell which signals

one whenever he is called.

An automatic telephone is

a common battery system telephone

equipped with a dial. When the

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with an electric bell which signals

one whenever he is called.

An automatic telephone is

a common battery system telephone

equipped with a dial. When the

dial is spun according to telephone

signal, the correspondent is called

through the automatic switchboard.

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As for ~~the~~ types of telephone sets, there are the wall, desk and portable telephones (Fig 37).

Part THREE: Telephone Switchboards

At first the telephone was used to communicate between only two places. However, with the subsequent increase in the number

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Pt THREE: Telephone Switchboards

At first the telephone was used to communicate between only two places. However, with the subsequent increase in the number of telephone sets, the necessity of communicating freely with any set arose; in other words there grew

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a need for a telephone exchange.

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There are two types of switchboards, namely the manual-switchboard and the automatic-switchboard.

The former is operated by a switch-board operator while the latter works by ~~a~~ automatic mechanism.

(1) The Manual Switchboard.

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The former is operated by a switch-

board operator while the latter

works by an automatic mechani-

sm.

(2) The Manual Switchboard.

The manual switchboard is classi-

fied as a magneto system or a

common battery system.

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I The Magneto Switchboard.

There are two types of magneto switchboards; the wall model (Fig 38-2) and the desk model (Fig 38-1).

The former is used when there are only a few subscribers accomodated, i.e. about 20 to 30.

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(Fig 38-2) and the desk model

(Fig 38-1).

The former is used when there are

only a few subscribers accomoda-

ted, i. e. about 20 to 30.

For circuits numbering more than

30, the latter is used.

The construction of the magneto

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switchboard is quite simple, but it is somewhat inconvenient for serving subscribers. Consequently, it is more adapted for a telephone exchange in small towns where the telephone traffic is comparatively light. Aside from big cities,

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Consequently, it is more adapted for a telephone exchange in small towns where the telephone traffic is comparatively light. Aside from big cities, in police communication also, the magneto switchboard is in most commonly use.

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According to the number of accomodated subscriber circuits, the magneto switchboard is divided into two types from the standpoint of performance- the single system switchboard and the multiple system switchboard.

(1) The Magneto Single System Switchboard.

As mentioned earlier, in the magneto

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types from the standpoint of performance-

the single system switchboard

and the multiple system switchboard.

(4) The Magneto Single System Switchboard.

As mentioned earlier, in the magneto

system of exchange the transmitting

current of subscribers is supp-

lied from the local batteries which are

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provided in the telephone of each sub-
scriber.

When calling the exchange or when
signalling the completion of conver-
sation, the indicator of the exch-
ange is put into motion by using
the magneto dynamo attached
to the telephone.

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sation, the indicator of the exch-
ange is put into motion by using
the magneto dynamo attached
to the telephone.

When the magneto switchboard
receives a signal from the
telephone, the switchboard

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drop line is pulled out and the telephone operator inserts the answering plug (a metal peg to fit the jack, Fig 3.8-3) into the jack of the subscriber corresponding to the indicator that moves and answers (cylindrical opening in the switchboard.

The opening is metallic and the

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of the subscriber corresponding to the indicator that moves and answers (cylinderical opening in the switchboard.

The opening is metallic and the inner part has a spring contact surface.

In the switchboard, it forms

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the terminal of the telephone circuit.

Fig 38-4)

~~and answers.~~

Next, the operator inserts the

calling plug of the connecting cord

into the jack of the correspande-

nt and gives a signal (the

operator turns the handle of

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calling plug of the connecting cord into the jack of the correspondent and gives a signal (the operator turns the handle of the ringer attached to the switchboard) to call the correspondent and connects the two.

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When the conversation ends,
the ring-off apparatus of the
cord circuit is set off by the
subscriber and the operator disco-
nnects the connecting cord.

A 100 circuit switchboard
is equipped with 100 jacks and
100 drop lines necessary to

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subscriber and the operator disco-

nnects the connecting cord.

A 100 circuit switchboard

is equipped with 100 jacks and

100 drop lines necessary to

handle the telephones it

accomodates a

Moreover, the plug board is

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equipped with a 12 circuit
connecting cord necessary for
operation of exchange connection.
This connecting cord has one
answering plug, one calling
plug and a ring-off appara-
tus and one combined key
corresponding to the two plugs.

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This connecting cord has one answering plug, one calling plug and a ring-off apparatus and one combined key corresponding to the two plugs.

For the operators to carry on conversation, the switchboard is equipped with one telephone circuit

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This connecting cord has one answering plug, one calling plug and a ring-off appara-tus and one combined key corresponding to the two plugs.

For the operators to carry on conversation, the switchboard is equipped with one telephone circuit.

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(It consists of transmitter and receiver) used jointly by each connecting cord, and one dynamo for signalling purposes.

Thus, the single system switchboard is equipped with a jack and a drop for each subscriber.

Since one jack is used jointly

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one dynamo for signalling purposes.

Thus, the single system switchboard is equipped with a jack and drop for each subscriber.

Since one jack is used jointly for both incoming and outgoing signals, as the number of

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switchboards increases, if the operator wishes to connect her switchboard directly with another switchboard other than the adjacent switchboard, she must connect them ~~two switchboards~~ through the junction line between the switchboards.

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another switchboard other than the adjacent switchboard, she must connect them ~~two switchboards~~ through the junction line between the switchboards.

(B) The Magneto Multiple System Switchboard

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The magneto multiple system switchboard is equipped with an answering jack and a multiple system jack for each subscriber circuit.

The multiple system jack has a multiple connection, therefore, every operator is able to use the jack.

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multiple system jack for each
subscriber circuit.

The multiple system jack has
a multiple connection, there-
fore, every operator is able
to use the jack.

Unlike the single system switch-
board, it does not have to

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handle the calls of the junction line, consequently, the operator's efficiency is markedly heightened.

2. The Common Battery System Switchboard

The operation of the common battery system switchboard is

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ccncy is markedly heightened.

2. The Common Battery System Swi-

tchboard

The operation of the common

battery system switchboard is

almost the same as that of

the magneto system switchboard

except that a lamp is used as

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the indicator.

The subscribers use the common battery system telephone, and the transmitting current is supplied from the joint source of electricity (batteries) which is provided at the exchange office.

To call the exchange, one simply

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the transmitting current is supp-
lied from the joint source of
electricity (batteries) which is
provided at the exchange office.
To call the exchange, one simply
has to take the receiver off the
telephone.
To send the ring-off signal,

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one merely replaces the receiver on the telephone.

The common battery system switch-board is therefore used where the telephone traffic is heavy or where there is a great number of accomodated circuits. (Fig 39)

There are also two types of common

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board is therefore used where the telephone traffic is heavy or where there is a great number of accomodated circuits. (Fig 39) There are also two types of common battery system switchboards; the single system and the parallel multiple system.

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The former is used for exchange in small towns where the number of subscribers ranges from 30 to 200 and the latter in large cities with 200 to 8.000 subscribers.

(2) The Automatic Switchboard.

The automatic switchboard belongs

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cities with 200 to 8.000 subscri-

bers.

(2) The Automatic Switchboard.

The automatic switchboard belongs

to the common battery system

switchboard class.

Its working principle is:

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When the finger plate of the dial on the telephone is dialed according to the telephone number of the correspondent, pulse current is transmitted to the switchboard putting the electro-magnet into action. With each number, the shaft

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set of the correspondent,
pulse current is transmitted
to the switchboard putting the
electro-magnet into action.
With each number, the shaft
of the switchboard rises and
rotates and selects the telephone
circuit to be connected. (Fig 40)

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The advantages of an automatic switchboard are;

1. It eliminates artificial errors caused by operators.

2. Protects secret of conversations.

3. Maintains constant service to subscribers day and night.

Part FOUR: Circuits

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caused by operators.

2. Protects secret of conversations.

3. Maintains constant service

to subscribers day and night.

Part FOUR: Circuits

A circuit serves to carry the

sound waves produced by the

telephone transmitter to distant

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places, and consists of electric wires and supports.

As for the kinds of circuits there are the overhead bare circuit, land cable circuit and submarine cable circuit.

(Fig 41)

(1) Bare circuit.

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there are the overhead bare circuit, land cable circuit and submarine cable circuit. (Fig 41)

(1) Bare Circuit.

By bare circuit is meant bare lines installed on poles. Hard copper wires are generally

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used, but occasionally from the standpoint of economy and in localities where there are heavy wind and snow storms, iron wires are used.

The number of lines installed on one circuit is limited to 24.

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wind and snow storms, iron

wires are used.

The number of lines installed

on one circuit is limited to

24.

However, there are a few

circuits with only one line,

although the minimum is

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generally two.

Two lines form one circuit.

Generally, for eight lines or

less of small wires, the height

of the poles used is over seven

meters, for 24 lines or

less of medium wires, the poles

are over eight meters and for

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less of small wires, the height of the poles used over seven meters, for 24 lines or less of medium wires, the poles are over eight meters and for 42 lines of big wires, nine meters.

In short, poles from 7 up to

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12 meters are used, but they are slightly smaller than those used to support electric light wires.

The poles are made from cryptomeria or Japanese cypress. When treated with creosote they last three to four times

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wires.

The poles are made from crypto-
meria or Japanese cypress.
When treated with creosote
they last three to four times
longer than non-treated poles.
In the past, practically all of
the poles were treated with

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creosote, but recently this is
difficult because of the shorta-
ge of creosote.
Cross-arms are used for stringing
the electric wires on the poles.
The length of the cross-arm ranges
from 60 centimeters to 2 meters.
40 centimeters.

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Cross-arms are used for stringing the electric wires on the poles. The length of the cross-arm ranges from 60 centimeters to 2 meters. 40 centimeters.

Generally, the cross-arm is installed about 20 centimeters from the top of the pole

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and three is the maximum
for four lines or eight lines.
The distance between the lines is
wider when short cross-arms
are used, and narrower in
case of long cross-arms.
The distance varies from 48
centimeters down to 28 centimeters.

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are used, and narrower in case of long cross-arms.

The distance varies from 48 centimeters down to 28 centimeters.

The regular route length (the sum of the distance between the poles) is used to indicate

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the length of the circuit, and the line length is indicated by the developed length (the sum of the length of the wires.

Bare circuits were widely used in the past, but because in many cases they are affected by the elements or other external

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sum of the length of the wires.

Bare circuits were widely used in the past, but because in many cases they are affected by the elements or other external conditions and the safety of communication becomes difficult to maintain, bare circuits today

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are used only in areas where few lines exist or where installation of cable is uneconomical. Especially, when a number of circuits are installed on one pole, electrical coupling between the circuits frequently occurs and lead to cross-talk.

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especially when a number of circuits are installed on one pole, electrical coupling between the circuits frequently occurs and lead to cross-talk.

To avoiding such a situation, the transposition system is used.

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(2) Land Cable Circuit.

A cable is made from thin copper wires (called core wire) wrapped spiral-wise in good quality insulated paper which are twisted into pairs and bundled into the needed amount. This is covered with good

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wrapped spiral-wise in good quality insulated paper which are twisted into pairs and bundled into the needed amount. This is covered with good quality insulated paper to form the core of the cable. The insulated paper is coated

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with three percent tin or lead containing one percent antimony.

This type of cable is generally called lead covered cable.

As a rule, soft ordinary single copper wire with a diameter of 0.5, 0.65 or 0.9

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one type of cable is generally called lead covered cable. As a rule, soft ordinary single copper wire with a diameter of 0.5, 0.65 or 0.9 millimeters is used as a conductor. For insulation, good quality

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paper like manila paper
which is uniform in quality
and thickness and which does
not absorb water is used.

(Fig 42)

For local circuits, cables with
a core of 13, 25, 50 or 100
pairs of wire or in multiples

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not absorb water is used.

(Fig 42)

For local circuits, cables with a core of 13, 25, 50 or 100 pairs of wire or in multiples of 100 are commonly used.

Recently, enormous cables with a core of 1200 or 1800 pairs

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of wire have been also used.

There are two kinds of cable line,

overhead cable and underground

cable.

Overhead cables are supported

by hangers which are attached

to the cable support wires strung

from pole to pole.

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