

TWO-DIRECTIONAL CALL FORWARDING DEVICETechnical Field

The present invention relates to a telephone call forwarding device.

Background Art

5 A conventional two-directional call forwarding device is disclosed in Japanese S49-13087 82 filed by the applicant hereof.

According to said prior art, when a telephone set A calls set B, a set C calls set D to forward the call.
10 When D responds to C, a loop is formed between A and D. In said prior art, even when a general calling party calls C, B can autodial set A, whose telephone number was memorized. However, a tape is used as a recording medium for automatic dialing of telephone numbers in
15 the conventional device, and only one telephone number of the calling party A, which number is memorized, can be called. Thus, nothing further can happen if A doesn't answer the call after the automatic dialing.

Disclosure of the Invention

20 The present invention is intended as a remedy to the problem aforesaid.

According to the present invention there is provided a two-directional call forwarding device
25 comprising first and second telephone sets;

interconnection means, co-operative with said first and second telephone sets, for coupling said first and second telephone sets to establish a call between an outside party and a subscriber each at a respective outside telephone set;

a memory for storing a succession of telephone number codes;

memory entry means, co-operative with said memory and said first telephone set, for entering into said
5 memory said succession of telephone number codes, each of which codes corresponds to a call-back telephone number indicated by a respective outside party via said first telephone set;

auto-dialing means, co-operative with said memory
10 and said first telephone set, for calling, via said first telephone set, each outside party indicated by each respective telephone number code stored in said memory; and

control means, co-operative with said
15 auto-dialing means, said memory and said second telephone set, responsive to an incoming call to said second telephone set from the subscriber, for controlling said memory and said auto-dialing means in order to call one or more of the outside parties via
20 said first telephone set whilst said subscriber is still connected to said second telephone set.

It follows that a number of successive calls can be placed whilst the subscriber remains on line.

Further optional advantageous features are
25 described in the context of an embodiment of the invention a description of which will now follow.

Brief Description of the Drawings

Figure 1 - 1 is a principle view of the preferred embodiment of this invention.

5 Figure 1 - 2 shows a detailed view, showing a detail of Figure 1 - 1.

Figure 2, 3, and 4 are flow charts showing the operation of this invention.

Best Mode for Carrying out the Invention

10 The arrangement and operations in the preferred embodiment of the present invention will now be described. In the Figure 1-1, A refers to the telephone set of the calling party initiating the communication, from a location which is unsettled.

15 B identifies the telephone set for receiving the call. When a paging call is received from A and the present device is set to the paging mode, B becomes the telephone set for sending the paging call.

20 C refers to a telephone set for forwarding the call, when the signal is sent from A and the present device is set to forwarding mode. Under such conditions, C typically calls a telephone set D, which is set at a specific location, by a speed dialer. When the present device is set to a paging mode, C calls the pager E. When the party carrying the pager E, i.e. the
25 subscriber calls C via a nearby telephone, C is used as the telephone set for receiving the call.

30 Reference symbols LT-1 and LT-2 denote line transformers. Reference numerals 1 and 2 denote ringing circuits for detecting a ringing signal; and reference numerals 3 and 4 denote polarity detecting circuits for detecting a polarity reversal of the telephone line. As shown in Figure 1-2, the polarity detecting circuits include two light-emitting diodes, connected to each other in parallel and in opposite

direction, and two photocouplers PT1 and PT2 for receiving the outputs from said light-emitting diodes. The outputs of the two polarity detecting circuits are provided to input terminals DB2 to DB5 of a CPU.

5 The polarities detected by circuits 3 and 4 are memorized and the polarity reversion is detected by the program of CPU, as hereinafter described.

Reference numeral 5 denotes a two-directional amplifier for increasing the volume of a voice signal transmitted between A and D (B) to a suitable level. Reference symbols 6 to 8 denote one-directional amplifiers; and 9 denotes a tone decoder for decoding the telephone number of said calling party A, sent from A by dialing a pushbutton (tone) phone. Reference numeral 10 denotes a voice synthesizer for sending out by synthesized voice an outgoing message and an instruction to said calling party, and 11 denotes the speed dialer which sends the signal for calling D from C. Alternatively or equivalently, reference numeral 11 may be considered to denote the DTMF oscillator which changes the telephone number to a multiple frequency dialing tones generated by a push phone. Reference numerals 12 and 13 denote analog switches for switching the output of said tone to C or to B; and 14 and 15 denote operation switches for switching the operation of the present device to call forwarding or to paging.

Reference symbol IC-1 denotes a NOR gate; IC-2 denotes an OR gate; IC3 to IC6 denote drivers; and Y-1 to Y-4 denote relays whose contacts are shown in corresponding lower-case letters. For example, contact y1-1 corresponds to relay Y-1. Reference symbol CPU denotes a one chip microcomputer, for instance, INTEL 8049, wherein DB0 to DB7 and TEST1 are input terminals, INT is an interrupt terminal, P10 to P13 are input terminals and P20 to P27, P40 to P43, and P50 to P52 are output terminals. Each of the above components is

connected to the various input terminals or output terminals of the CPU for operations shown in the flow charts of FIGS. 2 to 4.

5 Operations of the present device will now be described with reference to the flow charts shown in Figures 2 to 4.

The flow chart of Figure 2 shows the operation for forwarding to D an incoming call from the calling party A received at the present device. Upon receiving an
10 incoming call from A to B, a ringing signal is detected by the ringing circuit 1. The output of ringing circuit 1 is introduced into the input terminal TEST1 of the CPU through the OR gate IC-2. When it is determined by the program that the input signal is a
15 ringing signal (step 201), output port P21 is switched to L (low) level from H (high) level and the relay Y-2 is kept energized through the driver IC-4 (step 202). The telephone set C is engaged by the contact y2-1 of then relay Y-2 through the line transformer LT-2 and a
20 dial tone is received from the central office. When the dial tone is detected (step 203), the line polarity at that time is memorized (step 204). More particularly, when the telephone set C is engaged, the engaging current flows through the polarity detecting
25 circuit 4 in a direction corresponding to the polarity thereof. For instance, when L3 is (+) and L4 is (-), the current flows through LED1 and not through LED2, as shown in FIG. 1-2. Accordingly, in response to the illumination output of LED1, photo transistor PT1 is
30 energized and photo transistor PT2 is not energized. Thus, an output terminal d is at the L level and an output terminal c is at the H level. The output status of circuit 4 is stored into a register or a RAM in the CPU through the input terminals DB4 and DB5 of the CPU.
35 For example, the status is stored as a hexadecimal code "01" into a register R7 of the CPU.

Next, the speed dialing operation is carried out so as to call the telephone set D (step 205). More particularly, in order to send a "*" tone first, a predetermined code is output from the output ports P40 to P43 of the CPU. The address of the DTMF oscillator 11 is set, and the start pulse is output from the output port P50. In response to said output, the "*" tone is output for about 0.5 second from the DTMF oscillator 11. This tone is amplified by the amplifier 8 through the analog switch 12 (the output port P52 is preset to H level) and sent out to the telephone line through the line transformer LT-2. Similarly, a "0" tone is sent out twice after a minimum pause, so that the speed dialing sequence "*00" is completed.

When telephone set D answers the call, the line polarity is reversed according to the response of D (step 206). The line polarity reversion is detected by comparison with the hexadecimal code "01" stored in register R7. When the polarity reversion is detected, the stored code is switched, for instance, to hexadecimal "10".

When D answers, the output port P20 is switched to L level from H level, and the relay Y-1 is kept energized through the driver IC-3. Thus, the telephone set B is engaged through the contact y1-1 of the relay Y-1 (step 208). Accordingly, a loop is formed between the calling party A and the telephone B.

Further, the relay Y-3 is kept energized in step 209, so the calling party A and the called party D can talk with each other through the contact y3-1 and the two-directional amplifier 5.

After the conversation, when the called party D hangs up, the line polarity of the telephone C is reversed. When this polarity reversion is detected as described above (step 210), the relays Y-1, Y-2 and Y-3 are deenergized (steps 211 to 213). The present device

thus returns to the standby mode. It is also possible to keep the relay Y-4 energized and drive the recorder 16 by the contact y4-1 thereof during the conversation so as to record the two-way conversation.

5 On the other hand, when the called party D does not answer, a loop in the program is formed from step 206 to step 207. In step 207, the ringing signal is detected through the ringing circuit 1. When the
10 calling party A stops calling, the program returns to step 201 and the present device returns to the standby mode to be ready for a next incoming call.

 When the changeover switch 15 (paging) is pushed, upon receiving a signal the present device performs a
15 paging operation of a portable paging unit. Namely, in the flow chart of Figure 3, when the device receives the signal, the relay Y-2 is kept in an ON condition, and the connection to telephone set C is closed by the
20 contact y2-1. When the dial tone is detected, the speed dialing code for calling the paging unit is output (steps 301 - 304). This speed dialing code is set, for example, to "*03", which is different from the code for call forwarding.

 After the speed dialing code is output, the relay Y-1 is set to an ON condition and the connection to
25 telephone set B is closed. As a result, the calling signal stops, and the connection between sets A and B is established to permit communication over the telephone (step 305). At the same time, a first
30 message is output by the speech synthesis section 10. Specifically, the first message is selected by the output ports P24 - P26 from the messages memorized in the speech synthesis section 10. The first message can be output by adding the start pulse from the output
35 port P27. Accordingly, the first message is amplified by the amplifier 7, and is forwarded to the calling party A. This first message may be, for example, "This

device is paging the subscriber now, please wait for a minute."

5 In the step 308, calling of the portable pager from the terminal has been finished. Accordingly, in order to free telephone set C, the relay Y-2 is set to an OFF condition. This operation is necessary so that the party carrying the pager calls the side C in response to the received call. In the step 309, the
10 relay Y-4 is set to an ON condition and the recorder 16 is operated. This operation in step 309 is provided for the calling party who thinks it enough only to leave a message on the recorder without talking directly with the carrier of the pocket-bell.
15 A message identifying the contents which may be recorded is included in the first message. As above, when the recorder starts operating, after a flag FO is set to "1", a two minute timer starts, and it is tested whether or not the two minutes have passed
20 (step 310, 311). If the called subscriber can call the set C via the telephone E within two minutes, he can talk with the calling party directly. This operation is shown in the flow chart of the Figure 4, and is explained later.

25 When the period of two minutes passes, the relay

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Y-4 is set to OFF and stops the recorder 16, and a second message is output from the speech synthesis section 10 (steps 313, 314). This second message may be, for example, "The subscriber cannot be reached.

5 If you are in a hurry, please dial your telephone number, and the subscriber will call you later".

When the calling party at A then starts dialing its own telephone number by the pushphone within a specified time, the head of tone of the pushphone is
10 detected in the step 316. When the head of tone is detected, a specific RAM area is designated. The

telephone number thus forwarded from the calling party is memorized in the RAM area (steps 317, 318).

Specifically, the telephone number forwarded from the calling party is amplified by the amplifier 6 through the line transformer LT-1, and is provided to the tone decoder 9. Accordingly, the tones representing the telephone number are output as 4 bit codes from the output terminal OUT of the tone decoder 9. This output is provided to the input terminals P10-P13 of the CPU. When a strobe signal from the strobe terminal S of the tone decoder 9 is input to the interrupt terminal INT through the NOR gate IC-1, the code is memorized in the RAM. This operation is performed on all digits of the telephone number. Thereafter, the memorized telephone number is read out from the RAM, and is heard for confirmation by the calling party at A (step 319).

In step 320, a third message is output. The telephone number memorized as above is confirmed by the third message and, at the same time, if the telephone number is wrong, the telephone number is dialed again by the calling party. The telephone number dialed again is sent to the step 318 by the interrupting operation.

When the calling party goes on-hook after finishing talking over the telephone, the on-hook condition is detected in step 322. This detection is achieved by reducing light of the light emitting diode in the polarity detecting circuit 3. After the relay Y-1 is set to OFF, the connection of the set B is released. The next RAM area is designated, and when the calling party has set to the on-hook condition, the flag F0 is cleared and the telephone line is restored.

The flow chart of Figure 4 shows the sequence of operations when the paged subscriber calls the set C. Namely, when the subscriber calls

telephone set C by the nearest telephone, the calling signal is detected by the ringing circuit 2, and is provided to the input terminal TEST 1 of the CPU through the OR gate IC-2. At the same time, the
5 signal is given to the interrupt terminal INT through the NOR gate IC-1. As a result, an interruption occurs, and the program shifts to the flow chart shown in Figure 4. Accordingly, in step 401, the relay Y-2 is set to ON and closes connection to the set C
10 through the contact y2-2. In the step 402, a test is performed for the flag FO shown in Figure 3. When the calling party is in an off-hook condition and is talking over the telephone, the flag FO is "1". As a result, the flow chart flows to the step 403. When
15 the calling party is not talking over the telephone, the flow chart flows to the step 410. When the calling party is off-hook, and in the process of talking over the telephone, in the step 403, after the said flag FO is cleared, the relay Y-3 is set to ON,
20 to establish contact between the calling party at A and the subscriber, to enable talking over the telephone (step 404).

At this time, in the step 318, the telephone number memorized in the RAM is not necessary. If it
25 is memorized in the RAM, it is cleared (step 405) and,

in step 406, the hook condition of the paged subscriber's set is detected. As soon as it is detected that the telephone set used by the subscriber is on-hook, the relays Y-1, Y-2 and Y-3 are set to
5 OFF, and the program returns to the waiting condition of the step 301, which is not shown in the Figure.

When the calling party at A has already returned his set to the on-hook condition, even if the paged subscriber calls the side C, the program shifts from
10 the step 402 to the step 410 as above. In the step 410, it is tested whether the telephone number is memorized or not, by detecting the RAM area which

memorizes the said telephone number. If the telephone number is not memorized, the program flows to the step 411 to output a fourth message. After the fourth message is sent, which may be, for example, "The
 5 telephone number is not memorized", the relay Y-2 is set to OFF (step 413), and the telephone line is restored.

When the telephone number is memorized, in the step 415 the relay Y-1 is set to ON, and contact is
 10 established to the side B by closing contact y1-1. After the closing, a test is performed for presence of the dial tone sent from the terminal (step 416). The address of the telephone number recorded in the RAM as above, is read out, the telephone number is changed to
 15 the speech synthesized form, as in steps 319 and 320, and is sent to the subscriber at E. More particularly, the telephone number, as memorized in the RAM in the CPU, is output from the output port P24-P27 digit by digit, and is changed by the speech
 20 synthesis section 10 to an analog speech synthesis signal. The analog signal representing the speech synthesized number is sent to the calling party through the analog switch 13, the analog switch 12, the amplifier 8, and the line transformer LT-2.

When the calling party, who confirms the synthesized telephone number which will be dialed automatically, thinks it acceptable to auto dial the telephone number, he leaves the dialing to this device. When the calling party thinks it inappropriate to call
 25 the other party now, the telephone is set to on-hook. As a result, the program shifts from the step 418 to the step 428, the relay Y-2 is set to OFF, and the device is restored.

Alternatively, at this time, for example, the
 35 subscriber at set E may push the key "*" on the pushphone twice, to eliminate the telephone number. As

a result, the next telephone number is read out from the RAM, and it is possible to auto dial the telephone number as provided in the following explanation (not shown).

5 When the auto dialing process is practiced, the program shifts to the step 419 through step 417 and step 418. After the line polarity at this time is memorized, the auto dialing is performed according to the telephone number memorized in the RAM, and the
10 set A is called. When the side A responds, the line polarity reverses (step 421), the relay Y-3 is set to ON, and the connection between the set A and set E is set to permit talking over the telephone.

 When the telephone conversation is finished, the
15 set A is set to the on-hook condition, and the line polarity reverses. This operation is detected by the step 421, the relay Y-1 is set to OFF, the set B is released, and the telephone number used for auto dialing is cleared (steps 424 and 425). In the step
20 426, after the next RAM area which memorizes the next telephone number is designated, the program returns to the step 410.

 As described above, the device continues the auto dialing procedure to call the side A until all the
25 telephone numbers are cleared in the RAM. It is

possible to auto dial the next telephone number of the calling party at set A2 by skipping (jumping over) the telephone number, if the set A1 does not respond during the specific time provided therefor.

5 This device does not use tape storage for the numbers but, instead, uses solid state memory as the memory medium. As a result, it is possible to call and to dial the information memorized in the solid state memory, automatically, easily, and quickly.

10 Thus, the device owner at set C calls a party at set A through set D. Even if the party at A does not respond thereto, this invention can correspond therewith at once, by calling a number of a next set at which the party may be located, and the practical
15 effect of the present forwarding device is increased.



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CLAIMS:

1. A two-directional call forwarding device comprising:

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first and second telephone sets;

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interconnection means, co-operative with said first and second telephone sets, for coupling said first and second telephone sets to establish a call between an outside party and a subscriber each at a respective outside telephone set;

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a memory for storing a succession of telephone number codes;

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memory entry means, co-operative with said memory and said first telephone set, for entering into said memory said succession of telephone number codes, each of which codes corresponds to a call-back telephone number indicated by a respective outside party via said first telephone set;



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auto-dialing means, co-operative with said memory and
said first telephone set, for calling, via said first
telephone set, each outside party indicated by each
respective telephone number code stored in said
5 memory; and

control means, co-operative with said auto-dialing
means, said memory and said second telephone set,
responsive to an incoming call to said second
10 telephone set from the subscriber, for controlling
said memory and said auto-dialing means in order to
call one or more of the outside parties via said first
telephone set whilst said subscriber is still
connected to said second telephone set.

15

2. A device as claimed in claim 1, wherein said
memory entry means includes signal conversion means
for converting signal tones to digital code whereby
the respective outside party is able to indicate his
20 call-back telephone number by selecting and sending a
succession of signal tones from his outside telephone
set.



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3. A device as claimed in either of claims 1 and 2,
~~when~~ comprising:

5 detection means for detecting when the subscriber is
called and not responding; and

first-message sending means, which is co-operative
with said detection means and said first telephone
set, and is operable to send a first message to an
10 outside calling party connected to the first telephone
set to invite that party to indicate a call-back
telephone number when it is detected that the
subscriber is called and not responding.

15 4. A device, as claimed in any one of the preceding
claims, ~~when~~ comprising:

voice synthesis means, which is co-operative with said
memory, and is operable to convert a telephone number
20 code stored in said memory to voice synthesised
form;

second-message sending means, which is co-operative
with said voice synthesis means and said first
25 telephone set and is operable to repeat said telephone



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number verbally and request confirmation or
retransmission of said telephone number indication;

5 and wherein said memory entry means is operable to
re-enter a telephone number code into the memory in
response to retransmission of the telephone number
indication.

10 5. A device as claimed in any one of the preceding
claims ~~when~~ comprising:

15 voice synthesis means, which is co-operative with said
memory, and is operable to convert each of said
telephone number codes stored in said memory to voice
synthesised form; and

20 third-message sending means, which is co-operative
with said voice synthesis means and said second
telephone set, and is operable to read out each of
said telephone numbers verbally once the subscriber
has called in and is still connected to said second
telephone set.



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6. A device as claimed in claim 5, wherein said control means is operable, in response to an interrupted pause following read-out of a telephone number to the subscriber, to control said memory and said auto^ldialling means to call the outside party at that read-out telephone number via said first telephone^{set}.

7. A device as claimed in claim 5, wherein said control means is operable to clear a corresponding telephone number code from said memory when signalled by the subscriber at said second telephone set following the read-out of a telephone number.

8. A device as claimed in any one of the preceding claims wherein said control means is operable to control said memory and said auto^ldialling means to call another of the stored telephone numbers via said first telephone set in the event that either a called one of the stored telephone numbers is unanswered or is answered and cleared whilst the subscriber is connected to said second telephone set.



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9. A device as claimed in any one of the preceding claims ~~when~~ comprising:

5 auto-dial^{ing} means, co-operative with said second telephone set, for calling the subscriber either at a predetermined call-forwarding telephone number address or at a predetermined pager address; and

10 switch means co-operable with said auto-dialing means for selecting either call-forwarding or paging mode of operation.

15 10. A two-directional call forwarding device constructed adapted and arranged to perform substantially as described hereinbefore with reference to and as shown in the accompanying drawings.
