(12) UK Patent Application (19) GB (11) 2 257 330 (13) A

(43) Date of A publication 06.01.1993

(21) Application No 9204455.1

(22) Date of filing 02.03.1992

(30) Priority data
(31) 9110497 (32) 24.06.1991 (33) KR
9114082 14.08.1991
9121146 25.11.1991

(71) Applicant
Samsung Electronics Co Limited

(Incorporated in the Republic of Korea)

416 Maetan-Dong, Kwonsun-Gu, Suwon-City, Kyounggi-Do, Republic of Korea

(72) Inventors
Yang-Seon Kim
Seung-Hwan Cho
Chang-Lae Jeong

(74) Agent and/or Address for Service
Appleyard Leeds
15 Clare Road, Halifax, West Yorkshire, HX1 2HY, United Kingdom

(51) INT CL[5]
H04M 3/22

(52) UK CL (Edition L)
H4K KFF

(56) Documents cited
US 4972453 A

(58) Field of search
UK CL (Edition K) H4K KFE KFF KTL
INT CL[5] G06F 11/22, H04M 3/08 3/22 3/24 3/26 3/28
Online databases: WPI

(54) Remote maintenance of a private branch exchange system

(57) A PBX system 200 is maintained by connecting the system with a remote maintenance center 220 through a public switch telephone network (PSTN). State information about the PBX system is transmitted to the remote maintenance center 220 by connecting a remote maintenance connection circuit 210 automatically when the PBX system receives an incoming call from the remote maintenance center 220. A MODEM control circuit (302, Fig. 3) communicates the state information with an external modem 221 by utilizing a MODEM (303, Fig. 3) built in the system, without using a separate port. Maintenance, including function change, can be carried out remote from the PBX so a technician's visit is not necessary.

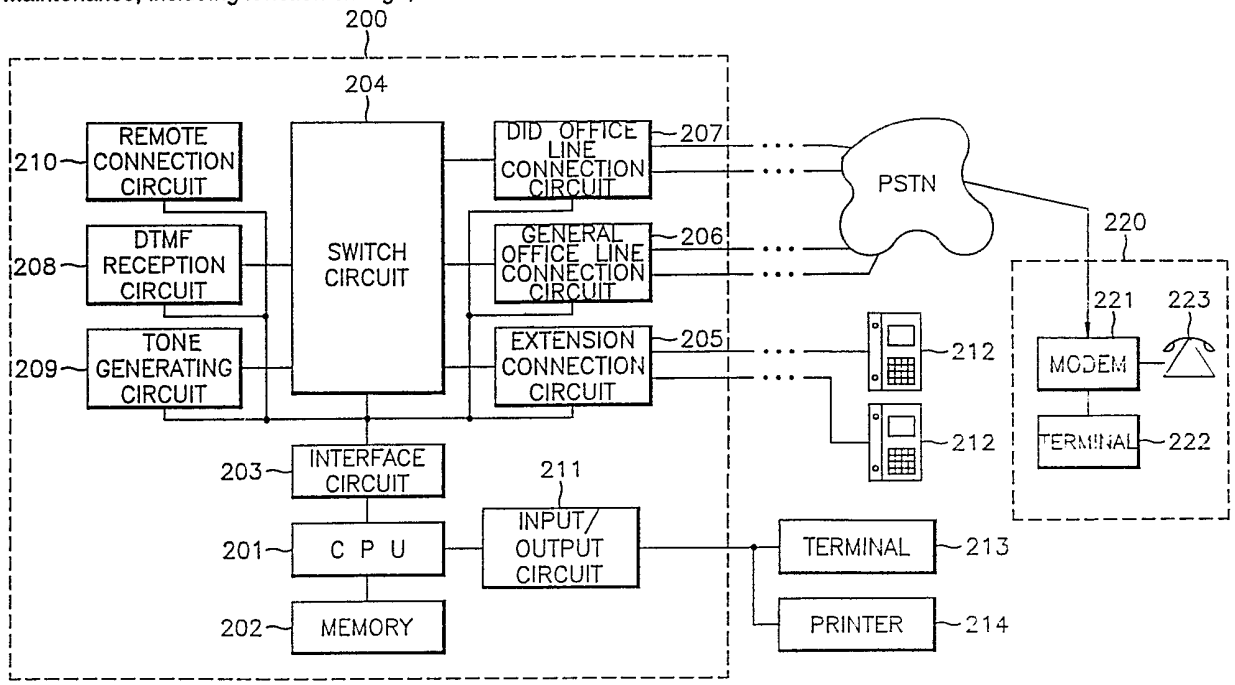
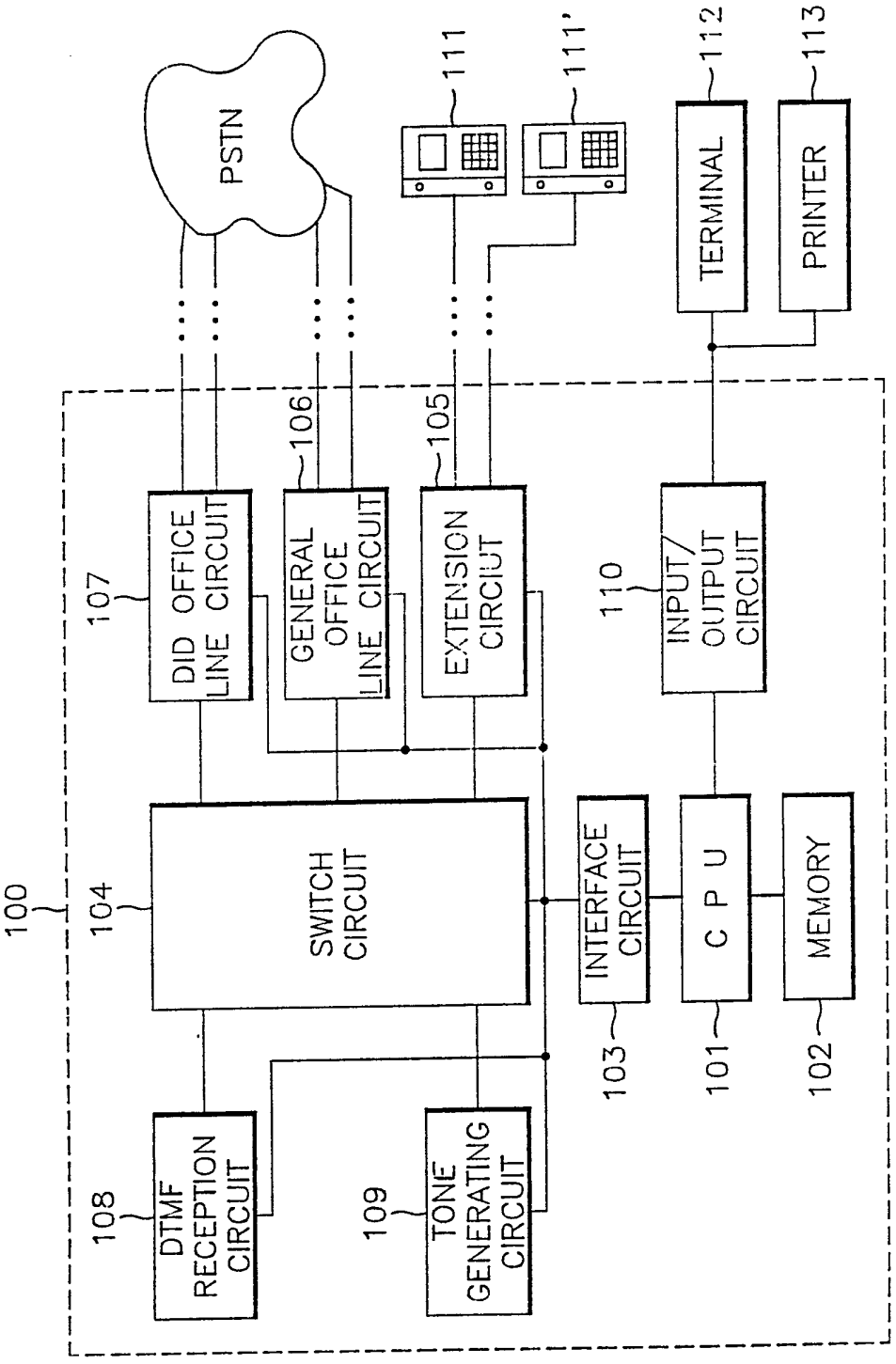


FIG. 2

GB 2 257 330 A



(PRIOR ART)

FIG. 1

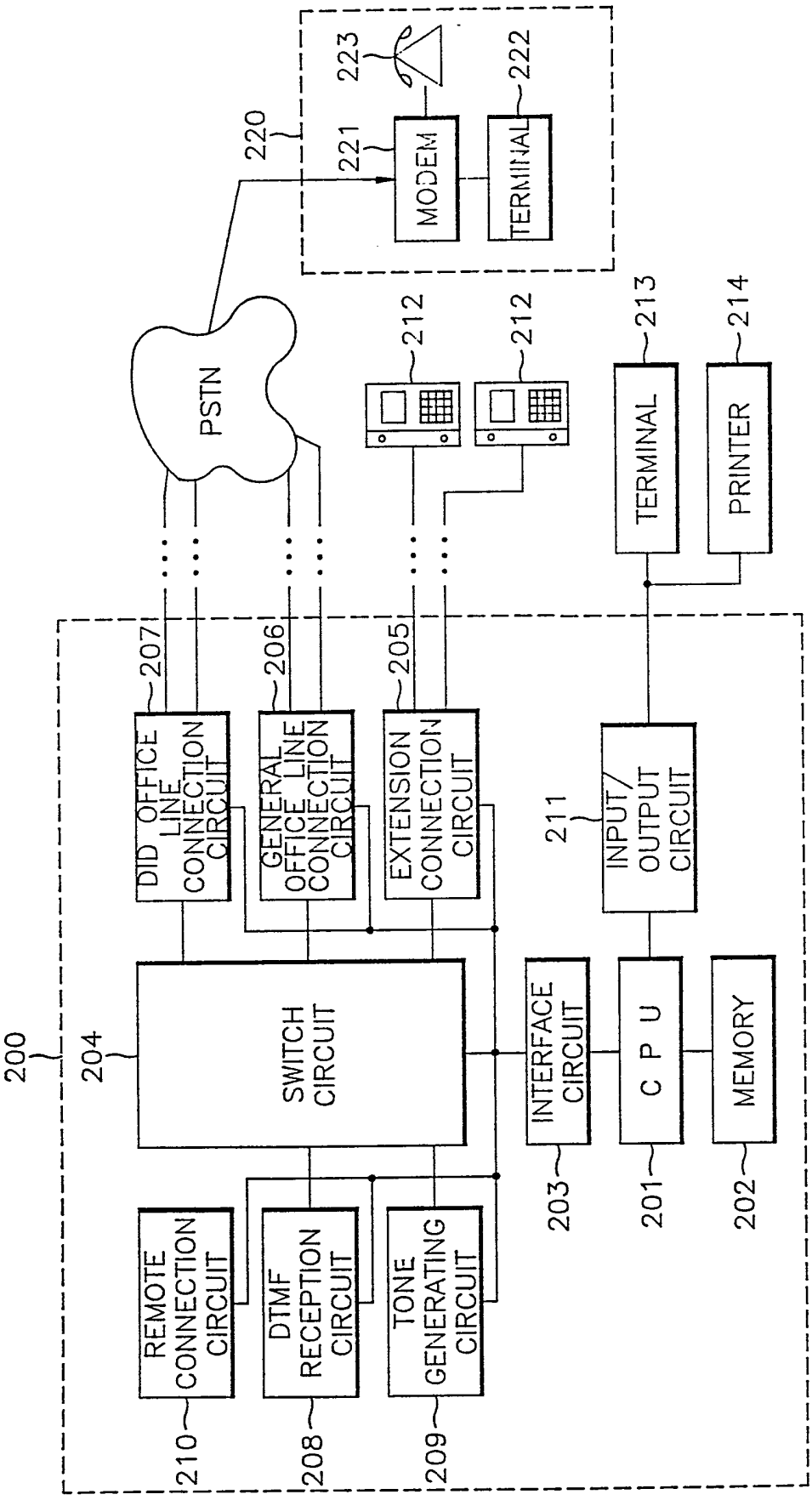

200
204
SWITCH CIRCUIT
207
DID OFFICE LINE CONNECTION CIRCUIT
206
GENERAL OFFICE LINE CONNECTION CIRCUIT
205
EXTENSION CONNECTION CIRCUIT
211
INPUT/ OUTPUT CIRCUIT
213
TERMINAL
214
PRINTER
212
212
PSTN
220
221
MODEM
222
TERMINAL
223
INTERFACE CIRCUIT
203
C P U
201
MEMORY
202
REMOTE CONNECTION CIRCUIT
210
DTMF RECEPTION CIRCUIT
208
TONE GENERATING CIRCUIT
209

FIG. 2

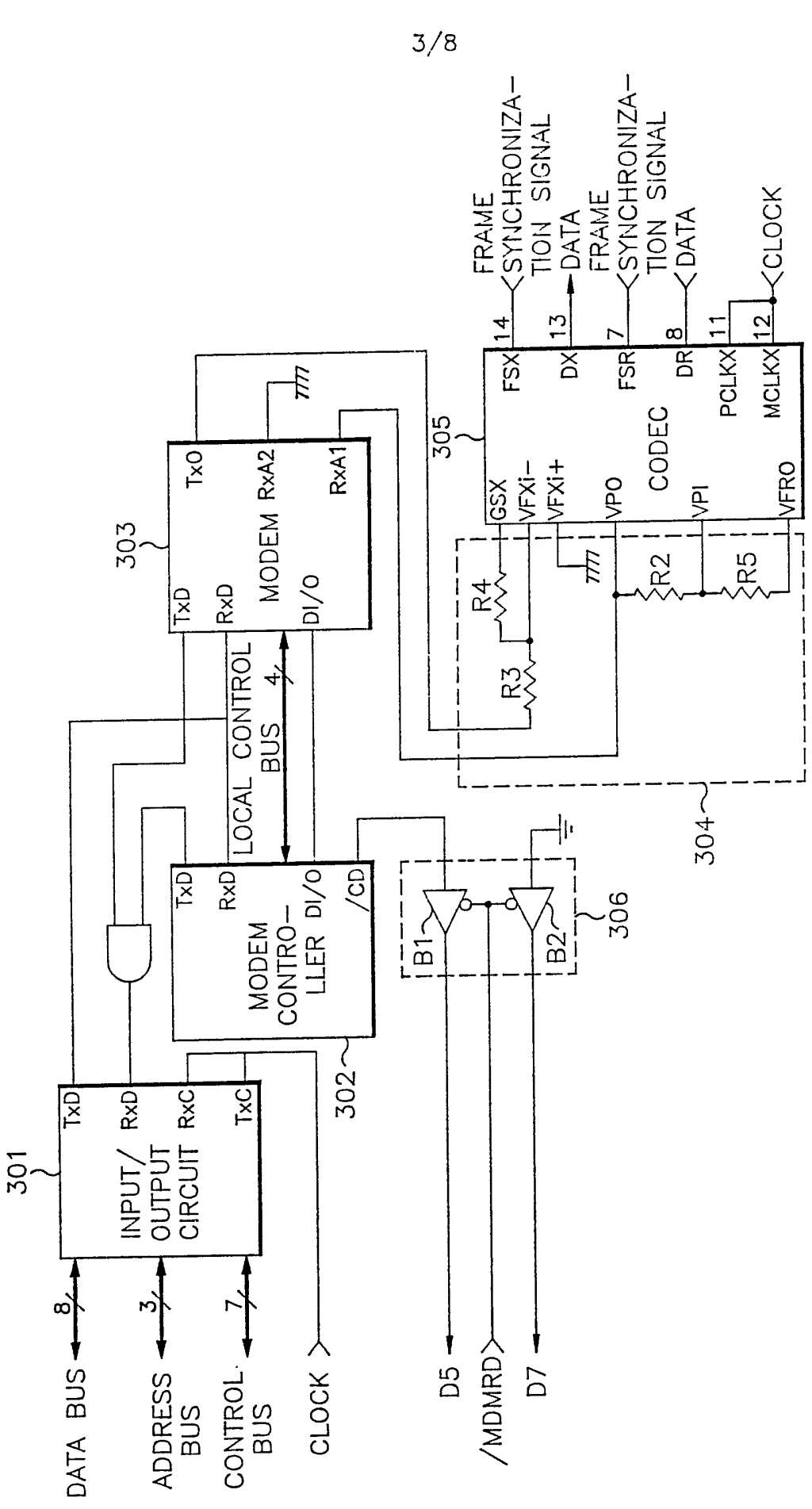

301
INPUT/ OUTPUT CIRCUIT
TxD
RxD
RxC
TxC
8
3
7
DATA BUS
ADDRESS BUS
CONTROL BUS
CLOCK
302
MODEM CONTRO- LLER DI/O
/CD
LOCAL CONTROL BUS
4
303
MODEM
TxO
RxA2
RxA1
TxD
RxD
DI/O
305
CODEC
FSX
DX
FSR
DR
PCLKX
MCLKX
GSX
VFXi-
VFXi+
VPO
VPI
VFRO
14
13
7
8
11
12
FRAME SYNCHRONIZA- TION SIGNAL
DATA
FRAME SYNCHRONIZA- TION SIGNAL
DATA
CLOCK
R4
R3
R2
R5
304
306
B1
B2
D5
/MDMRD
D7

FIG. 3

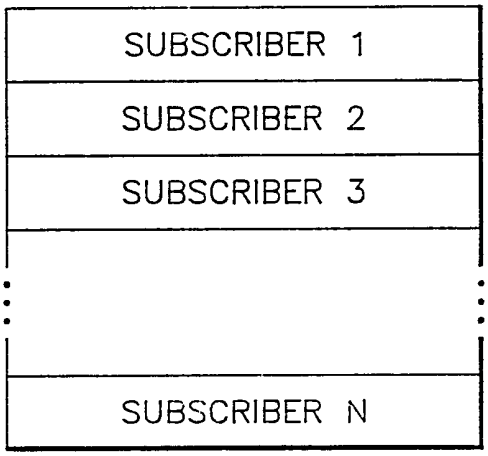

SUBSCRIBER 1
SUBSCRIBER 2
SUBSCRIBER 3
SUBSCRIBER N

FIG. 4A

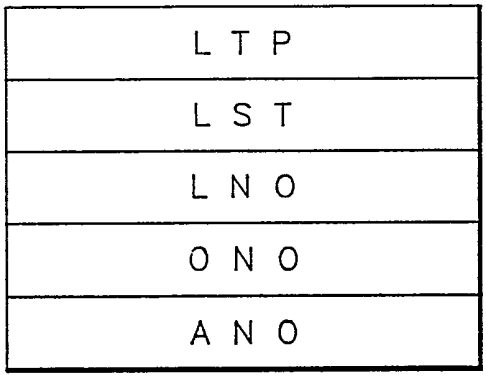

L T P
L S T
L N O
O N O
A N O

FIG. 4B

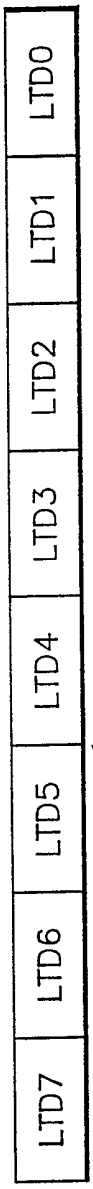

LTD7
LTD6
LTD5
LTD4
LTD3
LTD2
LTD1
LTD0
NOT USED

FIG. 4C

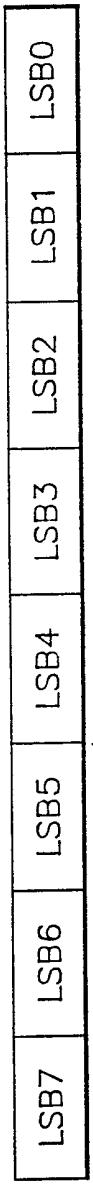

LSB7
LSB6
LSB5
LSB4
LSB3
LSB2
LSB1
LSB0
NOT USED

FIG. 4D

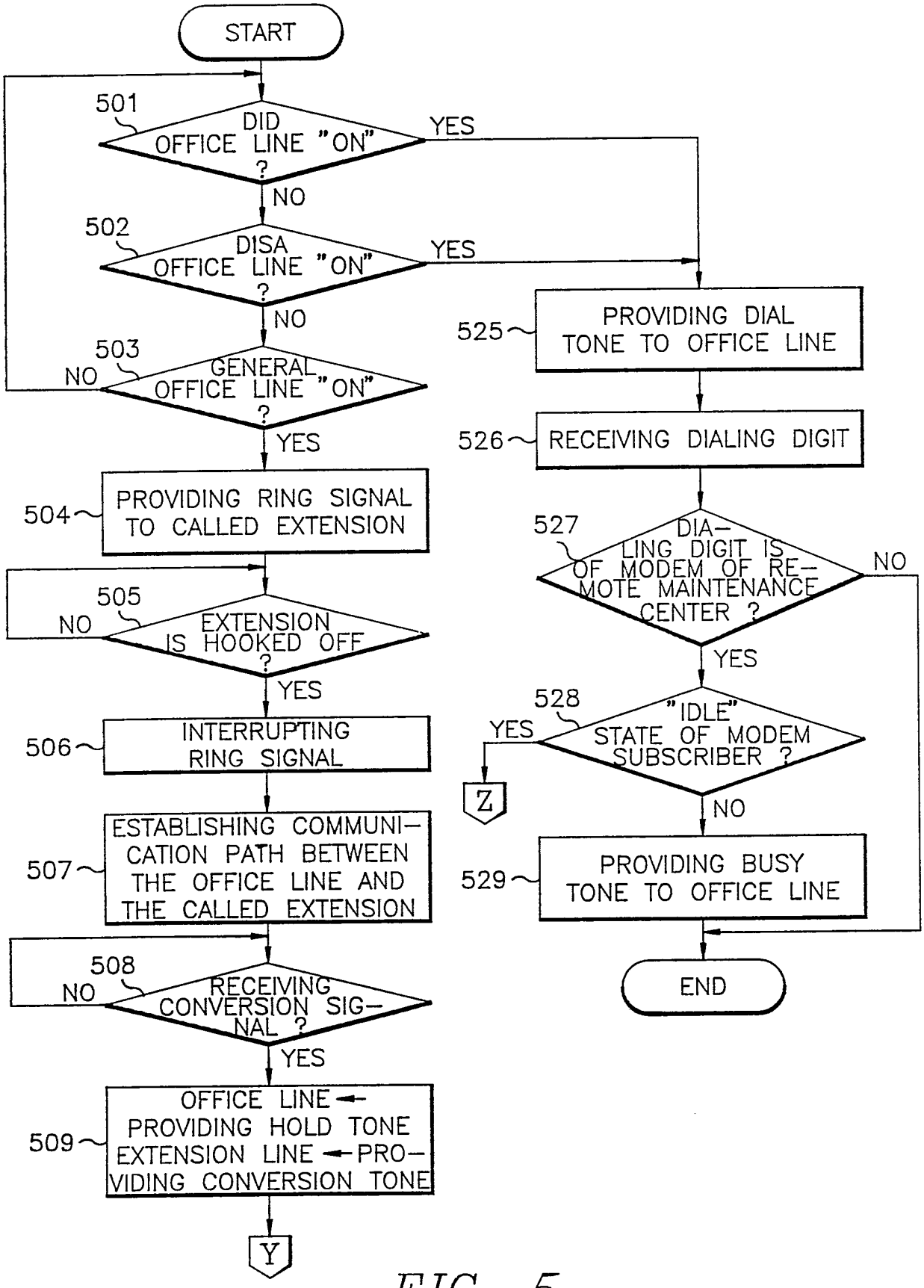

START
501
DID OFFICE LINE "ON" ?
YES
NO
502
DISA OFFICE LINE "ON" ?
YES
NO
503
GENERAL OFFICE LINE "ON" ?
NO
YES
504
PROVIDING RING SIGNAL TO CALLED EXTENSION
505
EXTENSION IS HOOKED OFF ?
NO
YES
506
INTERRUPTING RING SIGNAL
507
ESTABLISHING COMMUNICATION PATH BETWEEN THE OFFICE LINE AND THE CALLED EXTENSION
508
RECEIVING CONVERSION SIGNAL ?
NO
YES
509
OFFICE LINE PROVIDING HOLD TONE EXTENSION LINE PROVIDING CONVERSION TONE
Y
525
PROVIDING DIAL TONE TO OFFICE LINE
526
RECEIVING DIALING DIGIT
527
DIALING DIGIT IS OF MODEM OF REMOTE MAINTENANCE CENTER ?
NO
YES
528
"IDLE" STATE OF MODEM SUBSCRIBER ?
YES
NO
Z
529
PROVIDING BUSY TONE TO OFFICE LINE
END

FIG. 5

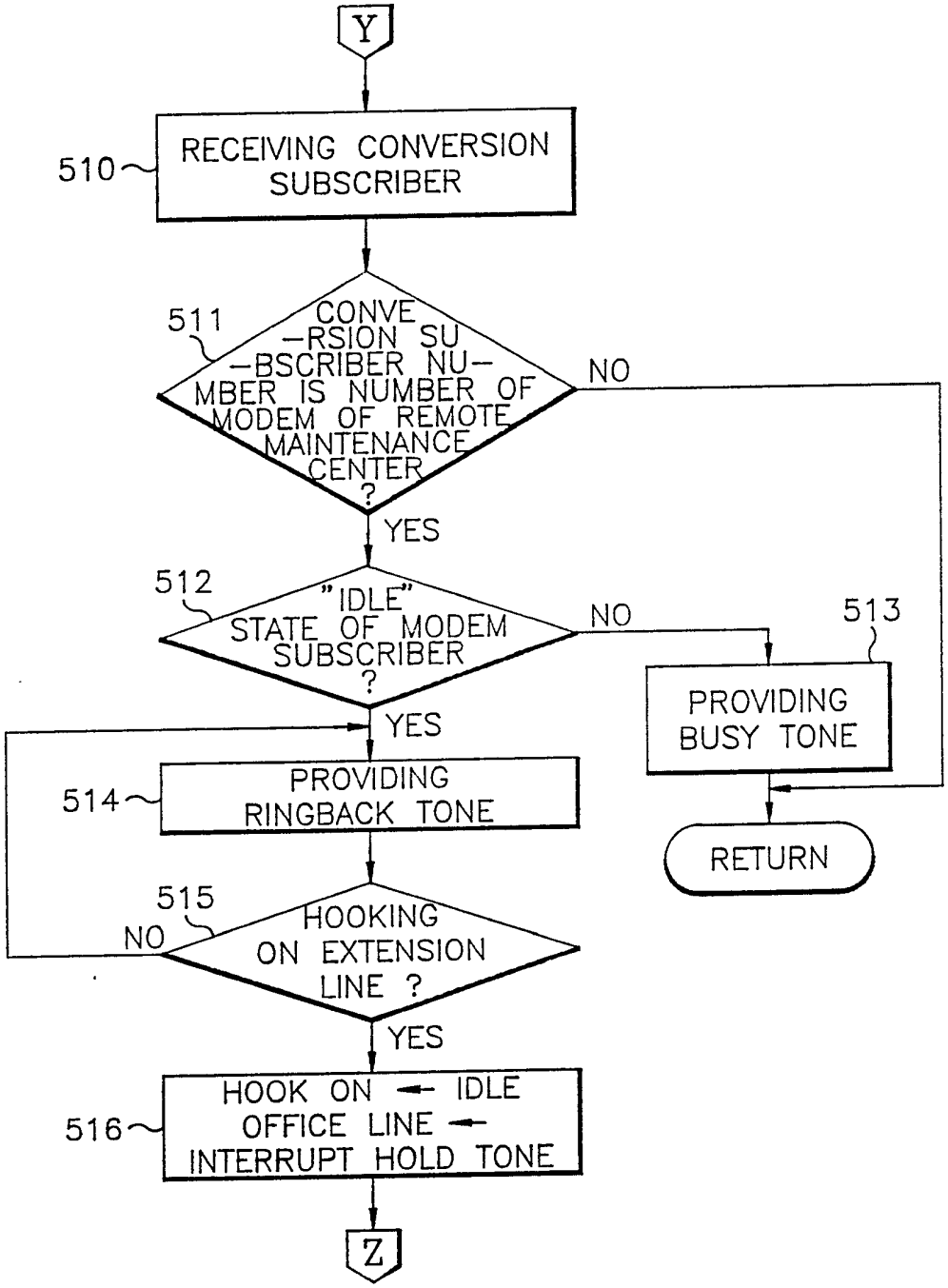

Y
510
RECEIVING CONVERSION SUBSCRIBER
511
CONVE -RSION SU -BSCRIBER NU- MBER IS NUMBER OF MODEM OF REMOTE MAINTENANCE CENTER ?
NO
YES
512
"IDLE" STATE OF MODEM SUBSCRIBER ?
NO
513
PROVIDING BUSY TONE
YES
514
PROVIDING RINGBACK TONE
RETURN
515
HOOKING ON EXTENSION LINE ?
NO
YES
516
HOOK ON ← IDLE OFFICE LINE ← INTERRUPT HOLD TONE
Z

FIG. 5

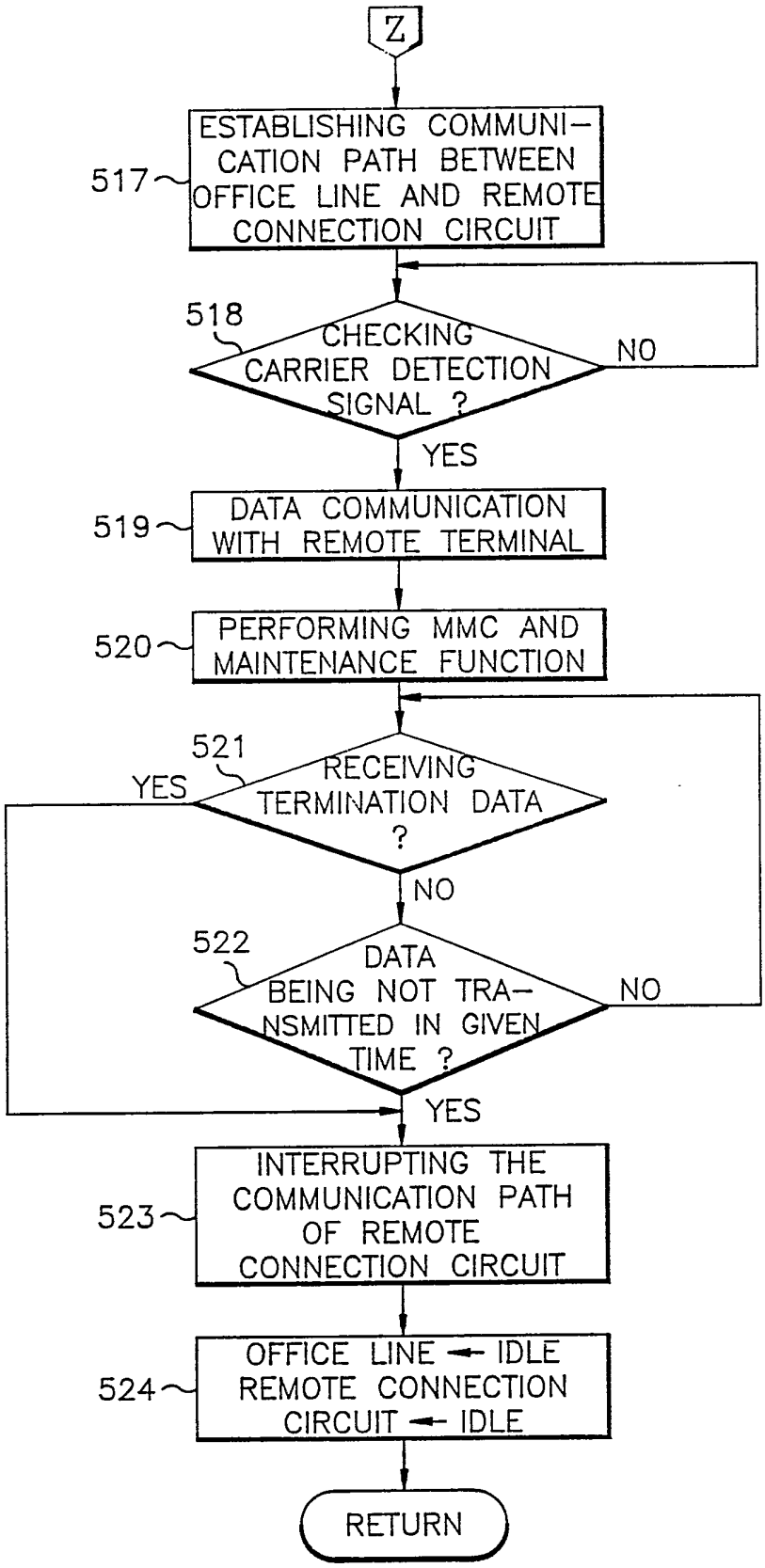

Z
ESTABLISHING COMMUNICATION PATH BETWEEN OFFICE LINE AND REMOTE CONNECTION CIRCUIT
517
518
CHECKING CARRIER DETECTION SIGNAL ?
NO
YES
519
DATA COMMUNICATION WITH REMOTE TERMINAL
520
PERFORMING MMC AND MAINTENANCE FUNCTION
521
RECEIVING TERMINATION DATA ?
YES
NO
522
DATA BEING NOT TRANSMITTED IN GIVEN TIME ?
NO
YES
523
INTERRUPTING THE COMMUNICATION PATH OF REMOTE CONNECTION CIRCUIT
524
OFFICE LINE ← IDLE
REMOTE CONNECTION CIRCUIT ← IDLE
RETURN

FIG. 5

MAINTENANCE OF TELEPHONE SYSTEM

The present invention relates to the maintenance of telephone systems, and more particularly to a method and device for maintaining a private branch exchange (PBX) system.

With reference to Figure 1 of the accompanying diagrammatic drawings, a central processing unit (hereinafter called CPU) 101 controls an overall operation of a known PBX system so as to perform all kinds of functions and establish a speech path.

A memory 102 comprises a ROM for storing a program and an initial service data to generate a basic call and perform all kinds of functions of the PBX system and a RAM for storing temporarily data generated while performing a program under a control of the CPU 101.

An interface circuit 103 is connected between the CPU 101 and various structural elements of the PBX system and interfaces all kinds of signals and data generated while performing an exchange function of the PBX system. A switch circuit 104 exchanges all kinds of tone signals, dialing data and voice data through a channel designated by a control of the CPU.

An extension circuit 105 is connected between the switch circuit 104 and a subscriber telephone set 111, establishes an extension speech loop under a control of the CPU 101, supplies an electric current to the telephone set 111, and interfaces all kinds of state signals and voice signals between the switch circuit 104 and subscriber telephones 111 or 111'.

A general office line circuit 106 is connected between the switch circuit 104 and the public switching telephone network (PSTN), establishes an office line speech loop by seizing an office line under a control of the CPU 101, transmits all kinds of state signals and voice signals received from the office line to the switch circuit 104, and in turn transmits the voice signal and state signal from the switch circuit 104 to the office line.

A DID (Direct Inward Dialing) office line circuit 107 is connected between the switch circuit 104 and the PSTN, connects a call signal to the subscriber 111 directly according to a dialing signal from the office line by seizing a DID trunk under a control of the CPU 101, and interfaces all kinds of signals and voice signals between the DID trunk and the switch circuit 104.

A DTMF (Dual Tone Multi Frequency) reception circuit 108 is connected to the switch circuit 104, converts a received dialing signal into digital data and transmits it to the CPU 101. A tone generating circuit 109 is connected to the switch circuit 104 and transmits a designated tone signal to the switch circuit 104 under a control of the CPU 101. An input/output circuit 110 is connected to an external terminal 112 and printer 113 and interfaces data between the external terminal and the PBX system under a control of the CPU 101.

A key telephone system may be used in place of the PBX system as described above.

Generally a function of maintaining the PBX system is performed by utilizing the telephone set 111 or the terminal 112. If an abnormal state occurrs on the PBX system or changing information of a subscriber is

required, it is possible to check the abnormal state or change the information of the subscriber by utilizing the telephone set 111 or the terminal 112.

However, it is difficult for a system operator or user to maintain and administrate the PBX system by themselves because operation of the PBX system is complicated and varied. Accordingly it is required for a technician of the maintenance center to visit a site of the PBX system, in order to inspect an abnormal state and add or delete a function requested by a user.

However it is difficult to satisfy a user's requirement promptly because the technician has to visit the site of the PBX system for direct maintenance, and also it takes much time to maintain because of abnormal states being inspected on the spot. Furthermore, efficiency of the PBX system is decreased because an operation of the system may be impossible during maintaining of the PBX system. Also, the maintenance center needs to employ a great number of maintenance workers for satisfying various users' requirements.

Preferred embodiments of this invention aim to provide a method and device for maintaining a PBX system by connecting the PBX system with a remote maintenance center through a PSTN.

Another aim is to provide a method for transmitting state information of the PBX system to a remote maintenance center by driving a remote maintenance connection circuit automatically equipped with the PBX system in case of the PBX system receiving an incoming call from the remote maintenance.

It is still another aim to provide a modulator-demodulator (MODEM) control circuit for communicating a state information with an external device by utilizing a MODEM built in the PBX system without using an additional port.

According to one aspect of the present invention, there is provided a private branch exchange (PBX) system with a remote maintenance facility and comprising:

a remote maintenance center connected to a public switch telephone network (PSTN), for generating an inquiry data to said PBX system, receiving a reply data in response to said inquiry data, thereby diagnosing said PBX system according to said reply data, and thereafter generating a result data indicative of control of a maintenance function of said PBX system;

controlling means for controlling a speech function of said PBX system, transmitting said reply data to said remote maintenance center, and for setting up said maintenance function of said PBX system according to said result data;

office line connection circuit means for interfacing said remote maintenance center by said controlling means through said PSTN;

switch circuit means for establishing a data communication path between said remote maintenance center and said office line connection circuit means by said controlling means; and

a remote maintenance connection circuit means connected to said switch circuit means and said controlling means, for transmitting said inquiry data from said switch circuit means to said controlling means, in turn transmitting said reply data from said controlling means to said switch circuit means, and for transmitting said result data of said switch circuit means to said controlling means.

Preferably, said remote maintenance connection circuit means comprises:

input/output circuit means for converting parallel data or serial data received through a data bus into serial data or parallel data respectively, and thereafter producing converted output data through said data bus;

MODEM means receiving the converted serial data from said input/output circuit means, for converting said converted serial data of digital form into serial analog data, and for converting an analog signal applied thereto into a digital signal, and transmitting said digital signal to said input/output circuit means;

MODEM controlling means receiving said serial data from said input/output circuit means, for adjusting a state of said MODEM, analyzing an output data of said MODEM and thereafter transmitting an analyzed output data of said MODEM to said input/output circuit means, and for checking a state of carrier signal of said MODEM;

codec means receiving an analog signal from said MODEM means, for converting said analog signal into a digital signal and thereafter transmitting

that digital signal to said switch circuit means in a given time slot, and receiving data of a given time slot from said switch circuit means, and for converting said data into analog data and thereafter transmitting said analog data to said MODEM means; and

buffer means for buffering a signal of a carrier output end of said MODEM controlling means and transmitting the buffered signal to said controlling means according to a control of said controlling means.

Such a system may further comprise an interface circuit connected between said MODEM and said codec means, for adjusting gain and impedance of a signal applied to or generated from said codec means.

According to another aspect of the present invention, there is provided a method for remotely maintaining a private branch exchange system (PBX) by a data communication between a remote maintenance center and said PBX system through a public switch telephone network (PSTN), said PBX system having a remote maintenance connection circuit connected between an exchange controller and a switch circuit, said method comprising the steps of:

analyzing incoming information received through an office line connection circuit of said PBX, controlling said switch circuit, and establishing a data communication path between said remote maintenance connection circuit and an incoming port of a corresponding office line of said office line connection circuit;

transmitting a response data representative of a state of said PBX system to said exchange controller in response to an inquiry data generated at

said remote maintenance center, generating a result data in response to said response data, and performing a maintenance function in dependence upon said result data; and

controlling said switch circuit when a termination signal representative of a communication end is generated during the maintenance operation, thereby interrupting said data communication path, and initializing said remote maintenance connection circuit.

Preferably, the step of establishing said data communication path comprises the steps of:

when receiving said incoming information at a general office line connection circuit of said PBX, connecting a speech path between said general office line connection circuit and a called extension subscriber, and thereafter if a conversion data is received from said called extension subscriber to said remote maintenance connection circuit, establishing said data communication path between a port of said general office line connection circuit and said remote maintenance connection circuit;

when receiving said incoming information at a direct inward system access (DISA) office line circuit of said PBX, analyzing a continuously received dialing digit of said DISA office line circuit, and thereafter establishing said data communication path between said remote maintenance connection circuit and said DISA office line circuit in accordance with an analyzed output of said dialing digit; and

when receiving said incoming information at a direct inward dialing (DID) office line connection circuit of said PBX, analyzing a continuously received dialing digit of said DID office line connection circuit, and thereafter establishing said data communication path between said remote maintenance connection circuit and said DID office line connection circuit in accordance with an analyzed output of said dialing digit of said DID office line connection circuit.

For a better understanding of the invention, and to show how the same may be carried into effect, reference will now be made, by way of example, to Figures 2 to 5 of the accompanying diagrammatic drawings, in which:

Figure 2 is a block diagram illustrating one example of a PBX system according to the present invention;

Figure 3 is a detailed diagram illustrating an example of a remote maintenance connection circuit shown in Figure 2;

Figures 4A to 4D are examples of structural maps of a memory of the system of Figure 2; and

Figure 5 is a flow chart illustrating an example of a remote maintenance operation according to the present invention.

With reference to Figure 2, the configuration of the inventive PBX system is similar to that of the conventional PBX system of Figure 1. In addition to the conventional configuration of the PBX system, however, a

remote maintenance center 220 and a remote maintenance connection circuit 210 are added.

The remote maintenance connection circuit 210 is connected with a switch circuit 204, and establishes a data communication path by a control of a CPU 201, thereby transmitting state information of the PBX system to the remote maintenance center 220 through the switch circuit 204.

With reference to Figure 3, a configuration of the remote maintenance connection circuit 210 is illustrated as follows.

An input/output circuit 301 converts parallel data received through a data bus into serial data and, vice versa, serial data into parallel data, under a control of the CPU 201, and thereafter transmits the converted data to the CPU 201 through the data bus.

A MODEM controller 302 is connected with the input/output circuit 301, and receives the serial data from the input/output circuit 301 to analyze, thereby controlling the state of a MODEM 303. The MODEM controller 302 detects a carrier signal received through the MODEM 303, thereby checking a start and termination of data communication.

The MODEM 303 is connected between the input/output circuit 301 and an interface circuit 304, and converts digital serial data of the input/output circuit 301 into an analog signal, and analog serial data into digital data.

A codec 305 is connected between the interface circuit 304 and the switch circuit 204. The codec 305 converts an analog signal of the MODEM

303 into a digital signal, and synchronizes the digital signal with a corresponding time slot, transmitting it to the switch circuit 204. Also the codec 305 converts data of a corresponding time slot received from the switch circuit 204 into analog data and transmits it to the MODEM 303.

The interface circuit 304 is connected between the MODEM 303 and the codec 305, and adjusts data gain and external impedance.

A buffer part 306 comprising two buffers B1 and B2 buffers a signal received from a carrier detection terminal CD of the MODEM controller 302, and transmits a signal indicative of a presence of carrier signal to the CPU 201 by a MDMRD signal of the CPU 201.

With reference to Figures 2 and 3, an outside system operator places a call to an office line connected to a general office line connection circuit 206 or a DID office line connection circuit 207, in order to communicate with the PBX system. Then the general office line connection circuit 206 or the DID office line connection circuit 207 detects an incoming ring signal from the PSTN and transmits it to the CPU 201.

The CPU 201 recognizes the incoming call of the office line and controls the switch circuit 204 so as to establish a speech path. The speech path is established with a telephone set 212 of a called subscriber connected to an extension connection circuit 205 in case of the incoming call being received at the general office line connection circuit 206. And in case of the incoming call being received at the DID office line connection circuit 207 or office line with a DISA (Direct Inward System Access) function, the called

subscriber receives a dialing signal by connecting the DTMF reception circuit 208 with the outside system operator.

When the incoming call is received at the general office line connection circuit 206, the CPU 201 supplies a ring signal to the telephone set 212 of the called subscriber. By hooking off, the telephone set 212 receives the incoming ring and is connected to a speech path with an outside subscriber of the office line through the switch circuit 204. Assuming that the outside subscriber is the remote maintenance center 220, the outside subscriber requests to change mode for a remote data communication when the speech path is established.

Accordingly, the CPU 201 connects the incoming call of the general office line connection circuit 206 to the remote connection circuit 210 through the switch circuit 204 when the called subscriber 212 transmits a conversion key signal through the extension connection circuit 205 to the CPU 201.

The CPU 201 controls the switch circuit 204 so as to connect the incoming call of the office line with the remote connection circuit 210 if a direct communication with the remote connection circuit 210 is requested through the DID office line connection circuit 207 or the office line circuit of the DISA function.

After the remote connection circuit 210 is connected with the incoming call, a MODEM 221 of the remote maintenance center 220 is connected with the MODEM 303 of the remote connection circuit 210. Then a communication path is established for performing a data communication if the MODEM 303 detects a carrier signal.

When the remote maintenance center 220 puts data for communicating into the MODEM 221 under the detection of carrier, the MODEM 221 converts the data for communicating to an analog signal and transmits it through the PSTN to the general office line connection circuit 206 or the DID office line connection circuit 207 of the PBX system, by loading it on the carrier.

On the other hand, the general office line connection circuit 206 or the DID office line connection circuit 207 of the PBX system converts the received analog signal into a digital signal and transmits the digital signal to the switch circuit 204 connected to the remote maintenance connection circuit 210. The switch circuit 204 switches the digital signal and applies the switched signal to the remote maintenance connection circuit 210. The remote connection circuit 210 transmits the received digital signal to the CPU 201.

The CPU 201 analyzes the data received from the remote connection circuit 210, producing output data. The output data is transmitted to the remote maintenance center 220 through a transmission path in the opposite direction of a reception path for the incoming call.

With reference to Figures 2 and 3, an example of operation of the remote connection circuit 210 is illustrated in detail as follows.

When the remote connection circuit 210 receives an instruction of mode conversion, the CPU 201 controls the switch circuit 204 so that a communication path is established between the remote connection circuit 210 and the general office line connection circuit 206 or the DID office line connection circuit 207. At this time, the remote connection circuit 210

utilizes a fixed channel. The CPU 201 transmits a control data to the input/output circuit 301 through a data bus in order to place the MODEM 303 of the remote connection circuit 210 on-line.

The input/output circuit 301 converts parallel data transmitted from the data bus to serial data, which is produced through an output end TxD thereof. The MODEM controller 302 receives the serial data through its input end RxD and analyzes it. The MODEM controller 302 controls the MODEM 303 to be on-line through a local control bus if the received serial data is on-line data of the MODEM 303. The MODEM controller 302 controls an on/off-line operation and a communication speed of the MODEM 303.

The MODEM controller 302 checks the presence of carrier signal of the MODEM 303, and generates a "low" signal through an end CD in the case of the carrier signal existing.

An output from the carrier detection end CD of the MODEM controller 302 is applied to the buffer part 306. The buffer part 306 transmits the output signal of the carrier detection end CD to the CPU 201 in case of receiving an enabling signal/MDMRD from the CPU 201.

Accordingly the CPU 201 recognizes a start of communication by receiving a carrier detection signal from the buffer part 306 after generating on-line data.

The buffer part 306 comprises the first buffer B1 connected to the end CD of the MODEM controller 302 and the second buffer B2 connected to a ground terminal or an electric source. The first buffer B1 buffers a signal

representative of the presence of carrier signal, and the second buffer B2 buffers a signal representative of the relation between the remote connection circuit 210 and the MODEM 303. The outputs of the first and second buffers B1 and B2 are illustrated in Table 1.

- TABLE 1 -

	OUTPUT	REMARK
BUFFER 1	0	Carrier signal exists
	1	Carrier signal does not exist
BUFFER 2	0	MODEM connected
	1	MODEM not connected

When the remote connection circuit 210 is on line and a carrier signal is detected from an outside MODEM, the CPU 201 performs a step of receiving data from the outside subscriber and analyzes it.

In a step of receiving data, the switch circuit 204 transmits a frame synchronization signal and data to an end FSR and an end DR of the codec 305 respectively. The codec 305 receives data of a corresponding time slot by using a frame synchronization signal FSX and a clock MCLKX, and converts it into an analog signal, producing the output thereof through an end VPO. The signal from the end VPO is applied to an end RxA1 of the MODEM 303 after its gain and impedance are adjusted by resistances R2 and R5.

The MODEM 303 converts the analog signal received at the end RxA1 into a digital signal, and produces it through an end TxD thereof. The data from the end TxD of the MODEM 303 is transmitted to an end RxD of the input/output circuit 301 and converted into parallel data. The parallel data of the input/output circuit 301 is transmitted through the data bus to the CPU 201 and is analyzed. Thus, the CPU 201 generates a reply data in response to the received data, checking the state of the MODEM 303.

The MODEM controller 302 analyzes an output received from an end DI/O of the MODEM 303, and transmits it through an end TxD thereof to the end RxD of the input/output circuit 301. The input/output circuit 301 converts serial data of the end RxD thereof into parallel data and transmits it to the CPU 201. Thereby the CPU 201 analyzes the received parallel data and recognizes the state of the MODEM 303.

As described above, the CPU 201 generates the reply data by analyzing data received from an outside subscriber. At this time, the CPU 201 transmits the reply data through the data bus to the input/output circuit 301. The input/output circuit 301 converts the received parallel data into serial data, transmitting the serial data through an end TxD thereof according to a clock. The clock decides a transmission speed of the serial data, of which the speed is the same as a transmission speed of the MODEM 303.

An output of the end TxD of the input/output circuit 301 is applied to the end RxD of the MODEM controller 302 and the MODEM 303. The MODEM 303 converts the received serial digital data into an analog signal. The serial analog data of the end TxO is transmitted to the end GSX of the codec 305 after its gain and impedance are adjusted by resistances R3 and R4.

The codec 305 converts the serial analog signal received through the end GSX into a digital signal, and generates the converted digital signal through an end DX by loading it on a corresponding time slot. Output data of the codec 305 is transmitted to the switch circuit 204 and switched into a time slot of an outside subscriber. The switched data is transmitted to the outside subscriber through the general office line connection circuit 206 or the DID office line connection circuit 207.

In brief, the CPU 201 of the PBX system controls the remote connection circuit 210 so as to place the MODEM 303 on-line, and analyzes data received through the remote connection circuit 210 connected to a communication path of the outside subscriber. And the CPU 201 generates the reply data in response to the received data and transmits it to the remote connection circuit 210. The reply data is transmitted to the outside subscriber through the communication path of the switch circuit 204 and the office line.

If the outside subscriber generates data requiring an interruption of the data communication under the above data communication, the CPU 201 recognizes the data communication interruption through the communication path and controls the MODEM controller 302 so as to make the MODEM 303 off-line. And if there occurs an abnormality on a carrier signal during the data communication, the MODEM controller 302 senses an interruption of a carrier signal, and generates a logic signal "high" through the end CD thereof. Then the CPU 201 recognizes a discontinuation of carrier signal, thereby controlling the MODEM controller 302 so as to make the MODEM 303 off-line.

Figures 4A to 4D are structures of a map of memory 202, wherein the tables of extension and office line subscriber are the same in structure.

Figure 4A shows a table structure for N subscribers of the PBX system, and Figure 4B shows details of a table structure of one subscriber. Figure 4C shows a structural map of bits of Line Type as shown in Figure 4B and the functions of the bits are described in Table 2 below.

- TABLE 2 -

LTDO (STATION)	Whether it is an extension subscriber	
	0	Otherwise
	1	Extension subscriber
LTD1 (DID-CO)	Whether it is a DID office line	
	0	Otherwise
	1	DID office line
LTD2 (DISA-CO)	Whether it is a DISA office line	
	0	Otherwise
	1	DISA office line
LTD3 (NORMAL-CO)	Whether it is a general office line	
	0	Otherwise
	1	General office line

LTD4 (MODEM)	Whether it is a MODEM port for a remote maintenance	
	0	Otherwise
	1	MODEM subscriber

Figure 4D shows a structural map of bits of Line Status and the functions of the bits are described in the Table 3.

- TABLE 3 -		
LSD0 (IDLE)	Whether a subscriber is idle	
	0	Otherwise
	1	Idle
LSD1 (BUSY)	Whether a subscriber hears a busy tone. It is set under all states except for an idle state.	
	0	Otherwise
	1	Busy
LSD2 (RING)	Whether a call is ringing	
	0	Otherwise
	1	Ring

LSD3 (RING BACK)	Whether a subscriber hears a ring back tone.	
	0	Otherwise
	1	Ring back
LSD4 (TALK)	Whether a subscriber talks with other subscriber	
	0	Otherwise
	1	Talking
LSD5 (HOLD)	Whether a subscriber hears a hold tone	
	0	Otherwise
	1	Hold

With reference to Figure 4B, a subscriber's identification number is stored in a port of line number LNO, and a number of an opposite party on telephone is stored in a port of opposite number ONO. A number of an extension subscriber for receiving an incoming ring is stored in a port of answer number ANO when the general office line connection circuit 206 receives the incoming ring.

Figure 5 shows a step of connecting the remote maintenance center with the remote connection circuit 210. The connection step comprises three kinds of steps to be adapted in case of the general office line connection circuit 206 receiving the incoming ring, the DID office line connection circuit

receiving the incoming ring and the office line of the DISA function receiving the incoming ring. Details of the three kinds of steps are illustrated in Figure 5.

The step of establishing a communication path between the remote maintenance center 220 and the PBX system is described more specifically as follows.

Firstly a step of performing a maintenance through the general office line connection circuit 206 is described.

When the general office line connection circuit 206 receives the incoming ring signal, the CPU 201 recognizes reception of the incoming ring signal in the step 503. In the step 504, the incoming ring signal is supplied to a called extension subscriber recorded in the port of answer number ANO, a LSD0 bit of line status of subscriber LST is reset, and a LSD1 and a LSD2 bit is set, so that the called extension subscriber is set in a talking status and a state of supplying the ring signal is indicated.

Thereafter the CPU 201 checks in step 505 whether the port of the called extension subscriber is hooked off by inspecting a state of port of the called extension subscriber in the extension connection circuit 205. When the port of the called extension subscriber is hooked off, the CPU 201 interrupts the ring signal in the step 506. And then the CPU 201 establishes a speech path between an incoming port of the general office line connection circuit 206 and the port of the called extension subscriber of the extension connection circuit 205 by controlling the switch circuit 204 in the step of 507. The LSD2 bit of the line status LST is reset so as to indicate a state of cancellation of

ring signal, and the LSD4 bit is set so as to indicate a state of talking. An office line number is recorded in an opposite number port of the called extension subscriber table, and the called extension number is recorded in an opposite number port of the office line subscriber table.

Accordingly, a speech path is established between the office line and the extension line. When the office line subscriber announces himself as the remote maintenance center 220 and request to be connected with the remote connection circuit 210, the called extension subscriber dials a conversion key and an ID number of the remote connection circuit 210.

The CPU 201 recognizes a reception of the conversion key in the step 508, and controls the switch circuit 204 in the step 509 so as to provide a hold tone or music to the remote maintenance center 220 in the state of talking and to provide a conversion tone to the called extension subscriber.

Thereafter, when a conversion subscriber number is put in the extension connection circuit 205, in the step 510, the CPU 201 receives the conversion subscriber number through the DTMF reception circuit 208 and stores it in an opposite number port ONO of Figure 4B.

In the step 511, the CPU 201 checks whether the conversion subscriber number is a subscriber number of the MODEM 303 for receiving remote maintenance. The checking is done by inspecting the LTD4 bit of line type port LTP after accessing the conversion subscriber table. If the LTD4 bit is set, the conversion subscriber is a subscriber of the MODEM 303.

In step 512, the CPU 201 checks a state of the LSD0 bit of the conversion subscriber table as shown in Figure 4D after confirming the conversion subscriber number is the subscriber number of the MODEM 303 for receiving the remote maintenance in the step 511. If the LSD0 bit is reset as a state of "Otherwise" as shown in Table 3, the CPU 201 controls the tone generating circuit 209 and the switch circuit 204 so as to send a busy tone to the called subscriber in a step 513.

If the LSD0 bit is set as a state of "Idle" in the step 512, the CPU 201 controls the tone generator 209 and the switch circuit 204, providing a ring back tone to the called extension subscriber and setting a LSD3 bit of line status as shown in Figure 4D in a step 514.

Consequently, the incoming call from the remote maintenance center 220 is connected with the remote connection circuit 210 by the called extension subscriber. Accordingly, when the called extension subscriber hooks on his telephone set, the CPU 201 recognizes a state of hook-on through the extension connection circuit 205 in a step 515, and sets the called extension subscriber in a state of "Idle" and interrupts the hold tone being sent to the office line subscriber in a step 516. In the line status LST of the extension subscriber table as shown in Figure 4B, the LSD0 bit is set, LSD1 to LSD5 bits are reset, and FFH is stored in an opposite subscriber number port of the extension subscriber table. Thereby the remote maintenance connection circuit is initialized.

In a step 517, the CPU 201 controls the switch circuit 204 so as to connect the remote connection circuit 210 with the incoming office line port, and accordingly a communication path between the maintenance center 220

and the remote connection circuit 210 is established by using the PSTN. In this case, the LSD5 bit is reset and the LSD4 bit is set in the line status of the office line subscriber table, and the LSD4 bit is set as a state of "talking" in a line status of a subscriber of the remote connection circuit 210. A number of the remote connection circuit 210 is stored in an opposite subscriber number port of the office line subscriber table, and a number of the office line subscriber is stored in an opposite subscriber number port of the subscriber table of the remote connection circuit 210.

After the communication path for maintenance is established, data communication is performed in order to set up a MODEM and to form a communication path between the MODEM 221 of the remote maintenance center 220 and the MODEM 303 of the remote connection circuit 210.

The CPU 201 generates the MDMRD signal and enables the first buffer B1, thereby checking a state of carrier detection signal received from the end CD of the MODEM controller 302 in step 518. When the carrier signal is detected in the step 518, the CPU 201 recognizes the establishment of communication path between the MODEM 303 of the remote connection circuit 210 and the MODEM 221 of the remote maintenance center 220, and thereafter performs a function of maintenance in the steps 519 and 520.

In detail, when the remote maintenance center 220 transmits an inquiry data for inspecting a state of the PBX system to the CPU 201, the CPU 201 generates a reply data in response to the received inquiry data. The remote connection circuit 210 transmits the reply data to the remote maintenance center 220 through the communication path of the switch circuit 204. The remote maintenance center 220 transmits an instruction signal MMC (Man

Machine Communication) of maintenance or function change of the PBX system after receiving the reply data. The CPU 201 receives the instruction signal through the remote connection circuit 210, performing the maintenance or the function change.

After completing the maintenance function, the remote maintenance center 220 generates a given data such as "+++", representative of a termination of the data communication through terminal 222, and the CPU 201 recognizes the termination of data communication through the remote connection circuit 210 in a step 521.

The CPU 201 controls the switch circuit 204, interrupting a connection between the office line port and the remote connection circuit 210 in a step 523, and resets the LSD0 bit of the office line subscriber and the subscriber of the MODEM 303 in a step 524. At this time, all speech information recorded in the office line subscriber table and the extension subscriber table of the MODEM 303 are cleared and the steps of remote maintenance are finished.

If the remote maintenance center 220 does not transmit data for a given time in a step 522, the steps of 523 and 524 are performed for terminating the step of maintenance.

Secondly, the step of maintenance through the DID office line connection circuit 207 is described specifically as follows.

The DID office line connection circuit 207 is an office line for exclusive use of an incoming call. An opposite office line subscriber dials an

extension subscriber number together with an office line number of the PBX system, the extension subscriber number being assigned to the called extension subscriber. A LTD1 bit of line type is set for communicating with the DID office line in a subscriber table as shown in Figure 4C.

When the incoming call signal is received at the DID office line connection circuit 207, the CPU 201 recognizes the DID office line by checking a state of LTD1 bit of line status of the subscriber table as shown in Figure 4C. That is, when the LTD1 bit is set, the CPU 201 controls the switch circuit 204 so as to supply a dial tone to a receiving side Rx of the office line, resets the LSD0 bit a so as to be released from an "idle" state, and sets the LSD1 bit as a "busy" state in a step 525.

In a step 526, the CPU controls the switch circuit 204, connecting a transmission side Tx of the office line with the DTMF reception circuit 208, and receives a dialing digit through the DID office line.

In a step 527, the CPU 201 checks whether the received dialing digit is a number of the MODEM 303 of the remote connection circuit 210 for the remote maintenance. Wherein, if a LTD4 bit of line type as shown in Figure 4C is set in an extension subscriber table responding to the dialing digit, the dialing digit is the number of MODEM subscriber for remote maintenance.

After confirming the extension subscriber is the subscriber for the remote maintenance, the CPU 201 checks whether the MODEM 303 is in the "idle" state by inspecting the LSD0 bit of line status of the subscriber table of the MODEM 303 in a step 528. If the MODEM 303 is in the "busy" state in the step 528, the CPU 201 sets the LSD1 bit in a line status of the

subscriber table as shown in Figure 4D, and sends a busy tone to the office line in a step of 529 and returns. But if the MODEM 303 is in the "idle" state in the step 528, the CPU 201 goes back to the step 517, establishing the communication path for the maintenance and repeats the above described steps consecutively.

Thirdly, a function of remote maintenance can be performed in a DISA function through the general office line connection circuit 206. For performing the DISA function, a certain office line of the general office line connection circuit 206 is set with the DISA function. The DISA function can be set through a telephone or a terminal by performing the MMC. The CPU 201 sets the LTD2 bit of line type of the office line subscriber table such as Figure 3 so as to record the certain office line of the office line circuit as the DISA office line port.

Thereafter, if the remote maintenance center 220 accesses the DISA office line of the general office line connection circuit 206 through the PSTN, the CPU 201 recognizes a state of the DISA office line port of the general office line connection circuit 206 in the step 502. Accordingly the CPU 201 performs the steps of 525 to 529 in the same way as the DID office line when the incoming call signal is received through the DISA office line port.

In conclusion, it is possible to cope with a user's requirement rapidly by checking a state of the PBX system and performing maintenance with a telephone of remote distance in the PBX system. Cost of maintenance is reduced because it is not necessary for a technician to visit a site of the PBX system.

Furthermore, when the PBX system is connected with a remote maintenance MODEM, an extension port is saved because a MODEM actually connected with the remote maintenance MODEM is built in the PBX system. It is not necessary for the remote maintenance MODEM to adopt a ring detector because the PBX system is connected with the remote maintenance MODEM after establishing an extension speech path. Also a data communication is performed by the system in itself when a remote maintenance center requests a MODEM communication with the PBX system. As a result, efficiency of the PBX system is advanced.

While a preferred specific embodiment of the present invention has been particularly shown and described, it will be apparent to those skilled in the art that in the foregoing changes in form and detail may be made without departing from the spirit and scope of the present invention.

The reader's attention is directed to all papers and documents which are filed concurrently with or previous to this specification in connection with this application and which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.

All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

Each feature disclosed in this specification (including any accompanying claims, abstract and drawings), may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

The invention is not restricted to the details of the foregoing embodiment(s). The invention extends to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.

CLAIMS:

1. A private branch exchange (PBX) system with a remote maintenance facility and comprising:

a remote maintenance center connected to a public switch telephone network (PSTN), for generating an inquiry data to said PBX system, receiving a reply data in response to said inquiry data, thereby diagnosing said PBX system according to said reply data, and thereafter generating a result data indicative of control of a maintenance function of said PBX system;

controlling means for controlling a speech function of said PBX system, transmitting said reply data to said remote maintenance center, and for setting up said maintenance function of said PBX system according to said result data;

office line connection circuit means for interfacing said remote maintenance center by said controlling means through said PSTN;

switch circuit means for establishing a data communication path between said remote maintenance center and said office line connection circuit means by said controlling means; and

a remote maintenance connection circuit means connected to said switch circuit means and said controlling means, for transmitting said inquiry data from said switch circuit means to said controlling means, in turn transmitting said reply data from said controlling means to said switch circuit means, and

for transmitting said result data of said switch circuit means to said controlling means.

2. A system as claimed in Claim 1, wherein said remote maintenance connection circuit means comprises:

input/output circuit means for converting parallel data or serial data received through a data bus into serial data or parallel data respectively, and thereafter producing converted output data through said data bus;

MODEM means receiving the converted serial data from said input/output circuit means, for converting said converted serial data of digital form into serial analog data, and for converting an analog signal applied thereto into a digital signal, and transmitting said digital signal to said input/output circuit means;

MODEM controlling means receiving said serial data from said input/output circuit means, for adjusting a state of said MODEM, analyzing an output data of said MODEM and thereafter transmitting an analyzed output data of said MODEM to said input/output circuit means, and for checking a state of carrier signal of said MODEM;

codec means receiving an analog signal from said MODEM means, for converting said analog signal into a digital signal and thereafter transmitting that digital signal to said switch circuit means in a given time slot, and receiving data of a given time slot from said switch circuit means, and for converting said data into analog data and thereafter transmitting said analog data to said MODEM means; and

buffer means for buffering a signal of a carrier output end of said MODEM controlling means and transmitting the buffered signal to said controlling means according to a control of said controlling means.

3. A system as claimed in claim 2, further comprising an interface circuit connected between said MODEM and said codec means, for adjusting gain and impedance of a signal applied to or generated from said codec means.

4. A method for remotely maintaining a private branch exchange system (PBX) by a data communication between a remote maintenance center and said PBX system through a public switch telephone network (PSTN), said PBX system having a remote maintenance connection circuit connected between an exchange controller and a switch circuit, said method comprising the steps of:

analyzing incoming information received through an office line connection circuit of said PBX, controlling said switch circuit, and establishing a data communication path between said remote maintenance connection circuit and an incoming port of a corresponding office line of said office line connection circuit;

transmitting a response data representative of a state of said PBX system to said exchange controller in response to an inquiry data generated at said remote maintenance center, generating a result data in response to said response data, and performing a maintenance function in dependence upon said result data; and

controlling said switch circuit when a termination signal representative of a communication end is generated during the maintenance operation, thereby interrupting said data communication path, and initializing said remote maintenance connection circuit.

5. A method as claimed in claim 4, wherein the step of establishing said data communication path comprises the steps of:

when receiving said incoming information at a general office line connection circuit of said PBX, connecting a speech path between said general office line connection circuit and a called extension subscriber, and thereafter if a conversion data is received from said called extension subscriber to said remote maintenance connection circuit, establishing said data communication path between a port of said general office line connection circuit and said remote maintenance connection circuit;

when receiving said incoming information at a direct inward system access (DISA) office line circuit of said PBX, analyzing a continuously received dialing digit of said DISA office line circuit, and thereafter establishing said data communication path between said remote maintenance connection circuit and said DISA office line circuit in accordance with an analyzed output of said dialing digit; and

when receiving said incoming information at a direct inward dialing (DID) office line connection circuit of said PBX, analyzing a continuously received dialing digit of said DID office line connection circuit, and thereafter establishing said data communication path between said remote maintenance connection circuit and said DID office line connection circuit in accordance

with an analyzed output of said dialing digit of said DID office line connection circuit.

6. A private branch exchange system with a remote maintenance facility and substantially as hereinbefore described with reference to Figures 2 to 4 of the accompanying drawings.

7. A method for remotely maintaining a private branch exchange system, the method being substantially as hereinbefore described with reference to Figure 5 of the accompanying drawings.

Examiner's report to the Comptroller under Section 17 (The Search Report)

Application number

9204455.1

Relevant Technical fields

(i) UK Cl (Edition K) H4K (KFE,KFF,KTL)

(ii) Int CL (Edition 5) G06F 11/22; H04M 3/08,3/22, 3/24,3/26,3/28

Search Examiner

G N CHAPMAN

Databases (see over)

(i) UK Patent Office

(ii) ONLINE DATABASES: WPI

Date of Search

22 JUNE 1992

Documents considered relevant following a search in respect of claims 1 TO 7

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
A	US 4972453 (DANIEL) Note column 2 lines 18-62	

up - c:\wp51\doc99\fil000590

Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family, corresponding document.

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).

Published 1992 at The Patent Office, Concept House, Cardiff Road, Newport, Gwent NP9 1RH. Further copies may be obtained from Sales Branch, Unit 6, Nine Mile Point, Cwmfelinfach, Cross Keys, Newport, NP1 7HZ. Printed by Multiplex techniques ltd, St Mary Cray, Kent.