

REPLACED SHEETS

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☒ Description : paged ...1... to paged ...27...
☒ Claim(s) : paged ...28... to paged ...32...
☒ Drawing(s) : paged ...1/2... to paged ...3/4...
☒ Abstract : paged ...33... to paged ...-...

KEY TELEPHONE SYSTEM CAPABLE OF DISPLAYING
 A PLURALITY OF OUTGOING TELEPHONE NUMBERS
 INCLUDED IN INCOMING CALLS

Background of the Invention:

This invention relates to a key telephone system which is operable in response to an incoming call which is sent as an outgoing call from an outgoing subscriber and which includes an outgoing telephone number assigned to a telephone set of the outgoing subscriber.

As a rule, an outgoing call is sent from an outgoing subscriber through a public switch telephone network (will be often abbreviated to a PSTN) and is received as an incoming call by an incoming subscriber. Recently, a service has been performed such that an outgoing phone number is transmitted from an outgoing telephone set to an incoming subscriber and is displayed on a display member, such as a liquid crystal display. With this service, it is possible to previously confirm the outgoing subscriber on the incoming subscriber side before a telephone talk.

Heretofore, a wide variety of proposals have been made about informing an incoming subscriber of the outgoing phone number. For example, disclosure has been made in Japanese Unexamined Patent Publication Nos. Hei 5-244286 (244286/1993) and Hei 7-203006 (203006/1995) about key telephone systems each of which receives an incoming call from an outgoing subscriber and which can hold an outgoing telephone number assigned to the outgoing subscriber. Specifically, a private

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branch exchange of an electronic type has been disclosed in the former publication and can register an outgoing telephone number and an extension number in a history table and a history file. Such an outgoing telephone number can be displayed on a display device and can be ensured by an incoming subscriber. The incoming subscriber can automatically call back the outgoing subscriber by pushing a specific button.

On the other hand, a sequence of bell signals which is received with an time interval left between adjacent ones of the bell signals is delayed in the latter publication until an outgoing telephone number is received by a key telephone system. In other words, the outgoing telephone number is certainly received and, thereafter, a bell is repeatedly driven by the bell signal sequence. This is because the outgoing telephone number is interposed within the time interval between two adjacent ones of the bell signals.

In the meanwhile, it often happens that a key telephone system has a plurality of subscriber lines connected to the public switch telephone network and a main device which may be called a key service unit which accommodates the subscriber lines and which is connected to a plurality of extension lines. In this event, a plurality of key telephone sets are connected to the extension lines and have display members, such as liquid crystal display units. Each of the key telephone sets can display, on each display member, an outgoing telephone number included in an incoming call from an outgoing subscriber, before a hand set of each key telephone set is puts into off-hook.

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With this structure, each key telephone set is given the outgoing telephone number which is individually displayed in the display member. This shows that a single outgoing telephone number is sent from each subscriber line through the key service unit to an individual one of the key telephone sets.

Herein, it is to be noted that a plurality of outgoing calls concurrently arrive as incoming calls at the key telephone system through a plurality of the subscriber lines accommodated in the key telephone system. When the outgoing calls accompanies different outgoing telephone numbers, the outgoing telephone numbers are sent to different ones of the key telephone sets to be displayed, respectively. In other words, a single one of the outgoing telephone numbers alone is individually displayed on each display member of the corresponding key telephone sets.

This shows that the remaining outgoing telephone number or numbers can not be displayed on each display member of the remaining key telephone sets.

Under the circumstances, it is assumed that an emergency call arrives at one of the key telephone sets remote from each person, simultaneously with an insignificant call received at another key telephone set close to the persons. In this event, it is difficult to quickly respond to the emergency call even when the outgoing telephone number is displayed at the one key telephone set in question, because the outgoing telephone number of the emergency call is not displayed on any other key telephone sets.



Summary of the Invention:

It is an object of this invention to provide a key telephone system which is capable of coping with simultaneous reception of different incoming calls which include outgoing telephone numbers.

It is another object of this invention to provide a key telephone system of the type described, which is capable of quickly responding to an emergency call, even when the emergency call is received at an unattended key telephone set.

It is still another object of this invention to provide a key telephone system of the type described, which is capable of displaying a plurality of outgoing telephone numbers without an increase of costs.

A key telephone system to which this invention is applicable is operable in combination with a public switch telephone network to receive an incoming call which is sent from an outgoing subscriber as an outgoing call including an outgoing telephone number. The key telephone system comprises a key service unit coupled to a plurality of subscriber lines and a key telephone set which is coupled to the key service unit. According to this invention, the key telephone set comprises a display member, and a control portion which is coupled to the key service unit and which supplies the display member with a plurality of outgoing telephone numbers transmitted on the plurality of the subscriber lines to display the plurality of the outgoing telephone numbers on the display member.

A plurality of the key telephone sets may be included in the key telephone system to display the outgoing telephone



numbers transmitted through the plurality of the subscriber lines. Such displays of the outgoing telephone numbers are preferably executed in a time division fashion on the display member which has a display area of a single line and which may therefore be simple in structure.

On the other hand, the key service unit comprises a plurality of subscriber circuits connected to the subscriber lines, respectively, a plurality of telephone number detectors connected to the respective subscriber circuits for detecting the outgoing telephone numbers which are sent through the subscriber lines and which are included in the incoming calls, a plurality of extension circuits connected to the key telephone sets, a switch circuit for selectively carrying out connection between the subscriber circuits and the extension circuits to form a connection path therebetween, and a controller for controlling the switch circuit to form the connection path.

Brief Description of the Drawing:

Fig. 1 is a block diagram of a key service unit which is used for a key telephone system according to this invention;

Fig. 2 is a block diagram of a key telephone set according to a first embodiment of this invention;

Fig. 3 is a flow chart for use in describing operation of the key telephone system according to the first embodiment of this invention;

Fig. 4 is a block diagram of a key telephone set according to a second embodiment of this invention;

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Fig. 5 is a flow chart for use in describing operation of the key telephone system according to the second embodiment of this invention;

Fig. 6 is a block diagram of a key telephone set according to a third embodiment of this invention; and

Fig. 7 is a flow chart for use in describing operation of a key telephone system according to a fourth embodiment of this invention.

Description of the Preferred Embodiments:

Referring to Fig. 1, a key telephone system according to a first embodiment of this invention is applicable to a private exchange system of an electronic type which may be simply referred to as an electronic switch system. The illustrated key telephone system includes a central device, namely, a key service unit 1 which accommodates first through n-th subscriber lines 1 to Ln connected to the public switch telephone network (PSTN) (not shown) and which are connected to first and second extension lines in the illustrated example.

In the illustrated example, the key service unit 1 has first through n-th subscriber circuits 11 to 1n connected to the first through the n-th subscriber lines L1 to Ln and first and second extension circuits 14 and 15 connected to the first and the second extension lines which are also connected to first and second key telephone sets 2 and 3, respectively. Similar structure may be adopted in the key telephone system when three or more key telephone sets are connected to the key service unit 1, although not shown in



Fig. 1.

In Fig. 1, each of the first through the n -th subscriber circuits 11 to 1n serves to capture, connect, or release each subscriber line while each of the first through the n -th telephone number detectors is operable to detect each reception telephone number sent from the public switch telephone network through each subscriber circuit 11 to 1n. In addition, each of the first and the second extension circuits 14 and 15 controls a connection between each extension line and the subscriber lines.

The key service unit 1 further includes a switch circuit 16 between the first through the n -th subscriber circuits 11 to 1n and the first and the second extension circuits 14 and 15, a controller 17 for switching connection paths between the subscriber circuits 11 to 1n and the extension circuits 14 and 15 from one to another, and a memory 18 storing a control program executed in the controller 17. The illustrated controller 17 is also operable to process an absent notification sent from the key telephone sets 2 and 3.

In the illustrated example, first through n -th telephone number detectors 101 to 10n are connected to the controller 17 to detect outgoing telephone numbers which are received through the first through the n -th subscriber circuits 11 to 1n, respectively, and which might be called reception telephone numbers, respectively, so as to avoid confusion between the words "incoming" and "outgoing".

Referring to Fig. 2 together with Fig. 1, each of the key telephone set includes an input/output (I/O) interface



(I/F) circuit 20, a telephone circuit 21, a hand set, a timer circuit 24, and a memory portion 25. The I/O interface circuit 20 executes interface processing between the key service unit 1 and the telephone circuit 21 in response to a ringing signal, a speech signal, and the like while the telephone circuit 21 amplifies a transmission speech signal or a reception speech signal and processes a side tone. Further, the illustrated hand set is structured by a microphone 22 and a loudspeaker 23 while the timer 24 determines a timing on displaying a plurality of subscriber line numbers and a plurality of reception (outgoing) telephone numbers on a display member in a time division fashion, as will become clear later. In addition, the memory portion 25 temporarily stores the subscriber line numbers and the reception telephone numbers sent from the key service unit 1.

Each of the illustrated key telephone sets 2 and 3 further comprises a display member 26, such as a liquid crystal display (LCD), a key board 27, and an light emitting portion 28, such as a light emitting diode. The key board 27 is operable to put the key telephone set into an off-hook state or an on-hook state on transmission or reception of a call and to input a telephone number in a well known manner. As will become clear, the illustrated display member 26 can display a plurality of subscriber lines and a plurality of outgoing telephone numbers in a time division fashion when a plurality of incoming calls are simultaneously received through a plurality of the subscriber lines L1 to Ln. In addition, the light emitting portion 28 is lightened on

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transmitting or receiving a call.

Moreover, the illustrated key telephone set 2 or 3 further has a hard disk device 40 for storing the outgoing telephone number each time on reception of each incoming call and a control portion 29 coupled to the above-enumerated members 20, 21, 24, 25, 26, 27, 28, and 40 to control them. Herein, it is to be noted that the illustrated control portion 25 serves to make the display member 26 display a plurality of the subscriber line numbers and a plurality of the outgoing telephone numbers on reception of the incoming calls through the first through the n-th subscriber lines L1 to Ln. More specifically, the plurality of the subscriber line numbers and the plurality of the outgoing telephone numbers are successively displayed along a single line on the display member 26 in the time division fashion. In other words, the illustrated display member 26 has a display area formed by the single line and is therefore simple in structure and inexpensive.

Referring to Figs. 1 and 2, description will be made about an operation of the key telephone system according to the first embodiment of this invention. In the key service unit 1 illustrated in Fig. 1, the first through the n-th subscriber lines L1 to Ln are captured, connected, and released under control of the first through the n-th subscriber circuits 11 to 1n and the controller 17. Each of the first through the n-th telephone number detectors 101 to 10n detects the outgoing telephone number to produce a detected telephone number in response to the incoming calls received through the first through the n-th subscriber lines

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L1 to Ln through the public switch telephone (not shown).

The detected telephone number is sent to the controller 17 and is processed by the controller 17 to be displayed on the first and the second telephone sets 2 and 3 in the above-mentioned manner. In addition, the controller 17 controls the first and the second extension circuits 14 and 15 to make them connect between the extension lines and external lines.

The switch circuit 16 switches connection paths between the subscriber circuits 11 to 1n and the extension circuits 14 and 15 from one to another under control of the controller 17. In this event, the controller 17 is operable on the basis of the control program stored in the memory 18 to execute the switching operation of the connection paths between the subscriber circuits 11 to 1n and the extension circuits 14 and 15 and to set the absent notification sent from the key telephone sets 2 and 3. This shows that the controller 17 controls various operations of the key service unit 1 in accordance with the control program stored in the memory 18.

In each of the key telephone sets 2 and 3 illustrated in Fig. 2, the input/output interface circuit 20 carries out input/output interface processing which is concerned with the key service unit 1 shown in Fig. 1. In such input/output interface processing, the call tone signal and the speech signal are processed in the interface circuit 20. The telephone circuit 21 carries out amplification of transmission and reception signals from and to the microphone 22 and the loudspeaker 23 and also processes the side tone.

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The illustrated control portion 29 is operable in response to the incoming calls sent through the first through the n-th subscriber lines L1 to Ln to display, on the display member 26, a plurality of the subscriber line numbers and a plurality of the outgoing telephone numbers included in the incoming calls. Such a display operation is executed in the time division fashion.

Furthermore, the timer circuit 24 measures or times a display time when each of the outgoing telephone numbers is displayed on the display member 26 in the time division fashion. Such a display time or measured time can be varied by manipulating the key board 27 or under control of the control portion 29 and may be set by a user, for example, to one second.

In the illustrated key telephone set 2 or 3, the control portion 29 controls so that the display member 26 successively displays the subscriber line numbers assigned to the subscriber lines L1 to Ln and the outgoing telephone numbers of the incoming calls in the time division fashion and that the light emitting portion 28 is lightened on transmission of an outgoing call and reception of an incoming call. In addition, the key board 27 is manipulated to put the key telephone set 2 or 3 into the off-hook state or the on-hook state on an outgoing or an incoming call and to input a telephone number while the hard disk device 40 serves to store each outgoing (reception) telephone number included in each incoming call.

Referring to Fig. 3 together with Figs. 1 and 2, description will be made about displaying the subscriber



number lines and the outgoing telephone numbers in the time division fashion when a plurality of the incoming calls are received through the subscriber lines L_1 to L_n to the key service unit 1. When the incoming calls arrive at the key service unit 1 through the subscriber lines L_1 to L_n illustrated in Fig. 1, the first through the n -th telephone number detectors 101 to 10n detect, through the first through the n -th subscriber circuits 11 to 1n, the outgoing telephone numbers included in the incoming calls. The detected outgoing telephone numbers are sent from the detectors 101 to 10n to the controller 17.

Let the incoming call arrive from the first subscriber line L_1 to the key telephone set 2 due to dial-in. In this event, the controller 17 controls to make the first extension circuit 14 send a call tone signal to the key telephone set 2 specified by the incoming call.

On the other hand, let the incoming call indicate a representative telephone number. In this case, the controller 17 monitors the first through the n -th subscriber circuits 11 to 1n, the extension circuits 14 and 15, and the switch circuit 16 to detect an idle one of the key telephone sets 2 and 3 and to send the call tone signal to the idle key telephone set.

When the call tone signal is sent from the key service unit 1 to the key telephone set 2 illustrated in Fig. 2, simultaneous transmission is made from the key service unit 1 about the subscriber line number (the line number of the first subscriber line L_1) and the outgoing telephone number which is included in the incoming call and which is sent



through the public switch telephone network. As a result, the call tone signal, the subscriber line number L1, and the outgoing telephone number are sent to the key telephone set 2 in question. In the key telephone set 2, the subscriber line number L1 and the outgoing telephone number are memorized in the memory portion 25 and the hard disk device 40 under control of the control portion 29, respectively.

Furthermore, the call tone signal is delivered through the telephone circuit 21 to the loudspeaker 23 in the key telephone set 2 to generate a call tone. A predetermined ringer or speaker may be used to generate the call tone. On generation of the call tone, the subscriber line number L1 and the outgoing telephone number are read out of the memory 25 to be displayed on the display member 26. Such a display of the subscriber line number and the outgoing telephone number may be given in the form of, for example, "1. 1234-5678" in a line. Subsequently, when the hand set is off-hooked, such an off-hook state is transmitted as an off-hook signal to the key service unit 1 through the control portion 29 and the input/output interface circuit 20.

The key service unit 1 receives the off-hook signal from the key telephone set 2 through the extension circuit 14. Under the circumstances, the switch circuit 16 is controlled so that the subscriber line circuit 11 is connected to the extension circuit 14 to form a transmission path between the subscriber line circuit 11 and the extension circuit 14. Thereafter, a speech is started between subscribers through the public switch telephone network which has a closed speech path therein. When the speech is finished, the key service



unit 1 is given an on-hook signal to release the speech path.

Before the on-hook signal is received by the key service unit 1, the key telephone set 2 continues to talk to the outgoing subscriber generating the incoming call and is kept in a state of receiving the incoming call. The state will be called a reception state of the incoming call. During the reception state of the incoming call, the other incoming call or calls may be assumed to arrive at the other subscriber lines L2 to Ln and may include the other outgoing telephone number or numbers. In this event, the other outgoing telephone number or numbers are sent to the key telephone set 2 together with the other subscriber line number or numbers. The key telephone set 2 stores the other outgoing telephone number or numbers and the other subscriber line number or numbers in the memory portion 25. Thus, the key telephone set 2 finishes provision of display.

In Fig 3, the key telephone set 2 at first executes a first step S101 of starting a display on the display member 26 and proceeds to a second step S102 at which the timer circuit 24 is energized and starts measuring a time. The second step S102 is followed by a third step S103 at which the timer circuit 24 measures the time and detects a lapse of a predetermined time, for example, one second. As long as the lapse of the predetermined time is not detected at the third step S103 by the timer circuit 24, the third step S103 is succeeded to a fourth step S104 at which display contents on the display member 26 are kept unchanged and which are returned back to the third step S103. In the illustrated example, the subscriber line number (L1) and the outgoing



telephone number included in the incoming call are continuously displayed on the display member 26 at the fourth step S104.

On the other hand, when the predetermined time lapses at the third step S103, the control portion 29 clears the timer circuit 24 at a fifth step S105 which is followed by a sixth step S106. At the sixth step S106, the control portion 29 judges whether or not the memory portion 25 stores the subscriber line number or numbers and the outgoing telephone numbers other than the displayed line number and the displayed outgoing telephone number. This means that judgement is made at the sixth step S106 about whether or not any other incoming call is received during the reception time of the current call. Specifically, the memory portion 25 memorizes, as new display data signals, any subscriber line number or numbers (L2 to Ln) other than the subscriber line number (L1) and any outgoing telephone number or numbers to be received by the key telephone set 3.

If any new display data signals are not stored in the memory portion 25, the sixth step S106 proceeds to an eighth step S107 at which the current subscriber line number (L1) and the current outgoing telephone number are kept unchanged on the display member 26. This means that display contents or current display data signals are not changed on the display member 26 at the seventh step S107.

On the other hand, let the control portion 29 judge at the sixth step S106 that the new display data signals, such as new subscriber line number or numbers (L2 to Ln) and new outgoing telephone number or numbers, are stored in the



memory portion 25.

In this case, the sixth step S106 is followed by an eighth step S108 at which the control portion 29 reads the new display data signals out of the memory portion 25 to send the same to the display member 26. In addition, the current display data signals and the new display data signals are alternately displayed on the display member 26 under control of the control portion 29. For example, it is assumed that the current display data signals are representative of "1.1234-5678" while the new display data signals are representative of "5.8765-4321" which is a combination of the fifth subscriber line number "5" and the outgoing telephone number "8765-4321" included in the other incoming call. In this situation, the current display data signals of "1.1234-5678" and the new display data signals of "5.8765-4321" are alternately displayed on the display member 26 in the time division fashion.

Moreover, when a further new one of the incoming calls arrives at another one of the subscriber lines L3 to Ln, three subscriber line numbers and three outgoing telephone numbers are successively displayed on the display member 26 in the time division fashion. When the key telephone set 2 becomes an on-hook state by hanging down the hand set after the above-mentioned displays are carried out, namely, when the on-hook signal is sent from the key telephone set 2, the on-hook signal is delivered through the input/output interface circuit 20 to the extension circuit 14 and the controller 17 of the key service unit 1. The controller 17 of the key service unit 1 judges that the speech or talk is

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finished by detecting the on-hook signal at a ninth step S109. Furthermore, the controller 17 executes processing determined for the on-hook at a tenth step S110. Specifically, the controller 17 controls the switch circuit 16 to cut away the speech path or connection path between the subscriber circuit 11 and the extension circuit 14 and supplies the on-hook signal to the public switch telephone network through the subscriber circuit 11 to release the connection or speech path.

Simultaneously, the display member 26 is controlled by the control portion 29 to stop the alternate displays carried out in the time division fashion at an eleventh step S111. Subsequently, processing is returned back to the second step S102.

As mentioned above, each of the key telephone sets 2 and 3 has the display member 26 which has a display area composed of a single line. Each combination of the subscriber line number and the outgoing telephone number is automatically displayed along a single line on the display area in the time division fashion. With this structure, it is readily judged that an emergency call is received as a new incoming call during speech or talk related to another incoming call. In this case, the subscriber line number and the outgoing telephone number can be readily confirmed in connection with the emergency call.

On the display member 26, the subscriber line number and the outgoing telephone number are displayed along the single line in the time division fashion. Therefore, the display member 26 may be small in size and may be inexpensive.

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In other words, the above-mentioned structure dispenses with a large and expensive display member.

Referring to Fig. 4, a key telephone set 2A or 3A according to a second embodiment of this invention is similar in structure and operation to that illustrated in Fig. 2 except that a function key 30 is attached to a controller 29a instead of the timer circuit 24 illustrated in Fig. 2. The key service unit 1 may be identical with that illustrated in Fig. 1.

Like in Fig. 2, the key telephone set 2A or 3A illustrated in Fig. 4 has the input/output interface circuit 20, the telephone circuit 21, the microphone 22, the loudspeaker 23, the memory portion 25, the display member 26, the key board 27, the light emitting portion 28, and the hard disk device 40.

Moreover, the function key 30 is operable to supply a special number to the control portion 29a while the control portion 29a serves to process such a special number in a manner to be described later. It is needless to say that the illustrated control portion 29a controls the display member 26 to display a plurality of the subscriber line numbers and a plurality of the outgoing telephone numbers on the display member 26 in a time division fashion, like in Fig. 2. In the illustrated example, such displays can be achieved by manipulating the key board 27 and the function key 30.

Referring to Fig. 5 along with Fig. 4, description will be made about operation of the key telephone set 2A or 3A executed in connection with the key service unit 1 illustrated in Fig. 1. The operation of the illustrated key



telephone set 2A or 3A is basically similar to that of the key telephone set 2 or 3 shown in Fig. 2. More specifically, each subscriber line number (L1 to Ln) of an incoming call and each outgoing telephone number are sent in the form of a subscriber line number data signal and an outgoing telephone number data signal from the key service unit 1 to the key telephone set 2A or 3A. The outgoing telephone number is notified by the public switch telephone network.

Both the subscriber line number data signal and the outgoing telephone number data signal are stored in the memory portion 25 and the hard disk device 40. The data signals stored in the memory portion 25 are displayed on the display member 26 in the time division fashion by manipulating the key board 27.

On displaying the subscriber line number and the outgoing telephone number on the display member 26, the function key 30 is at first depressed or pushed down in each of the key telephone sets 2A and 3A to start a display process, as shown at a first step S201 in Fig. 5 and to put the display member 26 into a display mode, as shown at a second step S202.

In the illustrated example, the key board 26 has a plurality of line keys which correspond to the first through the n-th subscriber lines L1 to Ln, respectively. In this situation, the control portion 29a monitors a push-down signal sent from each line key and judges at a third step S203 whether or not either one of the line keys is pushed down. If none of the line keys is pushed down, the control portion 29a captures no push-down signal and keeps current

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display data signals intact, as shown at a fourth step S204. Subsequently, processing is returned from the fourth step S204 back to the second step S202. Otherwise, the third step S203 is succeeded to a fifth step S205 at which judgement is made about whether or not the subscriber line number and the outgoing telephone number which correspond to the pushed down line key (L1 - Ln) are stored in the memory portion 25. In other words, the control portion 29a detects whether or not display data signals are stored in an address of the memory portion 25 assigned to the pushed down line key.

If no display data signals are stored in the memory portion 25, the current display data signals are kept unchanged at a sixth step S206 and are continuously displayed. If new display data signals are stored in the memory portion 25, they are displayed on the display member 26 at a seventh step S207 in the time division fashion instead of the current display data signals. Such new display data signals may be a combination of the subscriber line number and the outgoing telephone number included in the incoming call.

In other words, the new display data signals are read out of the memory portion 25 under control of the control portion 29a to be sent to the display member 26 and are substituted for the current display data signals. Thus, the current and the new display data signals are switched from one to another in the time division fashion at the seventh step S207 and are alternately displayed on the display member 26 in the manner mentioned in conjunction with the first embodiment.

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Each of the sixth and the seventh steps S206 and S207 is succeeded by an eighth step S208 of detecting whether or not the on-hook signal is present. Thereafter, processing is carried out to process the on-hook signal and to stop the displays on the display member 26 at ninth and tenth steps S209 and S210, like at the tenth and the eleventh steps S110 and S111 in Fig. 3.

Thus, it is possible in the key telephone set according to the second embodiment of this invention to display a plurality of the subscriber line numbers and a plurality of the outgoing telephone numbers on the display member 26 by manually operating the key telephone set 2A or 3A. With this structure, each outgoing telephone number which arrives at each subscriber line can be readily detected at every incoming call. This enables quick and selective response to each incoming call.

In addition, each combination of the subscriber line number and the outgoing telephone number is displayed in the time division fashion along a single line on the display member 26, as mentioned in conjunction with the first embodiment. Therefore, the display member 26 may be small in size and dispenses with a large size of a display member. This results in a reduction of costs for the key telephone set.

Referring to Fig. 6, a key telephone set 2B or 3B according to a third embodiment of this invention is similar in structure and operation to that illustrated in Fig. 2 except that a voice synthesizer 45 is included in the illustrated key telephone set 2B or 3B. Specifically, the



illustrated key telephone set 2B or 3B has the input/output interface circuit 20, the telephone circuit 21, the hand set composed of the microphone 22 and the loudspeaker 23, the timer circuit 24, the memory portion 25, the display member 26, the key board 27, the light emitting portion 28, and the hard disk device 40.

Moreover, the voice synthesizer 45 in the key telephone set 2B or 3B is connected to a volume controller VR to control a volume of a synthesized audio signal and is also connected to a speaker 46 to generate a synthesized audio tone signal. As shown in Fig. 6, the voice synthesizer 45 is coupled to a control portion 29b which is operable to control the voice synthesizer 45 so that a plurality of subscriber line numbers and a plurality of outgoing telephone numbers included in incoming calls are generated in the form of a synthesized audio signal in a time division fashion. Furthermore, the illustrated control portion 29b serves to display each combination of the subscriber line number and the outgoing telephone number on the display member 26 in the time division fashion like in the other embodiments. Incidentally, the key service unit 1 may be identical with that illustrated in Fig. 1 and therefore may be omitted from this figure.

At first, operation will be schematically described in conjunction with the key telephone set 2B or 3B illustrated in Fig. 6. Like in the key telephone set 2 or 3 illustrated in Fig. 2, a plurality of the subscriber line numbers and a plurality of the outgoing telephone numbers included in the incoming calls are alternately displayed in the time division



fashion on the display member 26 of the key telephone set 2B or 3B shown in Fig. 6. In this case, each combination of the subscriber line number and the outgoing telephone number is automatically displayed along a single line on the display member 26.

In the illustrated example, the subscriber line number and the outgoing telephone number are successively transferred from the controller 29b to the voice synthesizer 45 in the form of data signals and are converted into a sequence of audio signals by the voice synthesizer 45. The audio signal sequence is subjected to volume control by the volume controller VR and is thereafter sent to the speaker 46 to be generated as an audio output signal.

The voice synthesizer 45 and the speaker 46 may be included in the key telephone set 2A or 3A illustrated in Fig. 4, although they are combined in Fig. 6 with the key telephone set 2 or 3 shown in Fig. 2.

At any rate, the key telephone set 2B or 3B shown in Fig. 6 can alternately display each of the subscriber line number and the outgoing telephone number in the time division fashion along a single line on the display member 26. In addition, each of the subscriber line number and the outgoing telephone number is informed in the form of the audio signal. Such notification due to the audio signal enables easy distinction of each of the subscriber line number and the outgoing telephone number even when the display member 26 is very small in size and is not readily readable.

Referring to Fig. 7, description will be made about operation of a key telephone set according to a fourth



embodiment of this invention. The key telephone set according to the fourth embodiment may be similar in structure to that illustrated in Figs. 2, 4, and 6, although the following description will be made on the assumption that the fourth embodiment will be applied to the key telephone set shown in Fig. 2.

Now, each outgoing telephone number is successively stored in the hard disk device 40. Thereafter, the names of outgoing subscribers which correspond to the outgoing telephone numbers are also stored in the hard disk device 40 by manipulating the key board 27 and under control of the control portion 29. The names and the corresponding numbers are rearranged or sorted out in a predetermined order, for example, an alphabetical order and can be retrieved some day to be automatically dialed.

In Fig. 7, an automatic dialing mode is set at a first step S301 by input manipulation of the key board 27 and under control of the controller 29. At a second step S302, the key board 27 is manually operated to indicate whether a single outgoing subscriber or a plurality of outgoing subscribers are retrieved. In other words, an input operation is carried out to retrieve a single outgoing subscriber or a plurality of outgoing subscribers by the use of the key board 27 at the second step S302. In the example being illustrated, it is assumed at the second step S302 that a full name or full characters of a single outgoing subscriber is input to retrieve the single outgoing subscriber by the use of the key board 27 while an initial or a first character is input to retrieve a plurality of the outgoing subscribers by the use



of the key board 27. When only the initial character is input, a plurality of the outgoing telephone numbers are retrieved which correspond to outgoing subscribers which are specified by the initial character.

When such a retrieval indication is given from the key board 27 so as to retrieve a plurality of outgoing subscribers, the names of the outgoing subscribers and the corresponding outgoing telephone numbers are displayed on the display member 26 under control of the control portion 29 (third and fourth steps S303 and S304). In this situation, the names and/or the corresponding outgoing telephone numbers displayed as an image can be scrolled on the display member 26 in response to a scroll indication given from a user or a subscriber. At a fifth step S305, the control portion 29 judges whether or not the scroll indication is given from the user. If the scroll indication is given, the fifth step S305 is succeeded to a sixth step S306 at which a scroll is executed on the image displayed on the display member 26 to select a desired outgoing subscriber name and the corresponding outgoing telephone number. At a seventh step S307, the desired outgoing subscriber name and the corresponding outgoing telephone number are selected and displayed on the display member 26.

Next, it is judged by the control portion 29 at an eighth step S308 whether or not an automatic dialing indication is issued from the key board 27.

On the other hand, the retrieval indication is given from the key board 27 to retrieve a single outgoing subscriber at the second step S302. In this event, retrieval



processing and display processing are executed at ninth and tenth steps S309 and S310 to finally display a desired single outgoing subscriber on the display member 26. Thereafter, the tenth step S310 is followed by the eighth step S308, as shown in Fig. 7.

After the eighth step S308 is executed under control of the control portion 29, the control portion 29 processes the automatic dialing indication to generate a DTMF signal which is determined in a PB system and which corresponds to the desired outgoing subscriber (an eleventh step S311). The DTMF signal is sent through the input/output interface circuit 20 to the key service unit 1 and processing is finished in connection with the automatic dialing indication at a twelfth step S312.

Responsive to the DTMF signal, the key service unit 1 illustrated in Fig. 1 transfers the DTMF signal through the extension circuit 14 or 15, the switch circuit 16, a selected one of the subscriber circuits 11 to 1n, and a selected one of the subscriber lines L1 to Ln to the public switch telephone network. As a result, the desired outgoing subscriber is connected as the desired subscriber to the user. Thus, telephone talk is started between them.

Subsequently, the control portion 29 controls the timer circuit 24 to measure a time (thirteenth step S313) and to interrupt a display on the display member 26 after lapse of a predetermined time (fourteenth step S314). Thus, processing is finished.

In the key telephone system according to the first through the fourth embodiments of this invention, a plurality

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of outgoing telephone numbers received as incoming calls through the public switch telephone network can be automatically or manually displayed in a time division fashion together with a plurality of subscriber line numbers on a display member of a key telephone set. Each combination of the outgoing telephone numbers and the subscriber line numbers may be informed in the form of a synthesized audio signal and is visually displayed in a line on the display member in the time division fashion. As a result, the key telephone system is improved in availability and can reduce a cost because the display member can be small in size.

In addition, automatic dialing can be executed when the hard disk device is included in the key telephone set and stores each outgoing telephone number. With this structure, a telephone directory is automatically made out in the hard disk device and is readily read out by manipulating the key board. This structure is effective to improve the availability.

While this invention has thus far been described in conjunction with a few embodiments thereof, it will readily be possible for those skilled in the art to put this invention into practice in various other manners. For example, each of the outgoing telephone numbers may be displayed on the display member without any subscriber line number and may not be always displayed in the time division fashion.

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**WHAT IS CLAIMED IS:**

1. A key telephone system operable in combination with a public switch telephone network to receive an incoming call which is sent from an outgoing subscriber as an outgoing call including an outgoing telephone number, the key telephone system comprising a key service unit coupled to a plurality of subscriber lines and a key telephone set which is coupled to the key service unit, the key telephone set comprising:

a display member; and

a control portion which is coupled to the key service unit and which supplies the display member with a plurality of outgoing telephone numbers transmitted on the plurality of the subscriber lines to display the plurality of the outgoing telephone numbers on the display member.

2. A key telephone system as claimed in claim 1, each of the subscriber lines having a line number, wherein the control portion successively sends each subscriber line number to the display member to display each line number on the display member together with each outgoing telephone number.

3. A key telephone system as claimed in claim 2, wherein the display member visually displays each outgoing telephone number and each line number in a time division fashion.

4. A key telephone system as claimed in claim 1, wherein the key service unit successively selects the plurality of the subscriber lines to successively send each outgoing telephone number of the incoming call to the key





telephone set when the incoming call is received through each subscriber line.

5. A key telephone system as claimed in claim 4, wherein the key service unit further successively sends each line number to the key telephone set when the incoming call is received through each subscriber line.

6. A key telephone system as claimed in claim 3, wherein the control portion of the key telephone set comprises:

a circuit for automatically transmitting each of the line numbers and the outgoing telephone numbers in the time division fashion to the display member.

7. A key telephone system as claimed in claim 3, wherein the control portion of the key telephone set comprises:

a manually operable element for transmitting each of the line numbers and the outgoing telephone numbers in the time division fashion to the display member.

8. A key telephone system as claimed in claim 1, wherein the display member has a display area for displaying the outgoing telephone number of the incoming call in a line.

9. A key telephone system as claimed in claim 1, wherein the key telephone set comprises a voice synthesizer coupled to the control portion and responsive to the outgoing telephone number for producing an audio signal representative of the outgoing telephone number.

10. A key telephone system as claimed in claim 9, wherein the voice synthesizer is given the line number to successively produce the line number and the outgoing





telephone number as the audio signal.

11. A key telephone system as claimed in claim 1, wherein the key telephone set comprises a memory unit for successively storing each of the outgoing telephone numbers together with outgoing subscribers corresponding to the outgoing telephone numbers.

12. A key telephone system as claimed in claim 11, wherein the memory unit further stores the line numbers through which the incoming calls are received with the outgoing telephone numbers accompanied.

13. A key telephone system operable in combination with a public switch telephone network to receive a plurality of incoming calls which are sent from outgoing subscribers and which include outgoing telephone numbers, the key telephone system comprising a key service unit coupled to a plurality of subscriber lines and a plurality of key telephone sets each of which is coupled to the key service unit, each of the key telephone sets comprising:

a display member; and

a control portion which is coupled to the key service unit and which supplies the display member with the outgoing telephone numbers transmitted through the plurality of the subscriber lines to display the plurality of the outgoing telephone numbers and the plurality of the line numbers on the display member in a time division fashion.

14. A key telephone system as claimed in claim 13, wherein each of the key telephone set further comprises:

an input/output interface circuit for carrying out input/output processing of a ringing tone signal and a speech





signal between the key service unit and the key telephone set;

a hand set having a microphone and a loudspeaker;

a telephone circuit coupled to the control portion, the hand set, and the input/output interface circuit for transmitting/receiving a transmission/reception speech signal between the hand set and the input/output interface circuit under control of the control portion; and

a timer circuit for measuring a time to display the plurality of the outgoing telephone numbers and the plurality of the line numbers on the display member in the time division fashion.

15. A key telephone system as claimed in claim 14, wherein the key telephone set further comprises:

a key board which has a function key for manually indicating to display the plurality of the line numbers and the plurality of the outgoing telephone numbers on the display member in the time division fashion.

16. A key telephone system as claimed in claim 15, wherein the key board selects one of the line number and the outgoing telephone number from the plurality of the line numbers and the plurality of the outgoing telephone number displayed on the display member.

17. A key telephone system as claimed in claim 14, wherein the key telephone set further comprises:

a memory unit for storing each of the outgoing telephone numbers included in the incoming calls; and

automatic dialing means for automatically reading each of the outgoing telephone numbers out of the memory unit.





18. A key telephone system as claimed in claim 14, wherein the key telephone set further comprises:

a voice synthesizer coupled to the control portion and responsive to the plurality of the line numbers and the plurality of the outgoing telephone numbers for synthesizing them into an audio signal.

19. A key telephone system as claimed in claim 14, wherein the key service unit comprises:

a plurality of subscriber circuits connected to the subscriber lines, respectively;

a plurality of telephone number detectors connected to the respective subscriber circuits for detecting the outgoing telephone numbers which are sent through the subscriber lines and which are included in the incoming calls;

a plurality of extension circuits connected to the key telephone sets;

a switch circuit for selectively carrying out connection between the subscriber circuits and the extension circuits to form a connection path therebetween; and

a controller for controlling the switch circuit to form the connection path.

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