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(54) Title: METHOD OF SHARING AND TRANSFERRING INFORMATION BETWEEN ISDN TELEPHONES		
(57) Abstract A method of automatically sharing and transferring information between a Work at Work (WAW) ISDN telephone and a Work at Home (WAH) ISDN telephone. This information includes, calling line identifier delivery from the WAW telephone to the WAH telephone, facilitating subsequent transferring of the call to the WAH telephone if desired. Message waiting status is also shared, facilitating the coordination of message waiting lamps at both the WAW and WAH telephone. Information from one telephone to the other is carried transparently through the ISDN network as user-to-user information, calling party subaddress, D channel X.25 packet message, lower layer compatibility or a combination of these elements. The telephones automatically establish ISDN calls between themselves and swap information pertaining to the status of the companion telephones.		

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METHOD OF SHARING AND TRANSFERRING INFORMATION BETWEEN ISDN TELEPHONES

Technical Field

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This invention relates to transferring information between telephones in an Integrated Services Digital Network (ISDN) and more particularly to the sharing and transferring of information between an ISDN
10 telephone located at a users workplace (work at work telephone) and an ISDN telephone located in the users home (work at home telephone).

Background Of Invention

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ISDN is capable of transferring data messages transparently between ISDN telephones. ISDN operates according to the call control methods and procedures defined by Bellcore in the National ISDN Technical
20 Requirements. The Bellcore requirements specify information elements such as user-to-user information, calling sub-address information, and lower layer compatibility. ISDN also has the capability of sending X.25 data on the network. These information elements do
25 not exist in any prior art analog service. ISDN basic rate service operates on a 2B+D configuration, that is, two 64 kilobyte per second B or bearer channels and one 16 kilobyte per second D or delta channel.

30

It has been proposed to use ISDN information elements to pass a calling party number received at a first ISDN telephone to a second ISDN telephone prior to transferring the call to the second telephone. See, for example, the patent to Kakwashima 5,422,942. One problem
35 with this prior art call transfer method is that communication between the calling party and the second

ISDN telephone is completed through the first ISDN telephone, occupying at least one channel of the first ISDN telephone until completion of the call.

5

Summary of the Invention

The present invention proposes a method of transferring information between ISDN telephones that are operable in either a local or remote mode of operation. The telephones are placed in the local mode of operation when the user is available to accept calls and is placed in the remote operation mode if the user wishes incoming calls or other information to be transferred to a companion phone at a different location. The selection of the telephone mode of operation may be controlled either locally or from a remote location.

In accordance with the present invention, a telephone placed in a remote operation mode upon receipt of an incoming call, automatically inserts appropriate information such as calling line identification into a call origination function and shares that information with its companion telephone. The companion telephone uses the information to illuminate indicators, display messages and, if desired, request transfer of the incoming call. The present invention also provides a message waiting feature that notifies one of the telephones of any messages that have been left as a result of unanswered calls to the companion telephone. A common message waiting feature is also provided that permits a plurality of telephones to be informed of a waiting message that may be answered by a user at any one of the telephones.

Brief Description of the Drawings

A more complete understanding of the present invention may be had from the following detailed description which should be read in conjunction with the drawings in which,

Figure 1 shows three telephone connected with a typical ISDN;

10

Figure 2 shows an ISDN telephone used at Stations B and C in practicing the present invention;

Figure 3 is a block diagram of the computer in the ISDN telephone;

15

Figures 4 and 5 are flowcharts of the call transfer procedure of the present invention;

Figure 6 is a timeline showing the relationship between telephones during transfer of a call;

20

Figures 7 and 8 show flowcharts of the call waiting feature of the present invention;

25

Figure 9 is a timeline of the sequence of events to remotely activate the message waiting indicator;

Figure 10 is a timeline of the sequence of events to remotely deactivate the message waiting indicator;

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Figure 11 is a system block diagram showing a dual message waiting distributor for controlling a common message waiting lamp on a plurality of telephones;

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Figure 12 shows a timeline associated with Figure 11, for activation of common message waiting indicators;

5 Figure 13 is a flowchart of software controlling activation of the dual message waiting indicators by the distributor of Figure 11;

10 Figure 14 shows a timeline associated with Figure 11, for deactivation of common message waiting indicators;

15 Figure 15 is a flowchart of software controlling deactivation of the dual message waiting indicators by the distributor of Figure 11; and

 Figures 16 and 17 are flowcharts of software controlling the remote switching of the mode of operation of one telephone by a another telephone.

20

Detailed Description of the Invention

Referring now to the drawings and initially to
25 Figure 1, Station A includes a telephone 10 from which a call is made by a calling or third party. Station B, includes a work at work (WAW) ISDN telephone 12, and Station C includes a work at home (WAH) ISDN telephone 14.
Although only three telephones are shown, it is
30 understood that a large number of ISDN telephones are connected with the network indicated generally at 16. The ISDN 16 could be any of the commonly used North American ISDN switches. In order to practice the invention, the telephones at Stations B and C must be compatible ISDN
35 telephones but it is not necessary for the telephone at Station A to be an ISDN telephone. By using standard ISDN

signaling messages, the telephones at Stations B and C can automatically pass information to the other.

As shown in Figure 2, each of the ISDN telephones or user telephones 12 or 14 includes a handset 20, a telephone keypad 22 and a display 24 for visually displaying messages. Each ISDN telephone further includes a plurality of call appearance or feature lamps 26 including a REMOTE OFFICE MONITOR 28, a WORK AT WORK MESSAGE WAITING lamp 30, a WORK AT HOME MESSAGE WAITING lamp 32, a MUTE key/lamp 34, and a SPEAKERPHONE key/lamp 36. Each ISDN telephone includes a LOCAL/REMOTE switch activator 38, manually selectable by the user or remotely selectable via the local serving ISDN switch. The activator 38 may be a pushbutton that is illuminated in the REMOTE position. If the user operates the pushbutton 38 locally, a flag is set to notify the software controlling the telephone of the desired mode of operation. A user may also set the mode of operation of a companion telephone to the Remote mode. For example the telephone 12 may be switched to the Remote mode from the telephone 14 by lifting the handset 20 to go "off hook", pressing the Local/Remote toggle switch 38 and when prompted dialing the number of the telephone 12.

Each ISDN telephone 12 or 14 transmits information to and receives information from ISDN 16 in two 64 kiobyte per second channels referred to as B-channels and in one 16 kilobyte per second channel referred to as a D-channel. Each B-channel is separately circuit-switched by network 16 to other user telephones (either ISDN or analog). The D-channel is used both to convey signaling packets to effect message signaling between ISDN telephones and the network 16, in particular the ISDN switch or control arrangement at the heart of the network 16, and to convey data packets between different ISDN telephones. The message signaling is referred to as

out-of band signaling since it occurs in the D-channel outside the bandwidth of the voice communication.

As shown in Figure 3, the ISDN telephones at Stations B and C contain a CPU 40 that, in addition to providing call control and network features control, monitors the status of certain programmable features. These programmable features are chosen and set at the time of installation. The CPU 40 exchanges call control information via a network interface 42 over a system bus 44 that includes the usual data bus, address bus, and control bus. The interface 42 provides connection between the system bus 44 and the ISDN signaling channel 46, and the communication channel 48. An incoming call is presented as a D channel message to the network interface 42 which passes the D channel message through the signaling channel 46 to the system bus 44. The operating parts of the telephone, i.e. dial, calling mechanism, ringers, lamps, etc. are indicated at 50. The CPU 40 functions in accordance with the instructions stored in ROM 52, that establish call control procedures. A RAM 54 contains information such as the directory number of the work at home telephone, the features to be monitored, special instructions such as circuit assurance, and any passwords.

Referring again to Figure 1 and to the flowchart of Figure 4, the call transferring procedure of the present invention will be described. It is assumed that a telephone user at Station A places a call to the WAW telephone 12 at Station B. Further, it is assumed that the Station B site is unattended and the WAW telephone 12 has been placed in the remote operation mode by activating the LOCAL/REMOTE pushbutton 38. Since Station B is an unattended site, the WAW telephone 12 will ring no answer, transmit calling line ID information to Station C, and if requested by the WAW telephone 14,

transfer Station A's call to Station C. The flowchart of Figure 4 represents instruction contained in the ROM of telephone 12. In Figure 4, incoming D channel messages are monitored at block 60. At block 62 a determination is made as to whether an incoming call is present. At block 64 a check is made to determine whether the WAW telephone 12 is in the local or remote mode. If in the local mode, normal call processing continues as indicated at block 66. If the WAW telephone 12 is in the remote operating mode, the incoming calling line ID is stripped out and stored in RAM 54 as indicated at block 68. In blocks 70 and 72, a setup message is constructed and sent over the D channel. The outgoing setup message from Station B to Station C, contains the calling line ID of Station A either in the user to user, calling party subaddress, or lower layer compatibility information elements. Along with the calling line ID, a flag or code is included to indicate to Station C that this call is from the WAW telephone 12. The constructed setup message is transmitted to the ISDN network 16 via the system bus 44, the signaling channel 46, and the network interface 42.

Referring now to Figure 5, a flowchart of a portion of the software that controls operation of the WAW telephone 14 at Station C is shown. Incoming D channel messages are monitored at block 74. At block 76 a determination is made as to whether an incoming call is present. If the call is from the WAW telephone 12, the flag or code contained in a D channel message will be detected at block 78. At block 80 the WAW telephone will produce an audibly alert (ring), a visual alert by energizing one of the lamps 26, display Station A's calling line ID on display 24, and energize a lamp indicating that this call is being received from the WAW telephone 12. If the user chooses to ignore the incoming call, the telephone will continue to ring until the call

is either answered or abandoned. If the call is answered, as detected at block 82, the WAH telephone 14 responds with the usual Q.931 signaling messages, stored in ROM 52, as indicated at block 84. If the flag or code in the D channel message is not present as determined at block 78, indicative of a call from other than the WAW telephone 14, then normal call processing continues as indicated at block 86.

Returning to Figure 4, WAW telephone 12 continues to monitor the D channel to determine if its outgoing call containing Station A's calling line ID has been answered. If so, WAW telephone 12 detects the answer at block 88 and automatically answers the incoming call from Station A, as indicated at block 90. The WAW telephone 12 then initiates a network transfer using the usual Q.931 signaling messages stored in ROM 52, as indicated at block 92. Third party telephone 10 at Station A will now be connected to WAH telephone 14 at Station C, and WAW telephone 12 at Station B will become idle, as indicated at block 94. Figure 6 is a timeline showing the relationship between Stations A, B, and C during the transfer of calls from Station A to Station C.

It will be understood that the Calling Line ID could be delivered to the WAH telephone without subsequently transferring the call. ID delivery even without call transfer would permit logging at Station C of calls made to a remote telephone for example at Station B. Also, WAW telephone 12 may store a list of telephone numbers in RAM 54 and "challenge" the incoming call. Only those calls allowed in the screening list would be passed on the WAH telephone 14.

If WAH telephone 14 at Station C elects not to answer the incoming call, WAW telephone 12 at Station B will eventually Call Forward Don't Answer to Voice Mail.

Both Call Forward Don't Answer and Voice Mail are conventional network features of the ISDN 16. When Call Forward Don't Answer takes place, WAW telephone 12 will respond with the usual Q.931 signaling messages stored in ROM 52. The local network switch will send a feature activator to WAW telephone 12 to energize lamp 30, indicating the presence of voice mail.

Remote Message Waiting Indicator

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A message waiting indicator is typically a visual indication on a telephone, such as a lamp, to notify a user that a caller has left voice mail. If the pushbutton 38 is in the Local operation mode, after a given interval, typically three rings, Station A's call to the WAW telephone 12 at Station B will Call Forward Don't Answer to voice mail. The Call Forward Don't Answer is a function of the ISDN switch serving telephone 12. After the user at Station A leaves voice mail, Station B's serving ISDN switch will send a D channel signaling message to activate the message waiting (MWT) lamp or indicator 30 on WAW telephone 12. This indicates to the user of the WAW telephone 12 that voice mail is stored.

25

Referring to Figures 7 and 8, flowcharts are depicted of the message waiting feature implemented by instruction in the ROM 52 of the ISDN telephones 12 and 14 respectively. The flowcharts will be described with reference to the incoming call originally placed from telephone 10 to WAW telephone 12. At block 100, the CPU 40 of the WAW telephone 12, monitors the status of the switch programmable Customer Premises Equipment (CPE) features. At block 102, the CPU 40 detects whether the status of a programmable feature activation has changed. If so, and the feature activation is for message waiting, as determined at block 104, the CPU 40 retrieves a directory number for the WAW telephone 14 from RAM 54 and

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constructs a D channel setup message, as indicted at block 106 and 108 respectively. A call is then automatically placed to the companion telephone, in this case the WAH telephone 14 as indicated at block 110. The outgoing call
5 will contain information in the user to user, calling party subaddress, or lower layer compatibility information element to describe to the called WAH telephone 14, the new status of the specific indicator, in this instance the message waiting feature. WAW telephone 12 at Station B
10 will then wait for the outgoing call to be rejected by the WAH telephone 14 at Station C, as detected by the block 112.

Referring now to Figure 8, the WAH telephone 14
15 monitors the D channel traffic at block 120. When traffic is detected, a determination is made at block 122 whether the traffic is an incoming call from a voice user (another person wanting to talk), or a remote feature activator. If the call is a user wanting to talk, the normal call
20 control procedures will be followed as indicated at block 124. If the call is a remote feature activator, a check is made at block 126 to determined whether the remote feature activator is a remote message waiting indicator. If the call was not a remote message waiting indicator,
25 the CPU 40 will check the code for other remote feature indicators at block 128.

If the call is a remote message waiting indicator, the CPU 40 will activate the corresponding
30 indicator at WAH telephone 14 at Station C as indicated at block 130. At block 132, the CPU 40 rejects the incoming call per the instructions stored in ROM 52. Since the call is rejected, there is no notification of an incoming call to the user, i.e. no audible ring, no flashing
35 lights, etc. If and when the voice mail is retrieved, the local network switch sends a message waiting deactivation code in the same fashion, that will be detected to

extinguish the message waiting lamp. Figures 9 and 10 show timelines of the sequence of events to respectively remotely activate and deactivate the MWT indicator as described above.

5 As stated above, at block 128 other remote feature indicators may be processed. For example, the status of call appearance information to be used as remote BLF (Busy Lamp Field) indicators may be carried in a similar fashion. A remote BLF along with a speed dial DSS
10 (Direct Station Select) allows a user to perform ISDN attendant console functions from a distant office location. The status of the call appearances is processed in the same way as the remote message waiting indicator. Further, control of the status of the Local/Remote
15 pushbutton 38 from a remote Station may be accomplished in a similar manner.

Dual Message Waiting Indicators

20 Referring now to Figures 11-15, a multiple message waiting feature is disclosed. The desirability of having multiple message waiting indicators arises when a user wishes to maintain a personal voice mail box separate from a company or common voice mail box. The common voice
25 mail box is used when a caller wishes to place a message that may be answered by any one of a plurality of individuals.

 With reference to Figure 11, each of the ISDN
30 telephones 140-146, such as shown in Figure 2, is provided with two message waiting indicators such as personal MWT lamps 148-154, and common MWT lamps 156-162. A dual MWT distributor 166 having a common MWT lamp 164, functions similarly to the WAW telephone 12 in the previous examples
35 with the exception that the distributor makes calls to multiple telephones in order to cause the common remote message waiting indicators to be energized.

Figure 12 shows a timeline of activation of common message waiting indicators. If voice mail is left for telephone 140, the local network switch activates the personal message waiting indicator 148 on telephone 140 in a conventional manner. If voice mail is left in a common voice mail box for all users of telephones 140-146, the local network switch sends a common message waiting feature activation over the D channel to the distributor 166 which activates its common message waiting lamp 164.

As shown in the timeline of Figure 12 and the flowchart of Figure 13, the dual MWT distributor 166 monitors the D channel as indicated at block 170. If the common MWT feature activation is detected, as determined at decision block 172 the distributor 166 energizes common MWT lamp 164 at block 174 and at block 176 places a series of calls to the telephones 140-146 using directory numbers stored in its RAM. Each of the telephones 140-146, is programmed to detect a common message waiting activator code contained in the call from distributor 166. When the code is detected, the call is rejected and the common message waiting lamp is energized. As each call is rejected a call is placed to the next telephone, until all common message waiting lamps 156-162 are energized, as determined at block 178. If any user at telephones 140-146 responds to the common message waiting, the local network switch sends a common message waiting feature deactivator to the distributor 166. Upon detection of the feature deactivator, the distributor 166 extinguishes the lamp 164 and initiates calls to the telephones 140-146 to extinguish the lamps 156-162 as indicated in the timeline of Figure 14 and in blocks 180-188 of the flowchart in Figure 15.

The Remote/Local pushbutton 38 is actuatable by the telephone user, while the telephone is on hook, to set or reset an internal software flag depending upon whether

the telephone is to be operated in the remote or local mode respectively. The operating mode of a companion telephone may also be placed in the remote operating mode through actuation of the pushbutton 38 as depicted in the flowcharts of Figures 16 and 17. Referring to Figure 16 manual activation of the pushbutton 38 is detected at block 190. If the telephone is not off hook, as determined at block 192, then an internal flag is toggled at block 194 and the light for pushbutton 38 is either energized or extinguished depending on its previous state. If, for example, telephone 14 is off hook and the pushbutton 38 is actuated, the user may be prompted to enter the companion telephone number i.e. the number of telephone 12, if it is desired to place telephone 12 in a remote mode of operation. If the number is entered within a predetermined interval of time, as detected at block 196, a setup message or D channel packet message is constructed as indicated at block 198 and sent to the companion telephone as indicated at block 200. The outgoing message contains a Local/Remote flag or code which when detected by the companion telephone will reset the companion telephone to the remote operating mode.

With reference to Figure 17, a flowchart is shown depicting the software for resetting the telephone 12 to the remote operating mode from the telephone 14. A decision block 202 is interposed between the blocks 126 and 128 of Figure 8 and checks whether a D channel message contains a Local/Remote flag or code. If so, the operating mode of telephone 12 is reset to the remote mode at block 204 and the incoming call is rejected at block 206. An incoming call to the WAW telephone 12 will now be automatically transferred to the WAW telephone 14, as discussed previously.

35

The procedures outlined above with respect to the use of information elements may also be used by the remote user to change the target telephone number. In Figure 1, Station B would, for example, be remotely
5 programmed from Station C to call a telephone at an alternate location. Using a combination of the features described above a user could call through a remote Station to take advantage of certain billing rates. In Figure 1, Station B, for example, would call Station C which would
10 then provide a dialtone to Station B permitting Station B to dial another call that would be billed to Station C. The information elements could also be used as described above to access a call log on a remote telephone. This feature is useful when voice mail is not available. The
15 present invention can also be used to monitor sound at a remote location. In Figure 1, Station C, for example, would place a call to Station B. The call from Station C would carry an information element that would cause Station B to automatically go off-hook in the speakerphone
20 mode, without audible alerting, lights, display, or speaker. Only the microphone would be activated. This would allow the WAW user to monitor any audible sounds at the WAW location. When the features of remote message waiting or remote programming of target numbers are used,
25 a Station may "call back" to provide assurance the feature was understood. For example, in Figure 1, if Station B turns on Station C's message waiting lamp, Station C would call back to Station B to report the status of Station C's message waiting light.

30 While the best mode for carrying out the present invention has been described in detail, those familiar with the art to which this invention relates will recognize various alternative designs and embodiments for practicing the invention as defined by the following
35 claims.

What Is Claimed Is:

1. A method of automatically transferring an incoming call made to a first telephone connected with an Integrated Services Digital Network (ISDN), to a second telephone connected with said network, each of said telephones including user operable means for selectively placing the telephone in a local or remote operating mode, said method comprising a sequence of the following steps:
- 10 transmitting a first D channel message from said network to said first telephone containing a first code identifying the origin of the incoming call;
- if said first telephone is operating in said remote mode, transmitting a second D channel message from said first to said second telephone through said network,
- 15 said second D channel message including said first code and a second code identifying the origin of the second message,
- detecting said second code at said second telephone and sending a third D channel message over said network from said second telephone to said first telephone requesting transfer of said incoming call;
- connecting said incoming call to said second telephone through said network.
- 25
2. The method of Claim 1, including the further step of commanding the remote operating status of said first telephone from said second telephone.

3. The method of Claim 2 wherein said step of commanding the remote operating status of said first telephone comprising the steps of:

detecting whether said user operable means of
5 said second telephone is actuated while said second telephone is off hook and if so constructing a fourth D channel message containing a remote operating code; and
transmitting said fourth message to said first telephone.

10

4. The method of Claim 3 comprising the further step of:

detecting said remote operating code at said first telephone; and

15 placing said first telephone in said remote operating state in response to said detecting step.

5. A method of controlling a message waiting indicator on a second telephone from a first telephone,
20 each telephone connected with an Integrated Services Digital Network (ISDN) including means for storing a voice mail message, comprising the steps of:

detecting a message waiting activation signal from said network at said first telephone;

25 constructing a D channel message at said first telephone indicating a message is stored on said network;

transmitting said D channel message to said second telephone; and

30 upon receipt of said D channel message at said second telephone, energizing a message waiting indicator on said second telephone.

6. The method of Claim 5, wherein the message activation signal commands the energization of a message
35 waiting lamp on said first telephone.

7. The method of Claim 1 wherein said first telephone is manually placed in said remote operating mode by actuating a pushbutton of said first telephone.

5 8. The method of Claim 1 wherein said first telephone is placed in said remote operating mode by constructing and sending a D channel message from a remote ISDN telephone to said first telephone commanding said remote operating mode.

10 9. A method of notifying each of a group of ISDN telephone users of the storage at a local ISDN switch of a message, comprising the steps of:

transmitting a first D channel message from
15 said switch to a dual message waiting distributor advising said distributor of the storage of a common message for each of said users; and

upon receipt of said first D channel message
transmitting a second D channel message from said
20 distributor to each ISDN telephone in said group in sequence to effect energization of a common message waiting indicator on each telephone.

10. The method defined in Claim 9 comprising
25 the further step of:

transmitting a third D channel message from
said switch to said distributor advising said distributor
of the retrieval of said common message by one of said
users; and

30 upon receipt at said distributor of said third D channel message from said switch, transmitting a fourth D channel message from said distributor to each ISDN telephone in said group in sequence to effect de-energization of said common message waiting indicator
35 on each telephone.

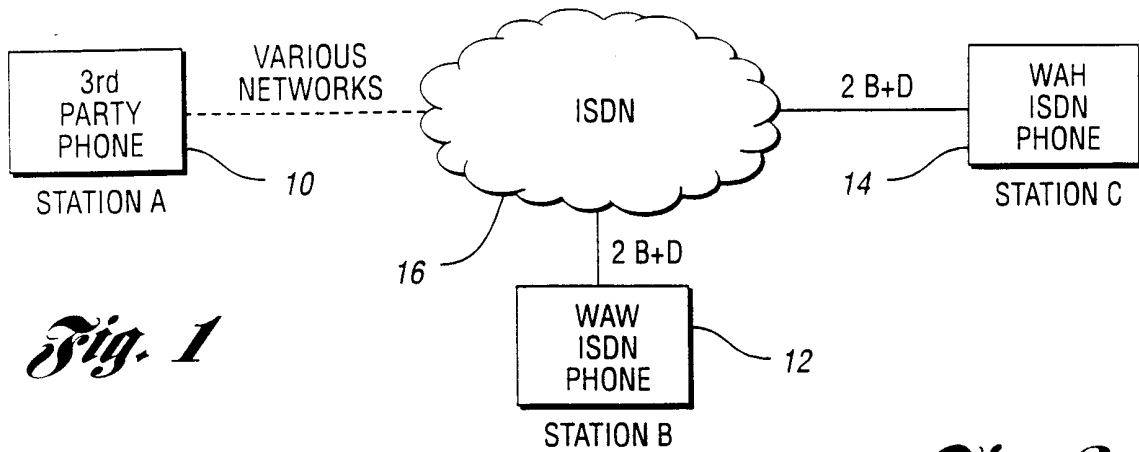


Fig. 1

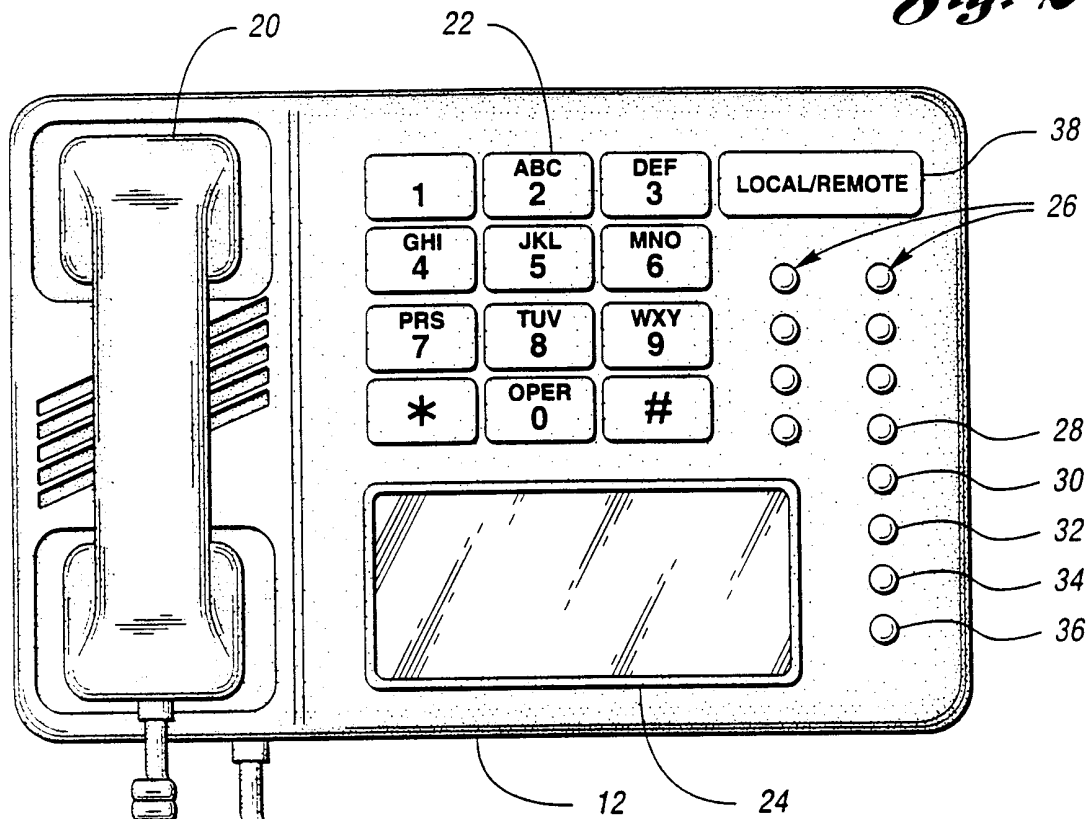


Fig. 2

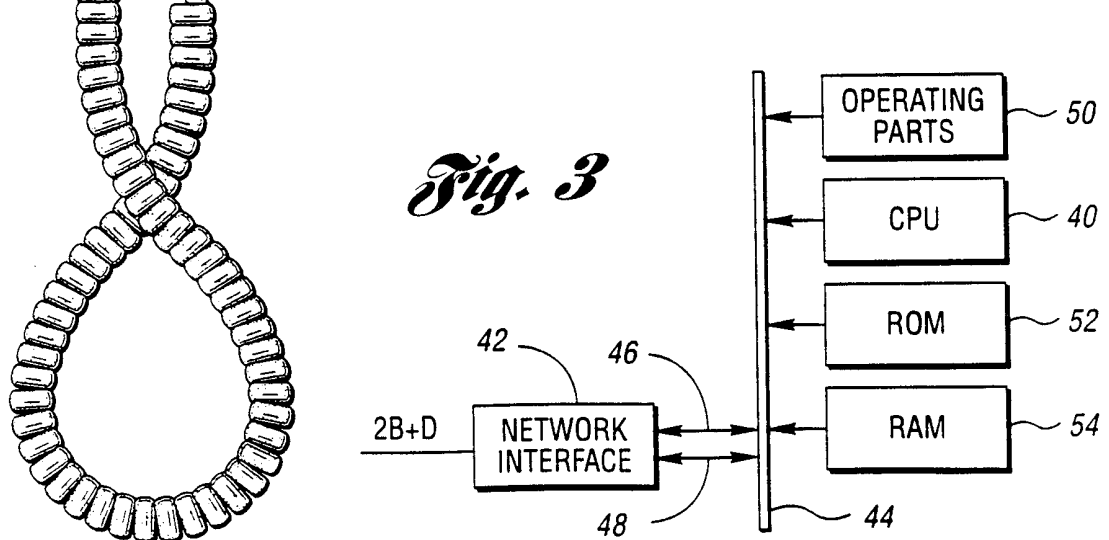
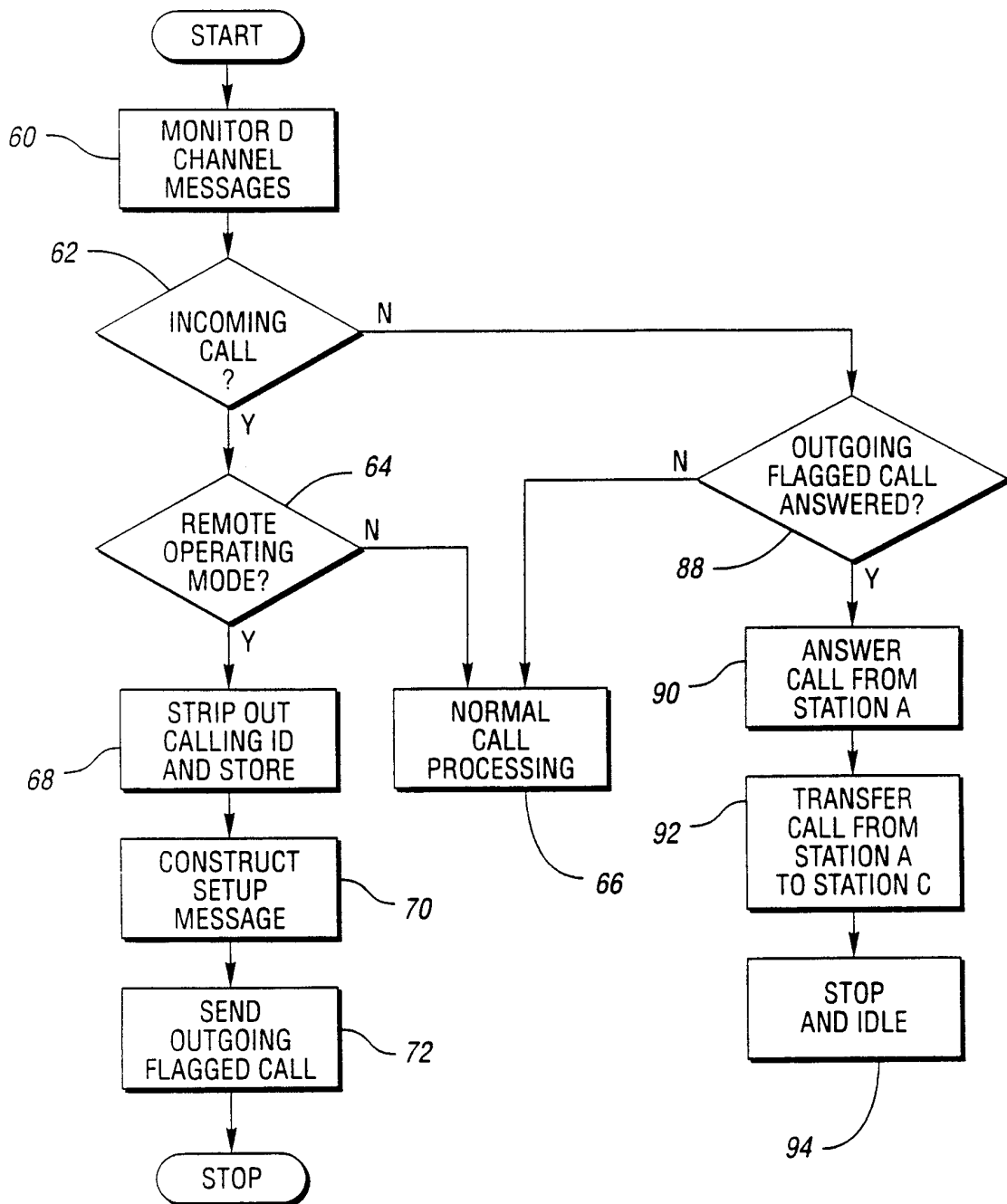


Fig. 3

*Fig. 4*

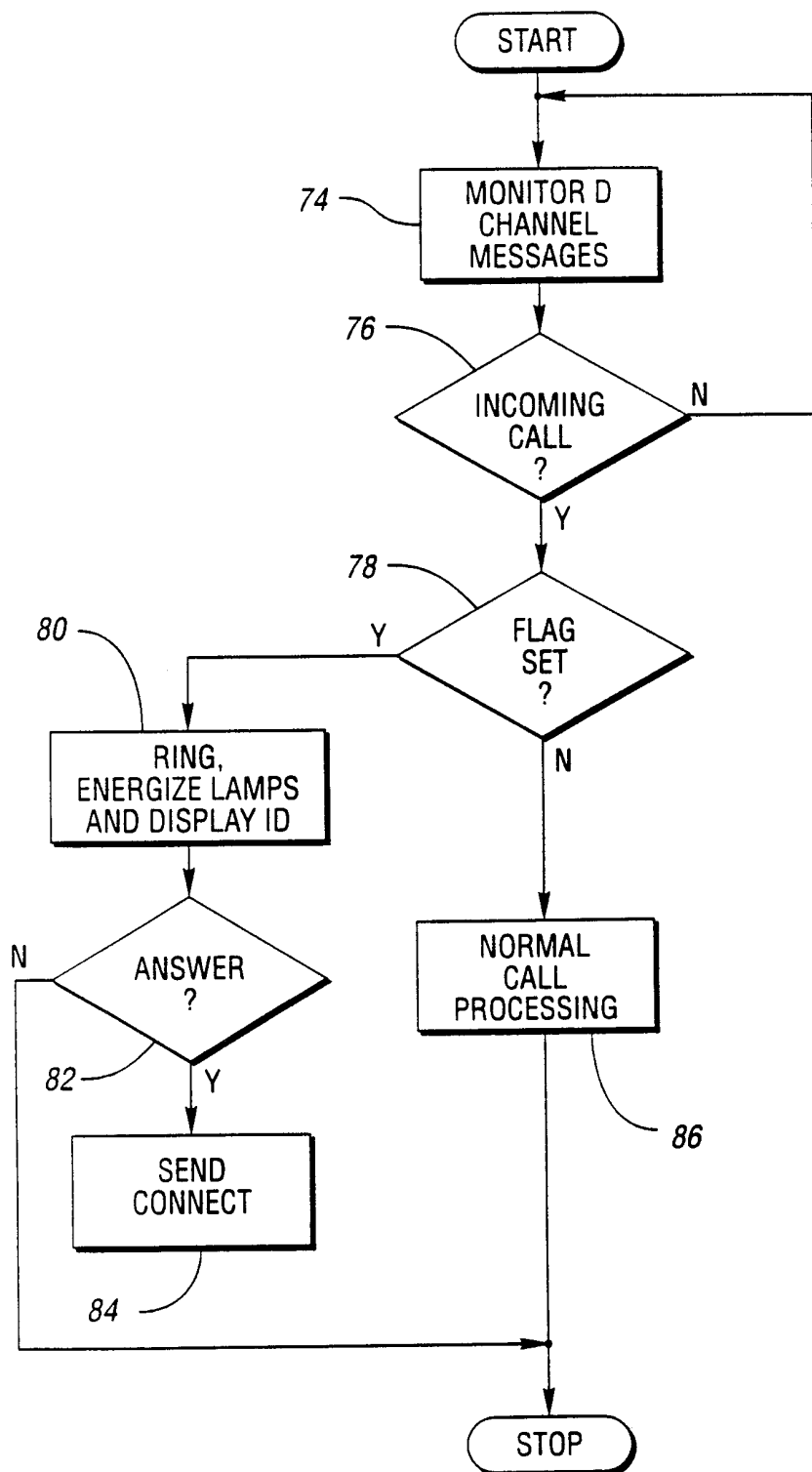
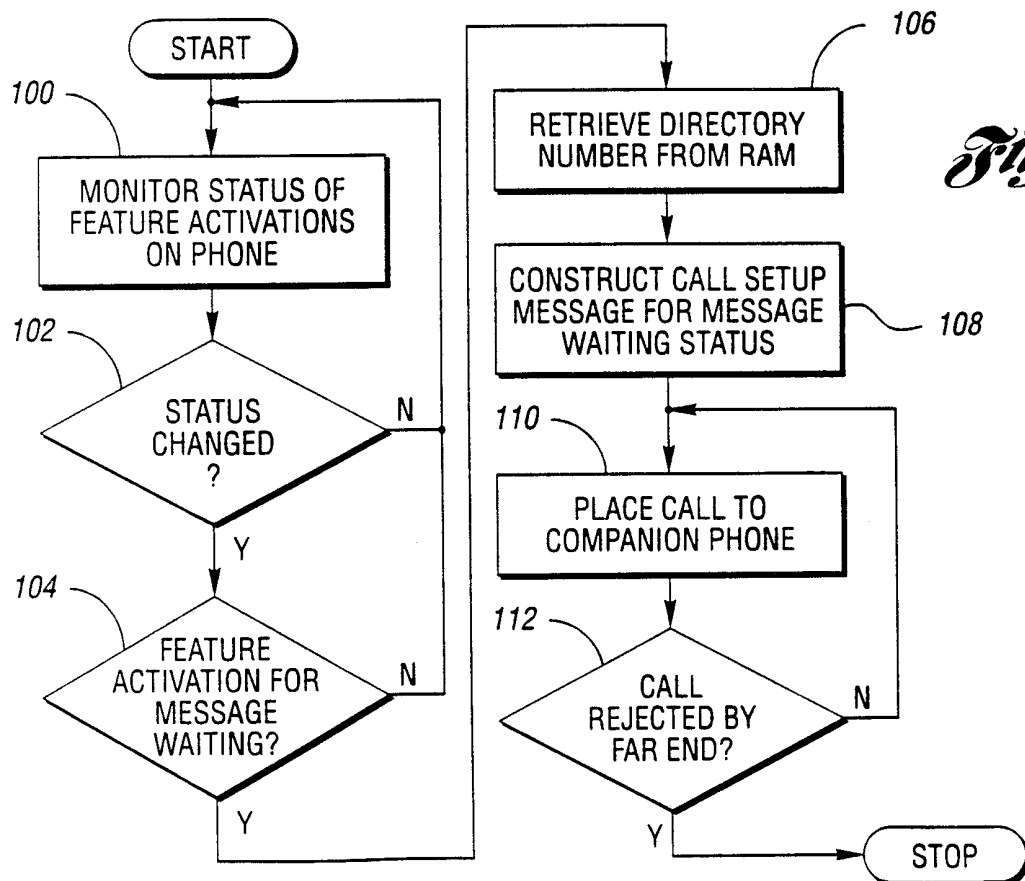
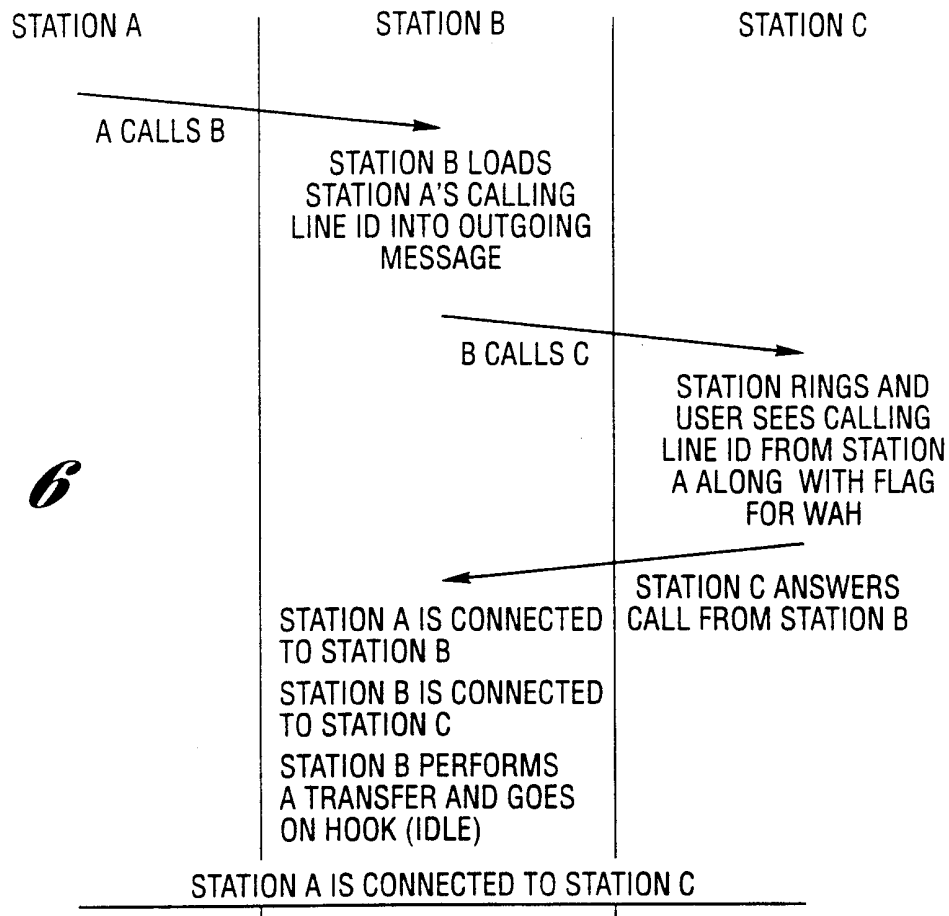
*Fig. 5*

Fig. 6*Fig. 7*

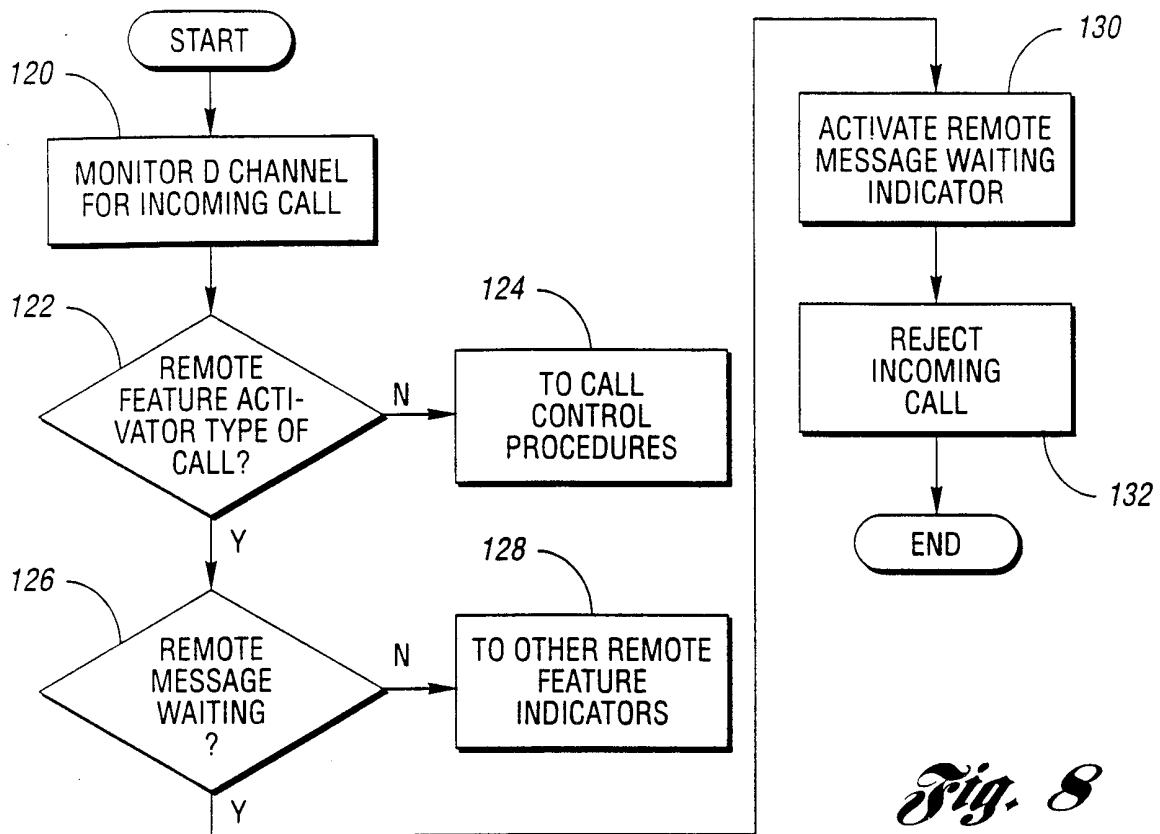
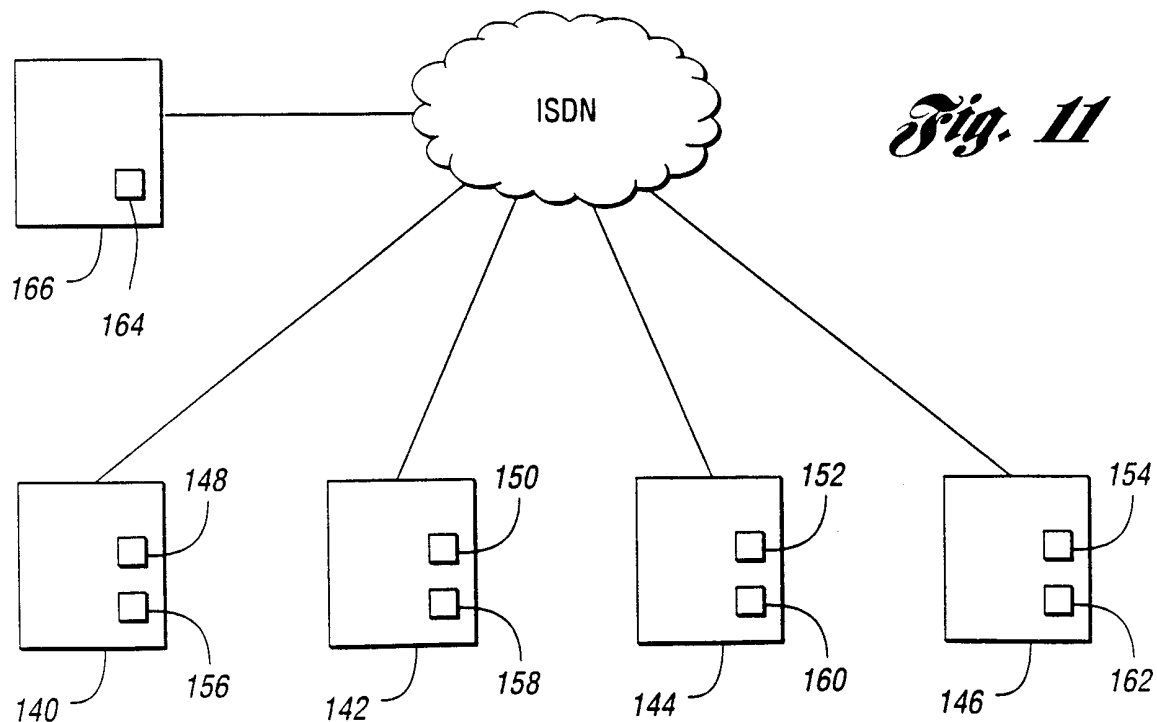
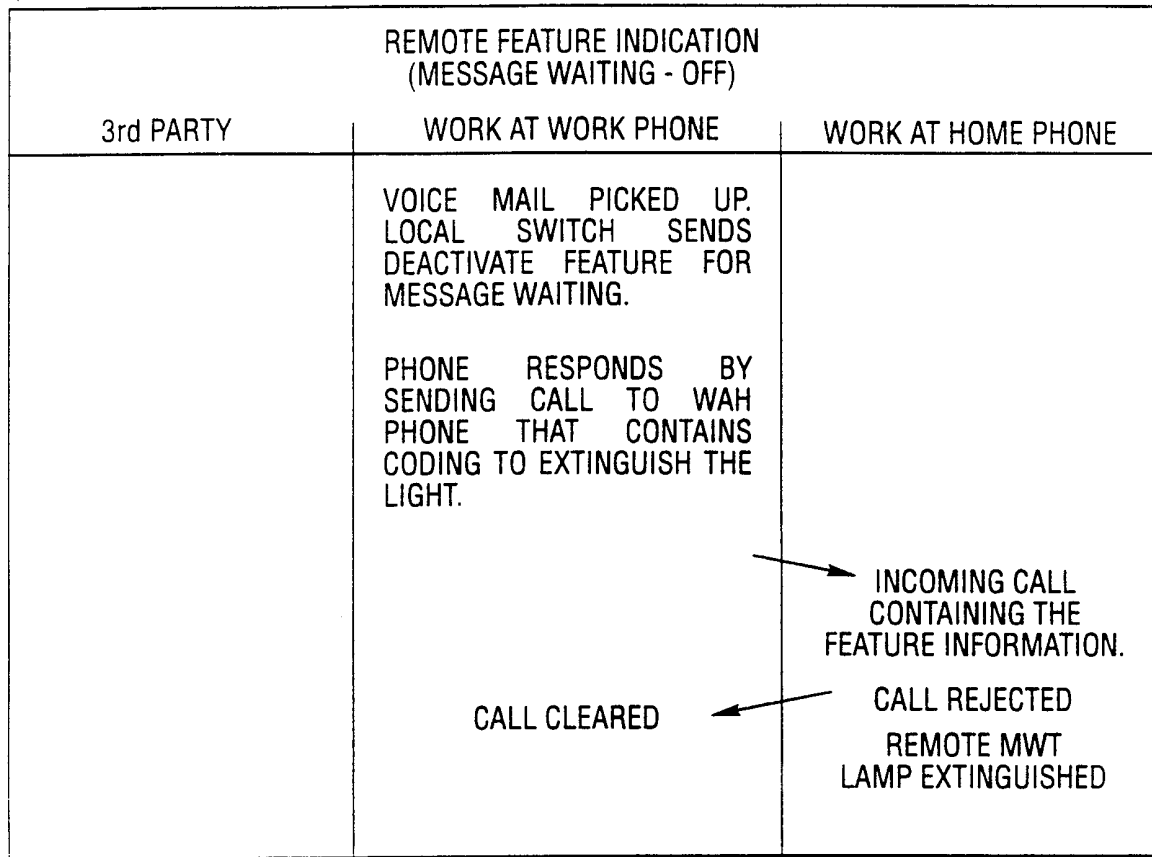


Fig. 8

Fig. 9

REMOTE FEATURE INDICATION (MESSAGE WAITING - ON)		
3rd PARTY	WORK AT WORK PHONE	WORK AT HOME PHONE
CUSTOMER ORIGINATES A CALL TO WORK LOCATION	INCOMING CALL IS NOT ANSWERED. CALL FORWARDS TO VOICE MAIL. LOCAL SWITCH SENDS FEATURE ACTIVATOR TO LIGHT MWT LIGHT. INDICATES VOICE MAIL PRESENT. PHONE AUTOMATICALLY GENERATES A CALL TO THE WAH PHONE. CONTAINS CODING TO LIGHT REMOTE MWT LIGHT.	INCOMING CALL CONTAINING THE FEATURE INFORMATION.
CUSTOMER LEAVES VOICE MAIL		
	CALL CLEARED	CALL REJECTED REMOTE MWT LAMP ENERGIZED

Fig. 10*Fig. 11*

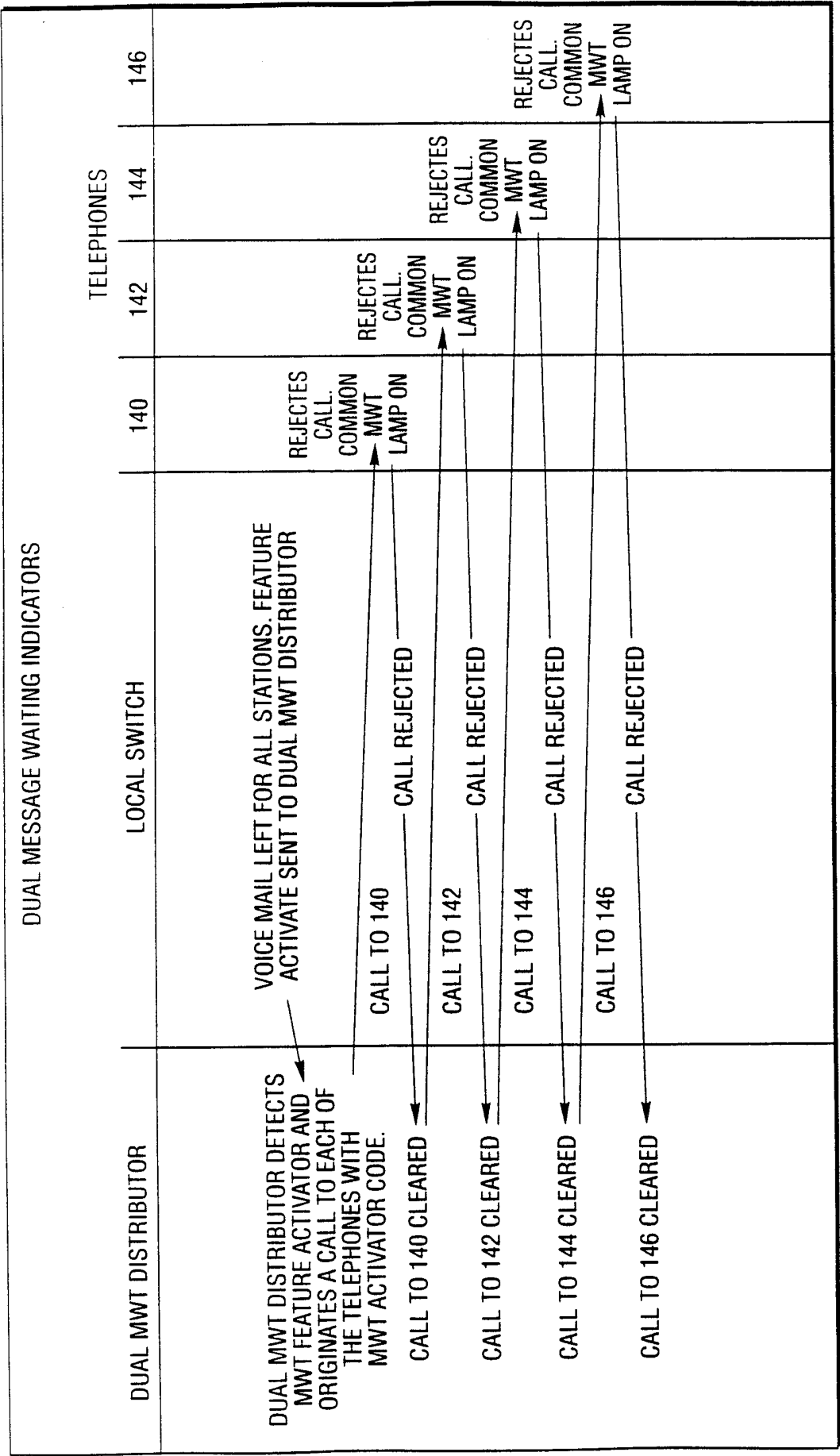
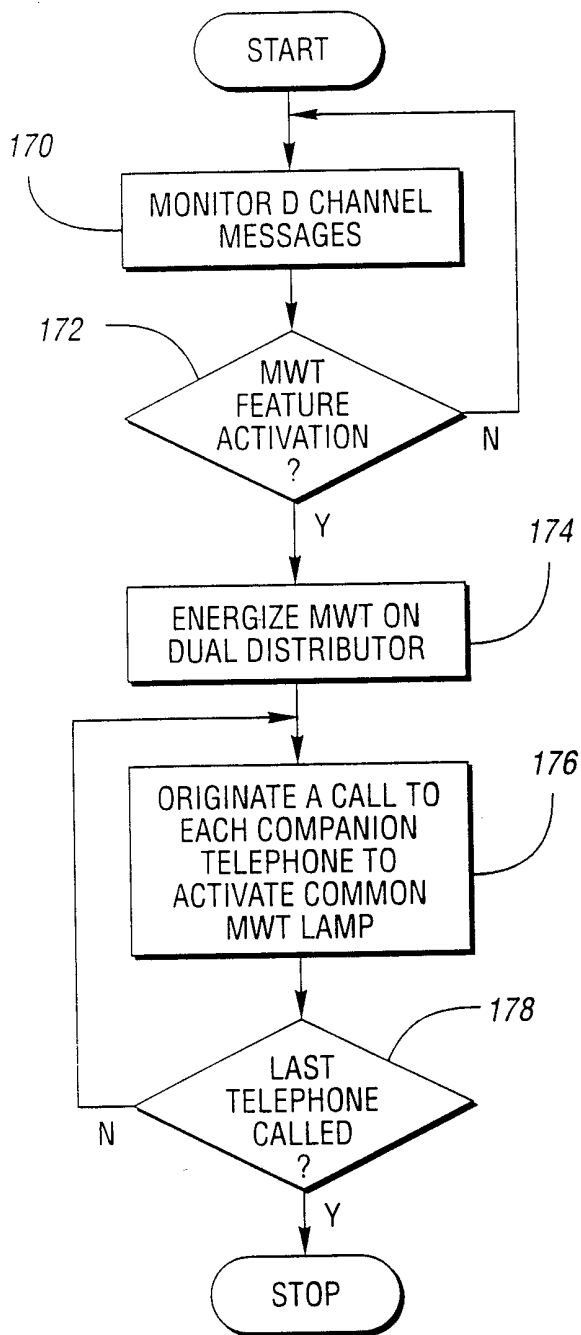
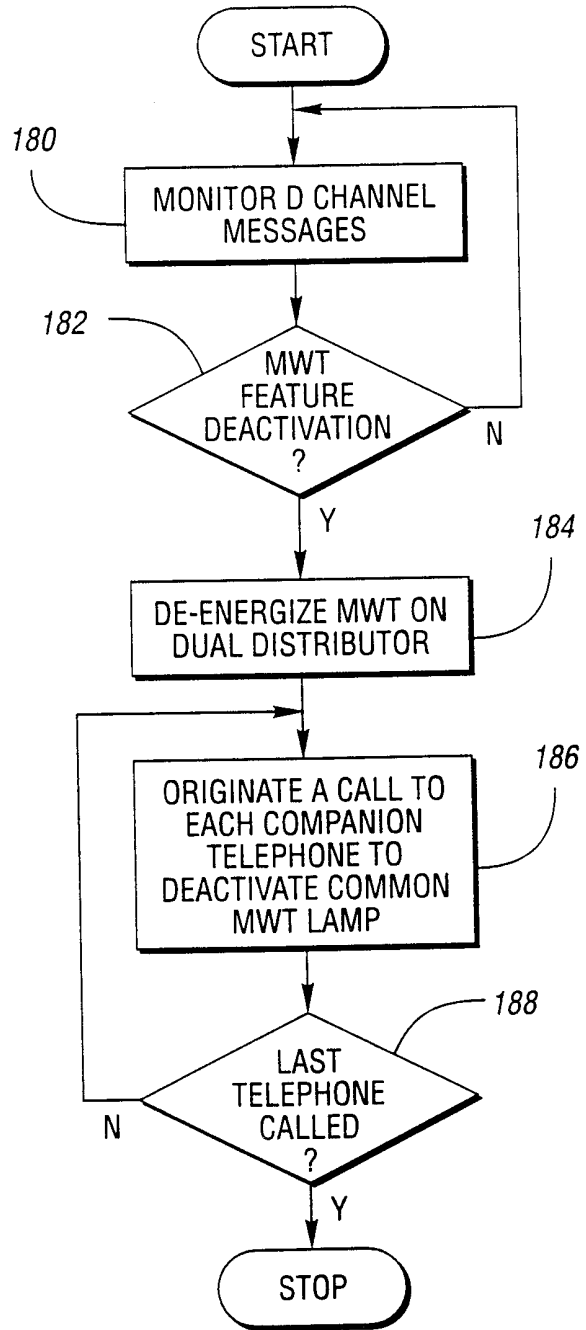


Fig. 12

*Fig. 13**Fig. 15*

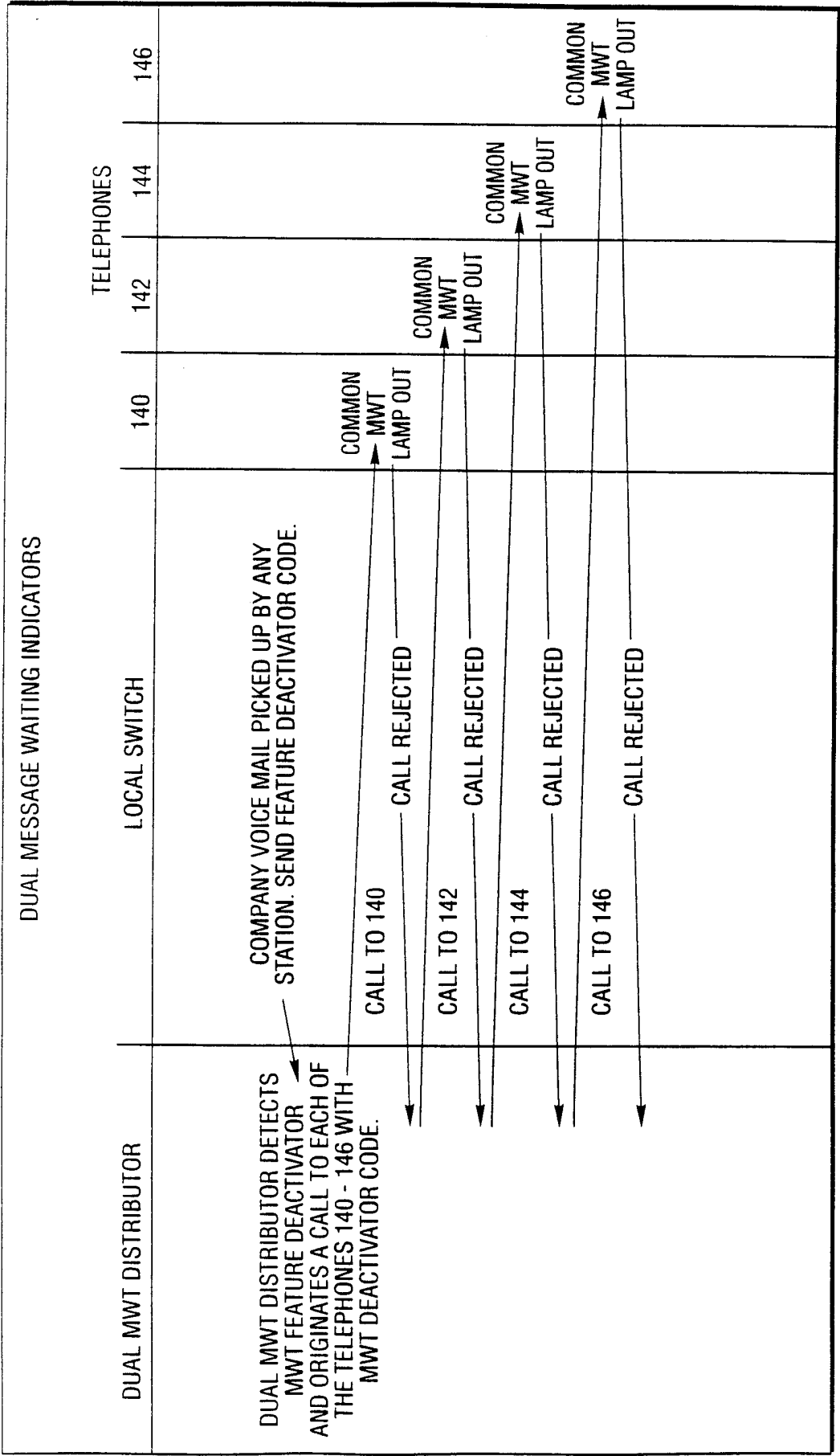
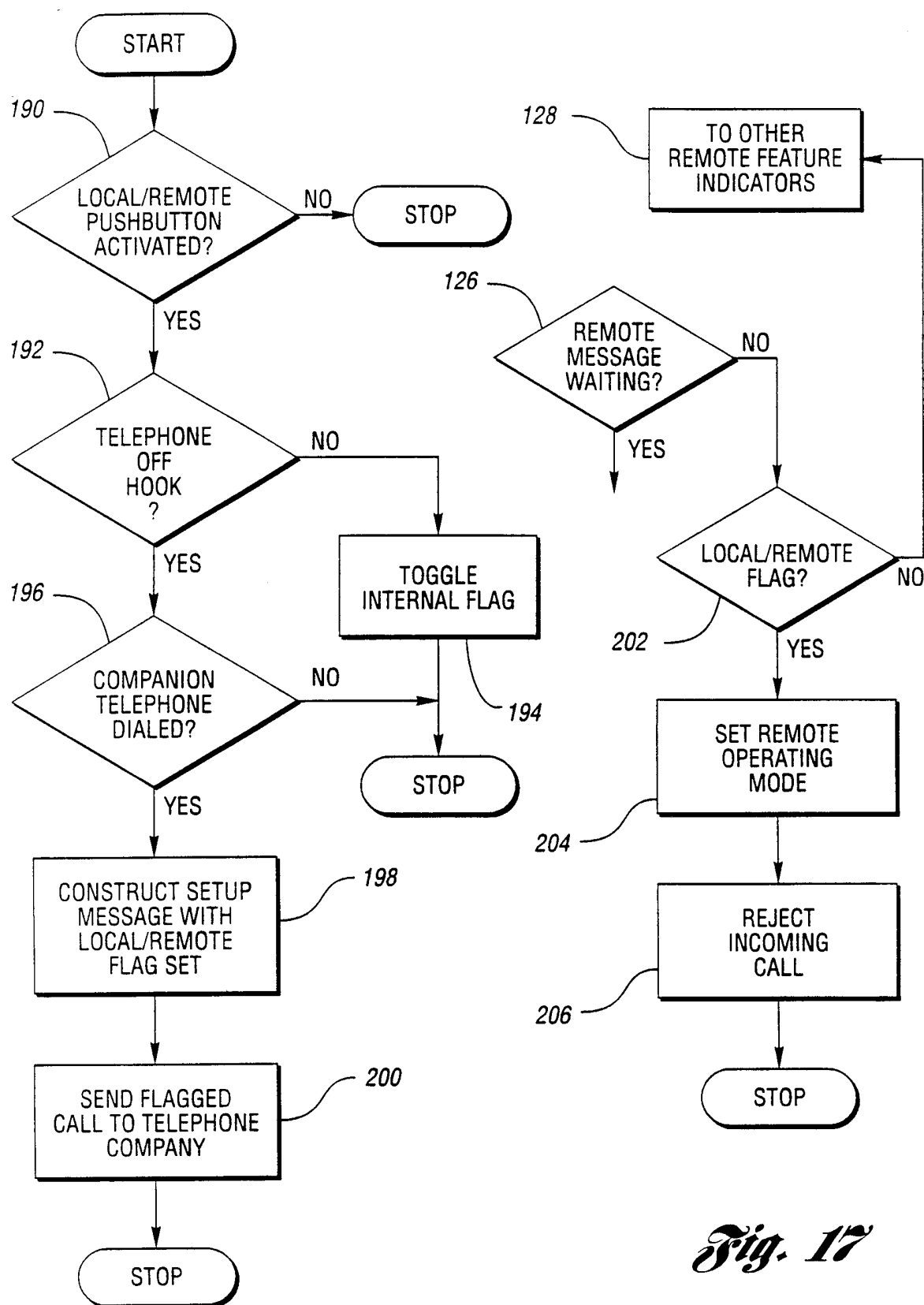


Fig. 14

*Fig. 16**Fig. 17*

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US98/21543

A. CLASSIFICATION OF SUBJECT MATTER IPC(6) : H04M 1/64, 11/00, 1/00, 3/42, 3/00. US CL : Please See Extra Sheet. According to International Patent Classification (IPC) or to both national classification and IPC														
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) U.S. : 379/74, 88.01, 88.17, 93.01, 93.06, 102.01, 165, 211, 212, 229, 311, 376 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched none Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) APS														
C. DOCUMENTS CONSIDERED TO BE RELEVANT														
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.												
X	US 5,422,942 A (KAKWASHIMA) 06 June 1995, (06.06.95) Col. 5, line 3 through Col. 6, line 19.	1-4, 7-8												
X	US 5,023,868 A (DAVIDSON ET AL.) 11 June 1991, (11.06.91) Col. 6, lines 1-4 and Figure 18.	1-4, 7-8												
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Y		5-6, 9-10												
Y	US 5,521,964 A (SCHULL ET AL.) 28 May 1996, (28.05.96) Col. 3, lines 59-67 and Figure 1.	5-6, 9-10												
Y	US 5,509,061 A (AMERELLER ET AL.) 16 April 1996, 16.04.96) Col. 2, lines 35-37.	5-6, 9-10												
Y	US 5,026,901 A (HARLOW ET AL.) 27 April 1993, (27.04.93) Col. 5, lines 39-54.	5-6, 9-10												
A	US 5,623,538 A (PETTY) 22 April 1997, Col. 1, lines 45-67.	1												
☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.														
<table border="0"> <tr> <td>* Special categories of cited documents:</td> <td>*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</td> </tr> <tr> <td>*A* document defining the general state of the art which is not considered to be of particular relevance</td> <td>*X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</td> </tr> <tr> <td>*E* earlier document published on or after the international filing date</td> <td>*Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</td> </tr> <tr> <td>*L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</td> <td>*G* document member of the same patent family</td> </tr> <tr> <td>*O* document referring to an oral disclosure, use, exhibition or other means</td> <td></td> </tr> <tr> <td>*P* document published prior to the international filing date but later than the priority date claimed</td> <td></td> </tr> </table>			* Special categories of cited documents:	*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention	*A* document defining the general state of the art which is not considered to be of particular relevance	*X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone	*E* earlier document published on or after the international filing date	*Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art	*L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	*G* document member of the same patent family	*O* document referring to an oral disclosure, use, exhibition or other means		*P* document published prior to the international filing date but later than the priority date claimed	
* Special categories of cited documents:	*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention													
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L document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	*G* document member of the same patent family													
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P document published prior to the international filing date but later than the priority date claimed														
Date of the actual completion of the international search 01 DECEMBER 1998		Date of mailing of the international search report 09 MAR 1999												
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230		Authorized officer Allan Hoosain <i>Joni Hill</i> Telephone No. (703) 305-4012												

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US98/21543

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5,436,962 A (HIRATA) 25 July 1995, (25.07.95) Col. 3, lines 5-20.	1

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US98/21543

A. CLASSIFICATION OF SUBJECT MATTER:

US CL :

379/74, 88.01, 88.17, 93.01, 93.06, 102.01, 165, 211, 212, 229, 311, 376