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FACSIMILE

BASIC 2000

REVISION 0

Canon

APR.2000 **HY8-53A2-00Z**
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This manual has been issued by Canon Inc. to provide information necessary to self-study to technicians who service facsimile products. This manual covers all localities where the facsimile products are sold. For this reason, there may be information in this manual that does not apply to your locality.

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DTP System

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PREFACE

This manual describes the general technology and principles of CANON facsimile operation so that those studying facsimiles for the first time and those already servicing facsimiles can gain a further understanding of these equipment.

Chapters 1 and 2 describe an overview of telephony and facsimile operation. Chapter 3 onwards describes the reading section, recording section, communications and electricians in more detail. Those studying facsimiles for the first time should begin their studies with Chapters 1 and 2. Those already servicing facsimiles or those who already understand facsimiles to a certain extent may refer to chapters that meet their particular requirements.

This manual is made up of the following chapters:

Chapter 1: BASIC OF TELEPHONE

Chapter 2: GENERAL DESCRIPTION OF A FACSIMILE

Chapter 3: READING SECTION

Chapter 4: RECORDING SECTION

Chapter 5: G3 FACSIMILE COMMUNICATIONS

Chapter 6: FACSIMILE SYSTEM

APPENDIX

The appendix is followed by a glossary with supplementary explanations of technology that could not be described in the main text. Refer to this glossary as necessary.

Words colored red in this document are explained in the “GLOSSARY” in the “APPENDIX” of this document.

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1. INTRODUCTION TO THE TELEPHONE

You can't transmit a document unless your facsimile and the receiving facsimile are connected over a telephone line. In this section, let's learn about the basics of telephones and telephone lines.

1.1 Parts of the Telephone

Very few people know the names of the parts of a telephone even though they use it every day. Let's learn the names of the parts on a telephone.

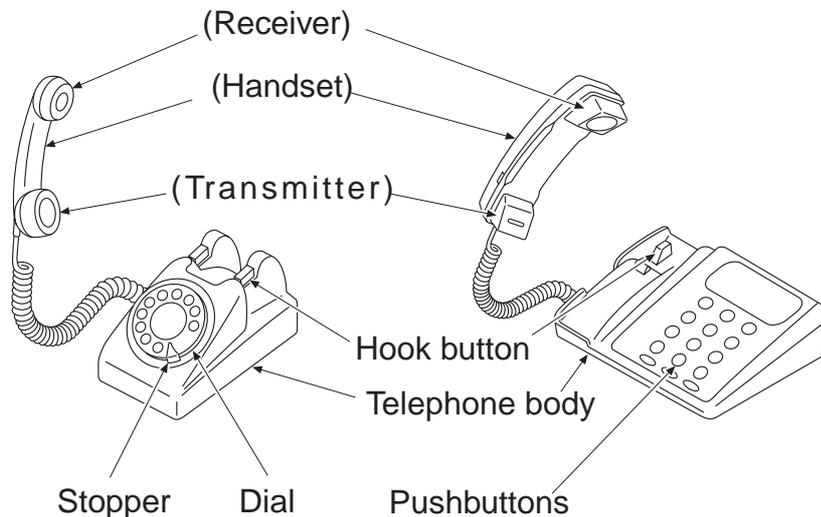


Fig. 1-1 Parts of the Telephone

What we generally refer to as the receiver was in fact the handset. The “receiver” is the part that we hold against the ear on the handset. Likewise, the part that we bring near our mouth on the handset is called the transmitter.

Some people mistakenly refer to the handset as the receiver.

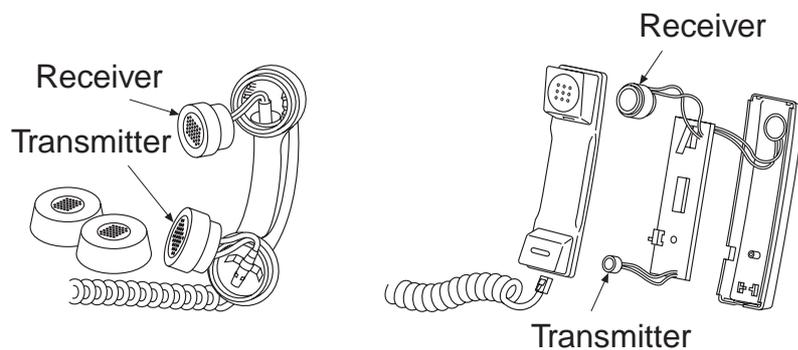


Fig. 1-2 Handset

1.2 Making a Call

There are names for the party being called and the party making the call. When we make a call, one of the two parties must first dial to call up the other party by the bell on its telephone. Making a call in this way, that is, dialing is called the “outgoing call”, and the call that arrives is called the “incoming call”.

1

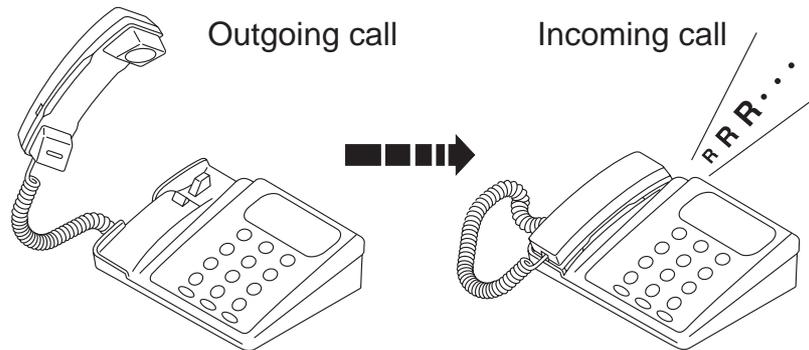


Fig. 1-3 Telephone Call State (1)

When you lift the handset, the handset is “off-hook”. When you hang up, the handset is “on-hook”.

These days, some telephones have an on-hook button. For example, even if the handset is placed on the telephone body, pressing this on-hook button sets the telephone to the same state (on-hook) as when the handset is picked up.

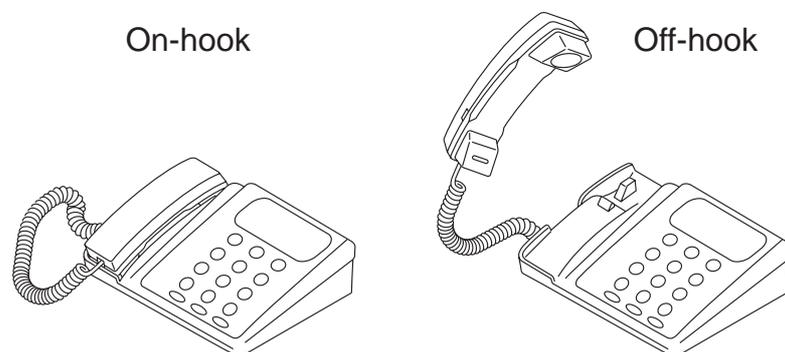


Fig. 1-4 Telephone Call State (2)

1.3 How do you make a call?

When you call someone, you must take various actions.

Let's consider each individual action needed for making a call.

- (1) You pick up the handset. This means you are making a calling request. The telephone **exchange** gets ready to connect you to your party.
- (2) The exchange emits the dial tone to indicate it is ready for the called number.
- (3) You dial your party's number. This is the dialing signal.
- (4) When the telephone exchange receives your dialing signal, it attempts to connect with your party. If your party is free, the exchange will make the connection, and you will hear a ringing tone.
- (5) When the other party picks up the handset, the exchange stops sending the ringing tone, so that you can have a conversation.
- (6) You have your conversation.
- (7) You hang up.



When the called number is in use, the calling party hears a busy tone. Even if the called party hangs up while the caller is listening, the calling party will still hear the busy tone. So the calling party needs to dial again.

1.4 Voice Frequencies Carried by the Telephone

The human ear can hear sounds with frequencies between 10 Hz and 15,000 to 20,000 Hz. The human voice is composed of many different frequencies. To be able to transmit the full range of hearing over the phone line would require very high-quality amplifiers and other equipment. Far more than is practical.

The telephone transmits enough voice frequencies to understand what is being said; usually between 300 to 3,400 Hz.

2. STRUCTURE OF A TELEPHONE

1

A telephone consists of a receiver (speaker), a transmitter (microphone), a voice circuit, a dial, a bell (speaker), and a hook button.

Of these parts, the parts that play the most important roles are the transmitter and the receiver. The transmitter converts human voice to electrical signals, and the receiver converts the electrical signals from the other party to voice.

Here, let's learn about the mechanism of these parts and the roles that they perform.

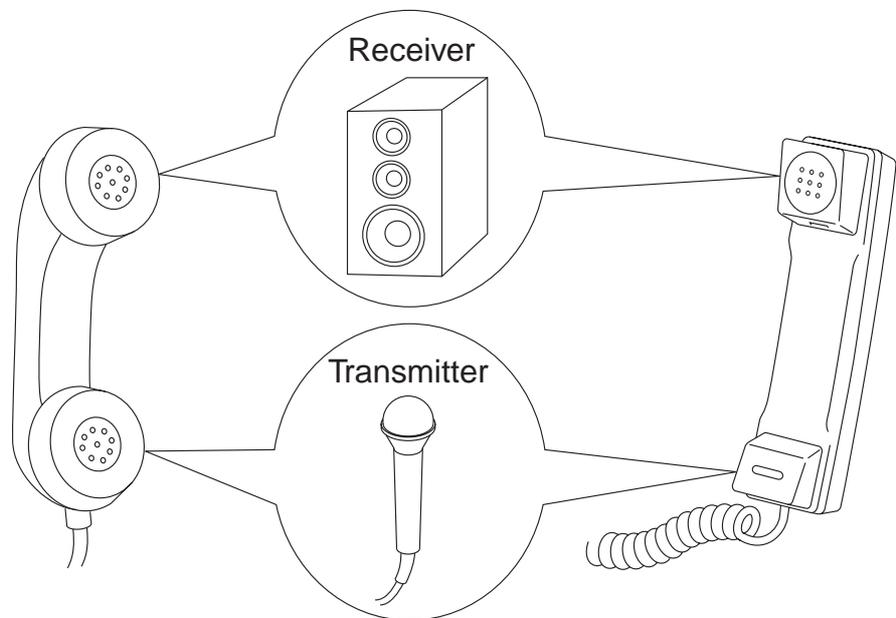


Fig. 1-5 Handset

2.1 Transmitter (Microphone)

The voice vibrates a diaphragm compressing/releasing carbon powder. When carbon powder is compressed, its contact resistance decreases. When the powder is released, its contact resistance increases. So direct current varies corresponding to the change of pressure (voice). This is called “voice current”. Recently, a microphone is applied to the transmitter of the telephone.

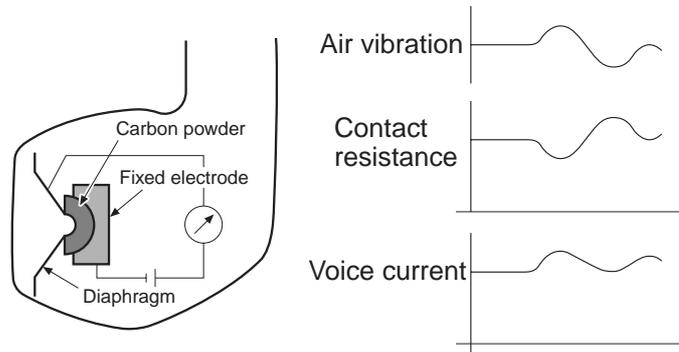


Fig. 1-6 Transmitter and Voice Current

2.2 Receiver (Speaker)

The receiver acts just like an electromagnet. The receiver creates voice waves by changing magnetic force, which move a vibrating diaphragm according to the current strength.

1

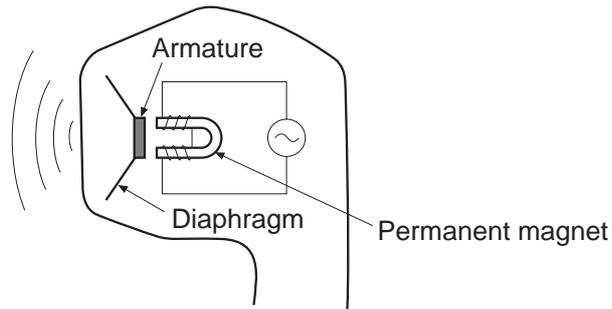


Fig. 1-7 Receiver

2.3 Voice Circuit

When the transmitter and receiver are connected as shown in the Fig. 1-8 to make a voice circuit, voice can be transmitted in both directions along the two wires.

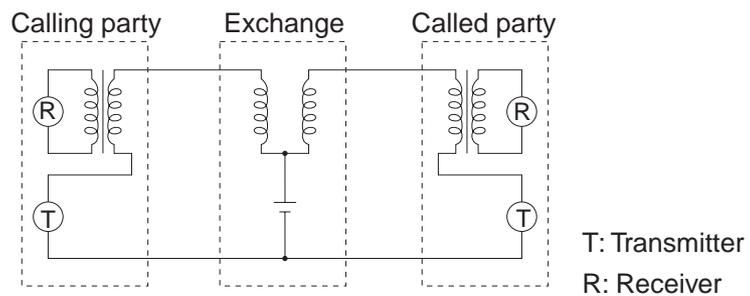


Fig. 1-8 Two-way Circuit (Two Wires)

2.4 Hook Button

When a hook button is closed by picking up a handset, direct current flows to the telephone circuits.

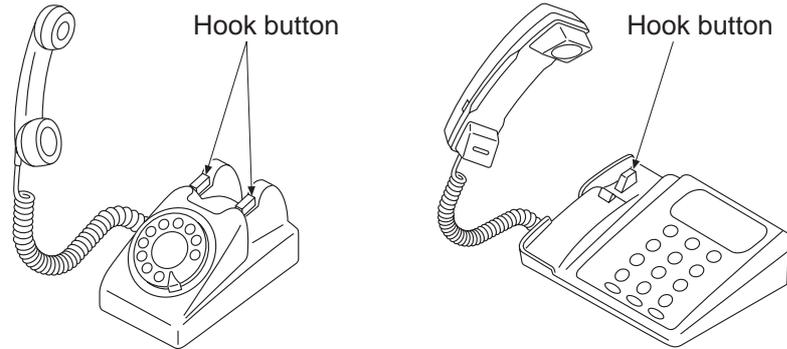


Fig. 1-9 Hook Button

The purpose of this is twofold (i) so that direct current is made to flow to the transmitter to provide current for sending voice when the handset is picked up, and (ii) so that the exchange detects this direct current to recognize that the handset has been picked up.

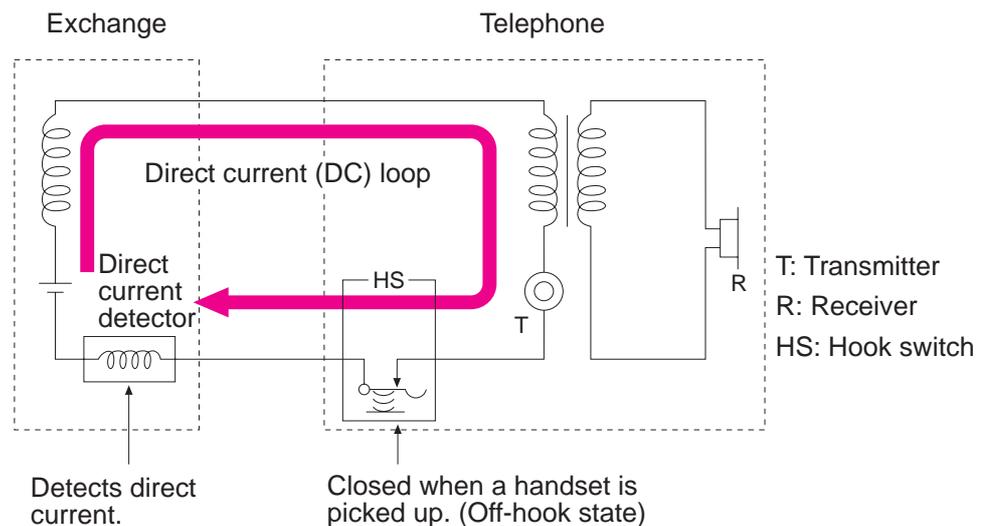


Fig. 1-10 DC Loop

Picking up a handset is called “making a DC loop”. A DC loop lets the exchange know that:

- (1) The calling party (the party making the call) is ready to call someone.
- (2) The called party answered. (The party receiving the call)
- (3) The handset is on-hook.

2.5 Dial

1

Dialling enables an exchange to connect one party to a requested number according to a dialing signal. “DP” means the Dial pulse contact. The contact is usually closed. When you turn a dial and release it, the contact opens the same number of times as the number you dialed. (When the dialed number is 0, the contact opens 10 times.)

When a DC loop is made as shown in the Fig. 1-11 and the dial returns to its start position after the number “4” is dialed, the DC loop is cut four times. This is called the “dial pulse”.

Dialing using this dial pulse is called “pulse dial” due to the fact that numbers are dialed by this pulse.

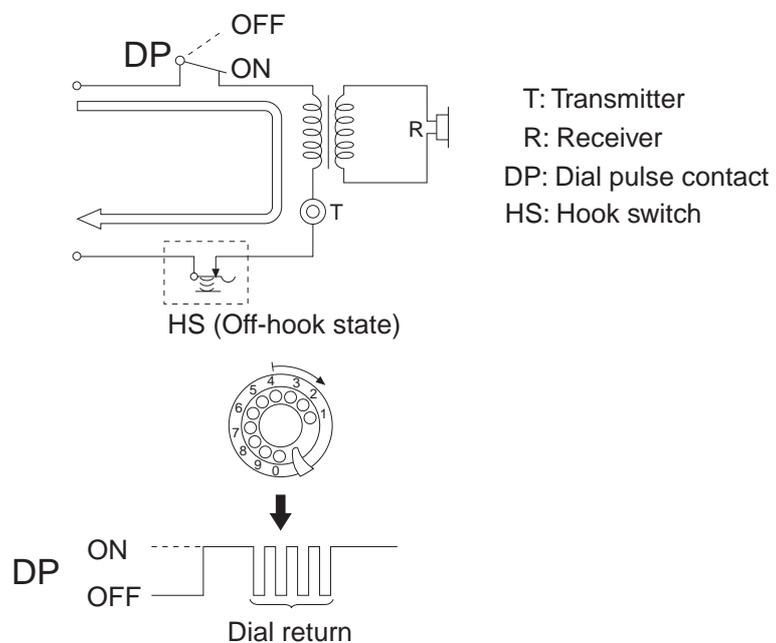


Fig. 1-11 Dial Pulse

The exchange selects and calls up the other party by counting the number of dial pulses.

Dials return to their start position at either of two speeds:

- 10PPS
- 20PPS

PPS (Pulse Per Second) indicates how many dial pulses are generated per second.



Here, we have described an example (number of dial pulses = N) where the number of dial pulses is the same as the dialed number (N). However, in some countries, the number of dial pulses is sometimes different as follows:

The number of dial pulses is the dialed number (N) + 1

Dialed number	1	2	3	4	5	6	7	8	9	0
Number of dial pulses	2	3	4	5	6	7	8	9	10	1

The number of dial pulses is the dialed number (N) - 1

Dialed number	1	2	3	4	5	6	7	8	9	0
Number of dial pulses	10	1	2	3	4	5	6	7	8	9

2.6 Bell (Speaker)

The calling identification (CI) signal from the exchange for notifying that you have an incoming call is converted to the ring tone and is output. Recently, a speaker or buzzer is used instead of the bell.

3. TYPES OF TELEPHONES

1

There are three types of telephone: dial telephones and pushbutton telephones that are used on analog lines, and digital telephones that are used on digital lines.

In this section, let's learn about these types of telephones.

3.1 Dial Telephones

The type of telephone having a dial as explained earlier in section 2.5 is a dial telephone.

3.2 Pushbutton Telephones

Pushbutton telephones differ from telephones that are operated by turning a dial in that buttons are pushed to output dialing signals.

Pushbutton telephones have 12 buttons and have an oscillator inside to generate seven different frequencies. For example, if you push button 1, two frequency currents, 697 Hz and 1209 Hz, are sent simultaneously. This is called **DTMF** (Dual Tone Multi Frequency), and dialing using this DTMF is called "tone dial" due to the fact that numbers are dialed by this tone. Dialing is also referred to as PB (Push Button) due to the fact that buttons are pushed.

The exchange distinguishes numbers by this DTMF.

Of these 12 buttons, the * and # buttons are special buttons, and are used for selecting various handy communications services.

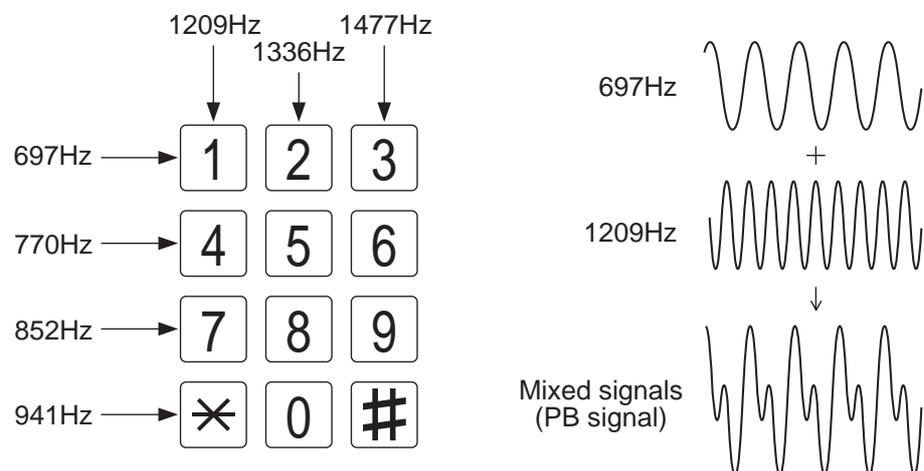


Fig. 1-12 Pushbutton Telephone



Some pushbutton telephones have a dial selector switch for selecting between tone dialing (PB) and pulse dialing. With these pushbutton telephones, if the selector switch is set to pulse dialing, the telephone outputs dial pulses even though the telephone looks like a pushbutton telephone.

3.3 Digital Telephones

Though digital telephones also have 12 buttons just like a pushbutton telephone, the dialing signals are output not as a tone (frequency) but as a code comprising a combination of digital 0s and 1s. Also, the signals for ringing the bell on the other party's telephone are sent as a code comprising a combination of digital 0s and 1s.

4. CIRCUIT DIAGRAM IN THE TELEPHONE

1

In this section, let's learn about the basic circuits inside a telephone.

4.1 Dial Telephones

The Fig. 1-13 shows the basic circuit of a dial telephone.

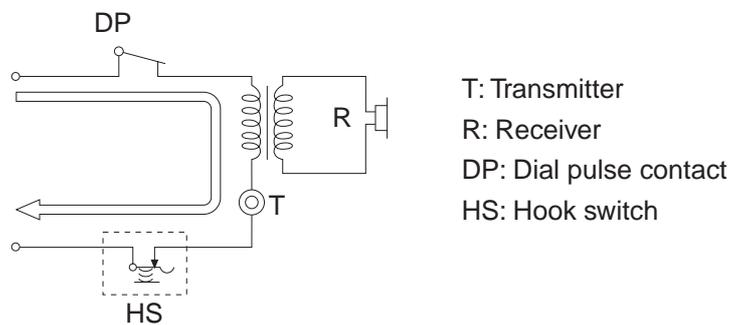


Fig. 1-13 Basic Circuit of Dial Telephone

However, in actual fact, hook switch HS2 is provided in addition to switch HS1 on dial telephones as shown in the Fig. 1-14. The bell circuit is closed and short-circuited by the switch HS2 when the handset is picked up. Ringing of the bell by dial pulses is thus prevented.

Dial telephones are also provided with a dial shunt contact DS to prevent noise caused by the entry of dial pulses on the receiver. The DS closes when you start dialing and opens when the dial has finished returning to its start position.

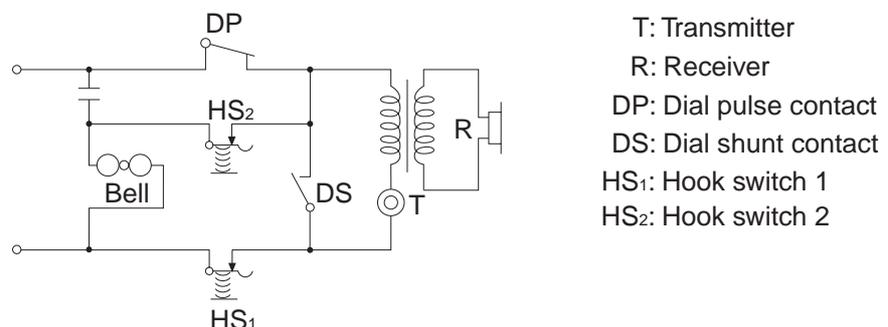


Fig. 1-14 Circuit of Dial Telephone

4.2 Pushbutton Telephone

The Fig. 1-15 shows the basic circuit of a pushbutton telephone.

Basically, the only difference between the circuit of a pushbutton telephone and the circuit of a dial telephone is that the dialing signal generator differs.

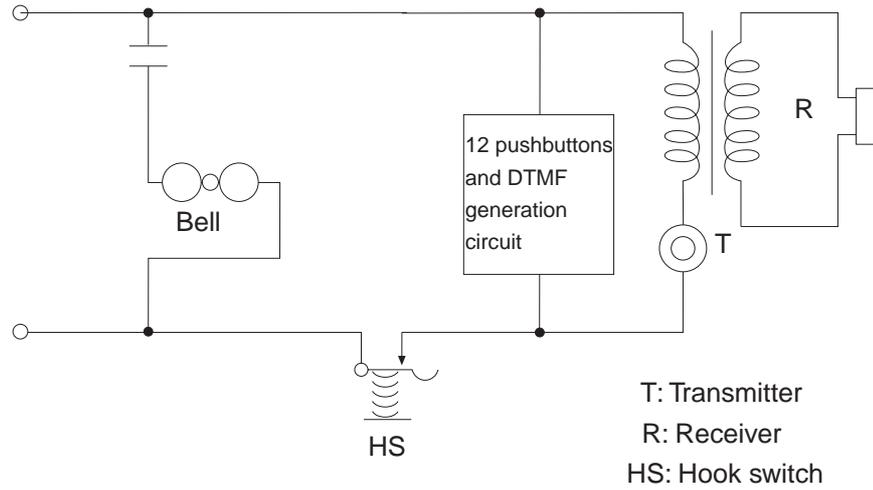


Fig. 1-15 Basic Circuit of Pushbutton Telephone

5. INTRODUCTION TO THE TELEPHONE NETWORK

1

We can talk to people over a long distance because we have an interlinked telephone network which contains many telephone centers.

In this section, let's learn about the mechanism of a telephone network.

5.1 Parts of a Telephone Network

To communicate over a telephone line, you need two telephones, a telephone line, and an exchange system. The telephone is sometimes called a terminal, because it is at each end of the telephone line.

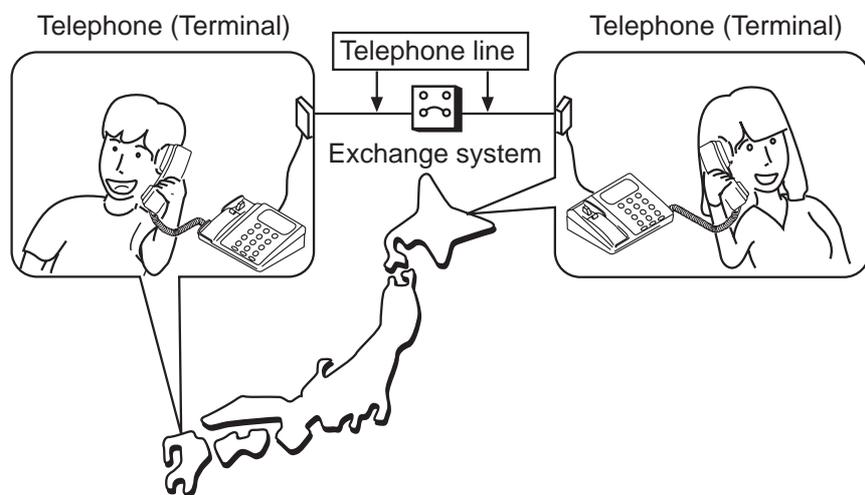


Fig. 1-16 Parts of a Telephone Network

To simply connect two telephones without using an exchange, every telephone must be connected individually to every other telephone. This type of network is called a mesh network.

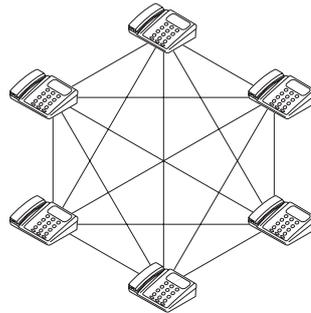


Fig. 1-17 Mesh Network

In a mesh network, you need more telephone lines than telephones.

The number of lines needed to connect telephone is given by $n(n-1)/2$. (For example, you need about 500,000 lines for 1,000 telephones.)

Clearly, it is impossible to connect many telephones in a mesh network.

So, you can see that a telephone exchange is quite necessary. An exchange connects a line to a telephone when it receives a calling request. In this system, the number of lines can be equal to the number of telephones serviced by the exchange. This network system is called a star network.

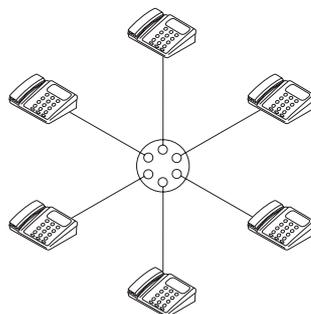


Fig. 1-18 Star Network

So far, we have the mesh network and the star network. These are the basic types of network systems. If we combine both networks into one system, we have a hybrid network.

1

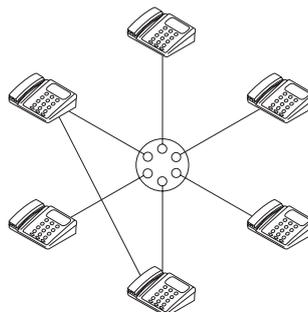


Fig. 1-19 Hybrid Network

In this way, a telephone network consists of telephones used as a terminal for converting voice to electrical signals and electrical signal back again to voice, a telephone line for transmitting electrical signals to places far away, and an exchange system for connecting two telephones.

Telephone lines come in various types: coaxial cable, optical fiber cable, microwaves communications satellites and submarine cable.

The places where the exchange system is located is called the telephone center (or the exchange center).

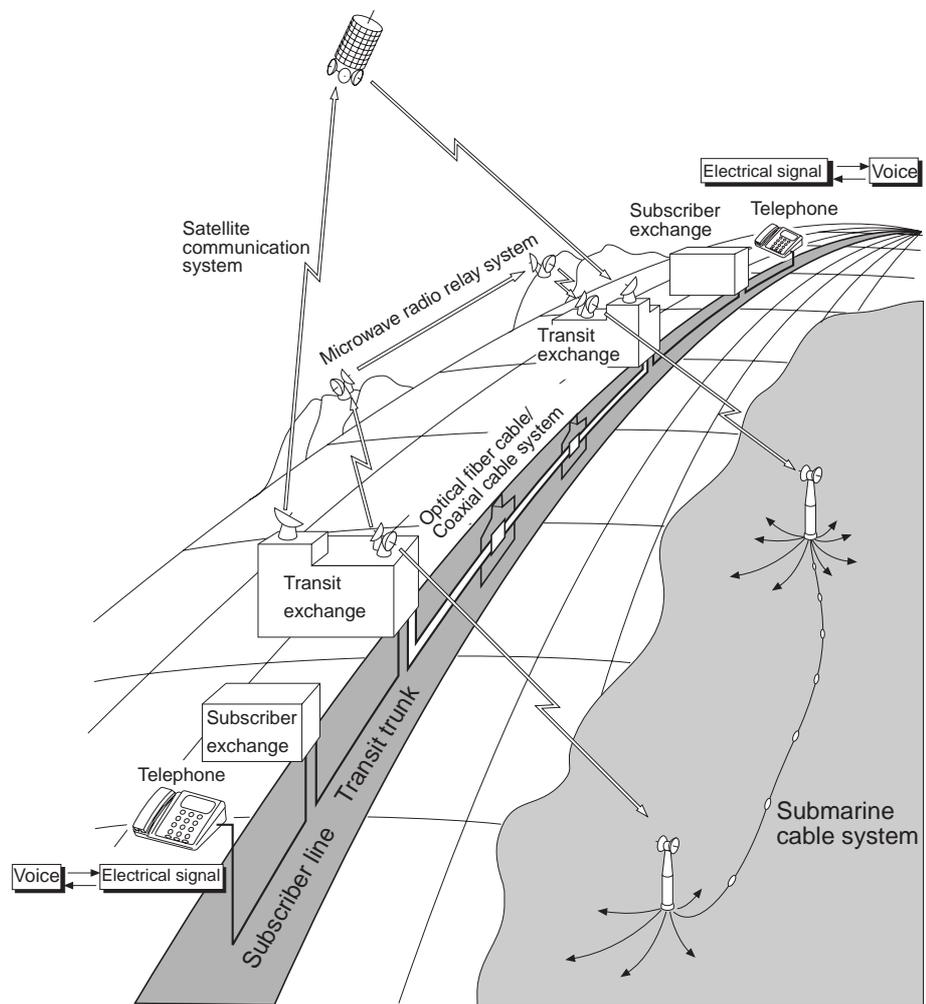


Fig. 1-20 Telephone Network Organization

5.2 Basic Structure of a Telephone Network System

As the number of telephones to be connected to the exchange increases and the conversation area expands, it becomes more economic to set up two or more exchanges and connect between exchanges by telephone lines rather than terminating all of the telephone lines in a single exchange.

The line connecting two exchanges is called a transit trunk.

The line connecting an exchange and a telephone is called a subscriber line.

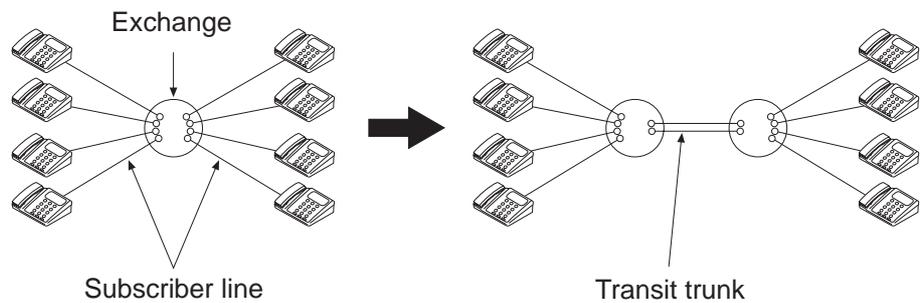


Fig. 1-21 Subscriber Line and Transit Trunk

As the number of telephone centers increases, it becomes more economic to set up an exchange for terminating only the transit trunks and connecting this exchange in the center in shape of a star rather than connecting telephone centers to others in the shape of an interlinked network by directly connected transit trunks.

This kind of exchange is called a transit exchange. An exchange that connects subscriber lines is called a subscriber exchange.

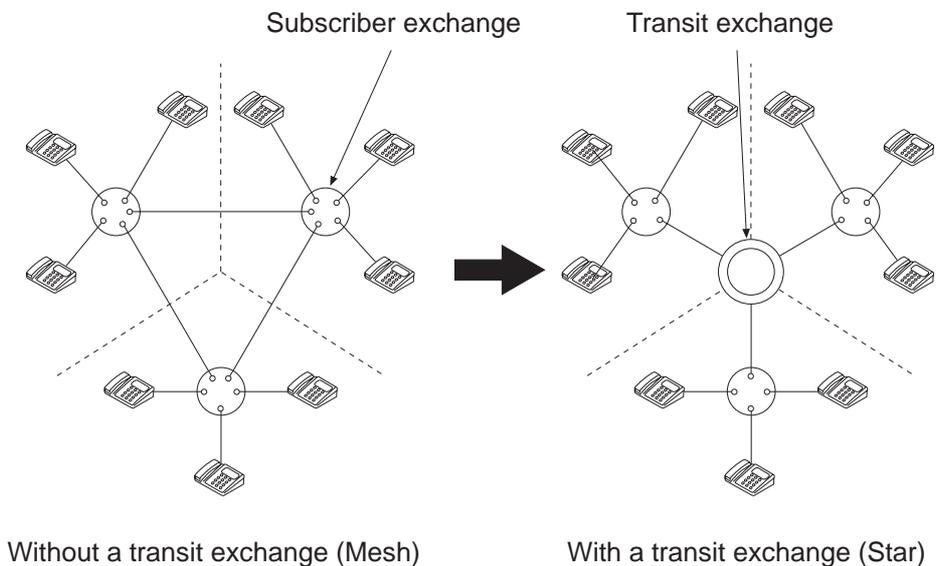


Fig. 1-22 Transit Exchange System

As the transit exchange relay-switches conversations between subscriber exchange, we can consider transit exchange to be ranked (classified) higher than the subscriber exchange. The rank for an exchange is called the grade, and the telephone center is called the center grade. That is, the high grade exchanges can route calls to a wider area.

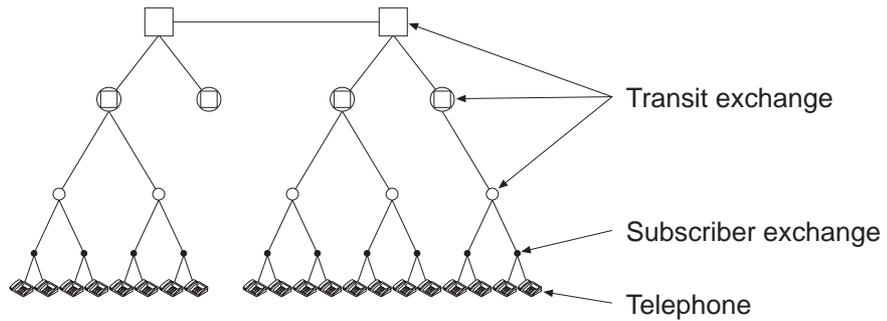


Fig. 1-23 Center Grade

5.3 Nationwide Telephone Network (In case of Japan)

The nationwide network in Japan can be divided into subscriber areas matched with administrative districts. A subscriber area has more than one subscriber exchange to connect all the telephones in the area.

A call within the area is called a local call, and can be made by dialing an exchange number and the subscriber number.

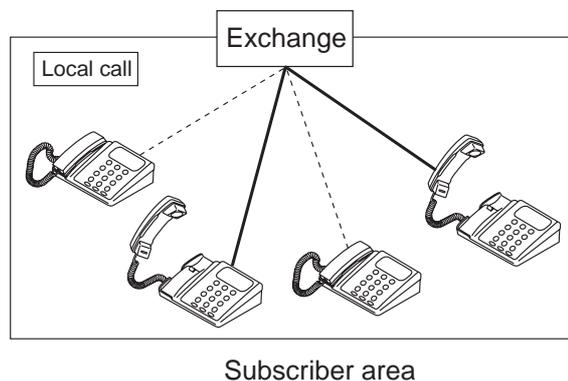


Fig. 1-24 Subscriber Area and Local Call

A call made between subscriber areas is called a long-distance call, and can be made by dialing an area code, an exchange number, and a subscriber number.

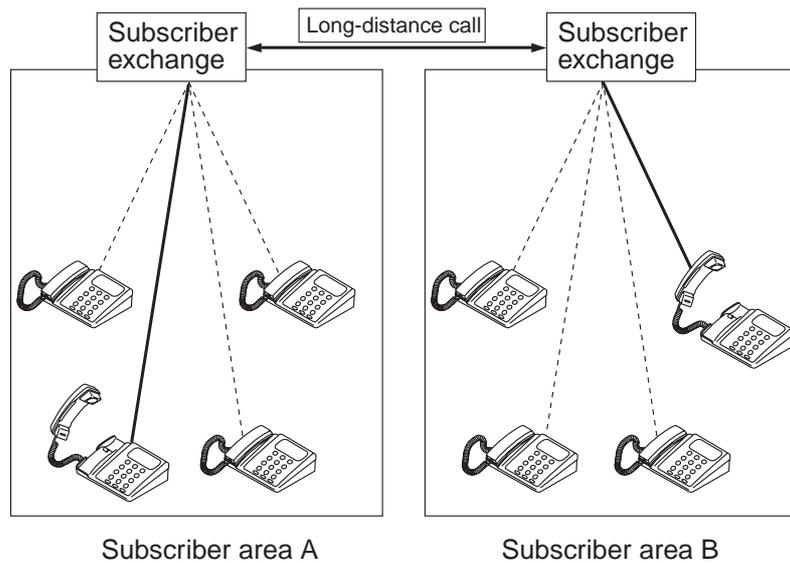


Fig. 1-25 Subscriber Area and Long-Distance Call

The network for local calls is the local network. And the line and the exchange for these calls are called the local line and the local exchange.

The network for long-distance calls is toll network. And the line and the exchange for the long-distance call are called the toll line and the toll exchange.

A toll exchange is classified into three ranks: toll centers, district centers, and regional centers.

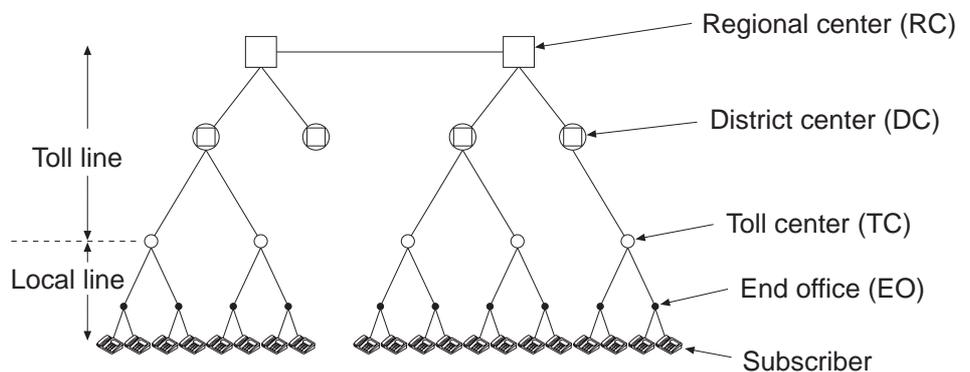


Fig. 1-26 Structure of Telephone Network

- Regional center (RC)
RCs have been established in Sapporo, Sendai, Tokyo, Nagoya, Kanazawa, Osaka, Hiroshima, and Fukuoka.

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District center (DC)

DCs have been established in every seat of prefectural government of the same rank city.

- Toll center (TC)

TCs have been established at central towns in a district center area.

- End office (EO)

An end office (EO) is an office that connects telephones in a subscriber area.

5.3.1 Local telephone network

The subscriber area has one end office, which connects all the telephones in the area. In this case, the subscriber area is called a single office area.

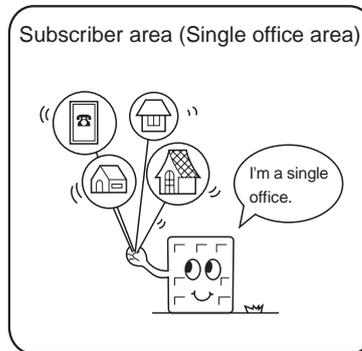


Fig. 1-27 Single Office Area

As the number of telephones increase, there will also be an increase in the number of end offices called branches. These branch offices are connected in a mesh network. In this case, the subscriber area is called a multiple office area.

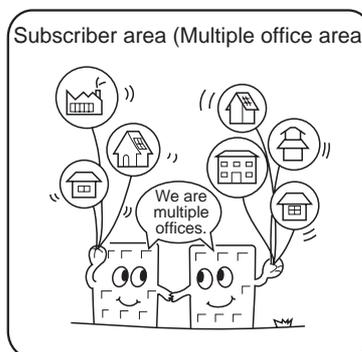


Fig. 1-28 Multiple Office Area