PATENT SPECIFICATION (11) 1 571 820

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(21) Application No. 49726/76 (22) Filed 29 Nov. 1976
(31) Convention Application No. 50/143 489 (32) Filed 29 Nov. 1975 in
(33) Japan (JP)
(44) Complete Specification published 23 July 1980
(51) INT. CL.[3] H04M 3/38
(52) Index at acceptance
H4K FB



(54) COMMUNICATIONS SWITCHING NETWORK

(71) We, NIPPON TELEGRAPH AND TELEPHONE PUBLIC CORPORATION, a Japanese corporation, of No. 1-6, Uchisaiwaicho, 1-chome, Chiyoda-ku, Tokyo, Japan, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to communications switching networks.

Closed user group facilities can be provided in which terminals, belonging to a switching network, registered with one another for communication, form closed user groups, the switching network ensuring smooth transmission between terminals of a closed user group and at the same time preventing transmissions within one closed user group from being disturbed by terminals belonging to other groups.

Two main previously-proposed methods of providing closed user group facilities in switching networks are the identification code method and the group code method.

In the identification code method, a switching centre having received a request for transmission from an originating terminal sends to a terminating (destination) terminal an identification code indicative of a particular closed user group, which code is sent originally from the originating terminal. The terminating terminal decides whether or not the identification code is coincident with that of the closed user group to which it belongs, and receives data from the originating terminal only in the case of coincidence.

This method requires the provision of an identification code decision function in each terminal, and hence has a demerit in that the terminals can be expensive. Further, whether or not a request for a closed user group service is proper is decided by a decision regarding the identification code sent to a terminating terminal, and there can arise cases in which a subscriber line and an intermediate line are held ineffective whilst the decision is made at the terminating terminal, so that the transmission efficiency of the network is reduced.

In the group code method, upon receipt of a request for data transmission from a terminal, a switching centre of a network discriminates group codes of the closed user groups of the originating terminal from subscriber data available at the switching centre, and sends out the group codes to a switching centre having accommodated therein a desired terminating terminal. The terminating centre decides whether or not any of the group codes of the closed user groups to which the terminating terminal belongs is coincident with any of the group codes received from the originating centre, and only in the case of coincidence of at least one group code permits transmission between the originating and terminating terminals.

This method requires the switching network to collectively manage all the group codes of the network for maintenance and management of the closed user groups, and can have a drawback in the cost of maintenance and management of the network attendant upon the numbering plan of the group codes, and entry and withdrawal of terminal use in or withdrawal from the group. Further, the originating centre is required to send to the terminating centre all of the group codes of the originating terminal, and the terminating centre is required to match those group codes with all the group codes of the terminating terminal at each request for transmission. This can lead to a disadvantage in that load on switching equipment increases. Moreover, it is necessary to enquire of the terminating centre about the appropriateness of the request for closed user group service from the originating terminal. Granting that ineffec-

tive holding of subscriber lines and intermediate lines does not occur as many times as in the abovesaid identification code method, the transmission efficiency of the network is still not as high as might be desirable.

According to the present invention, there is provided a communications switching network for passing data between a plurality of communications terminals, connected to respective data lines of the network when it is in use, by means of respective terminal designation codes associated individually with the said data lines, the network including group registration means, operable to store in respect of any selected one of the said data lines the terminal designation code individually associated with the or each other data line of the network that belongs to a closed user group of the said respective data lines that includes the selected one data line, and group membership verification means operable to examine whether a terminal designation code received by way of a data line, from any data-sending one of such terminals, and individually associated with a selected second data line, is stored in the registration means in respect of the sending data line, being the data line to which the data-sending terminal is connected, and whether the terminal designation code individually associated with the said sending data line is stored in the registration means in respect of the selected second data line, the network being such as to enable data to be passed from such a sending data line to such a selected second data line in dependence upon the results of such examination.

An embodiment of the present invention can provide, in use, a closed user group service in which the abovesaid defects of the identification code and group code methods are reduced or even eliminated, and is designed so that closed user group service is permitted only between terminals connected to data lines of the switching network that are mutually registered, thereby to ensure smooth transmission within a closed user group, eliminate disturbance of transmission by other groups and reduce processing required in terminals and in switching centres to which the data lines connect the terminals.

Briefly stated, in an embodiment of this invention, in a closed user group facility having a closed user group of data lines, to which respective terminals are connected, belonging to a switching network provided for communication of data, there are provided means for registering, in dependence upon a terminal registration request from an originating, or data-sending, terminal, *via* a sending data line connected thereto, a terminating terminal, connected to a selected second data line, corresponding thereto by means of one of a number of terminal designation codes by means of which all the terminals accommodated in the switching network and connected to respective data lines thereof can be identified individually; group membership verification means for verifying the presence in the group registration means of a code indicative of registration of the data lines of the originating and terminating terminals, and for controlling data transmission based on the result of verification of the abovesaid registration. The terminals requesting closed user group service previously mutually register in the switching network the terminal designation codes capable of mutual identification of the data lines to which those terminals are respectively connected, and in compliance with a request for closed user group service, data transmission is effected only in the case of the data lines of the originating and terminating terminals having already been mutually registered. An originating terminal mentioned above is one which has called for transmission or registration but it would be capable of both data transmission and reception in practice. A terminating terminal is one which is to receive data transmitted from the originating terminal, but would similarly be capable of data transmission and reception in practice, and can also be a terminal which an originating terminal has requested to register.

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

Fig. 1 is a schematic block diagram explanatory of one embodiment of the present invention;

Fig. 2 is a schematic block diagram explanatory of another embodiment of the present invention;

Fig. 3 is a block diagram of switching equipment used in an embodiment of the present invention;

Fig. 4 is a more detailed block diagram of the switching equipment of Fig. 3; and

Fig. 5 is a block diagram of apparatus for use in an embodiment of the present invention.

Fig. 1 is given for explanation of one embodiment of the present invention. T1 to T3 are respective terminals connected to respective data lines of a switching network N; LS1 to LS3 are respective switching centres in the switching network N; CT1 to CT3 are closed user group entry tables, or stores, corresponding to the terminals T1 to T3 respectively, which tables are respectively accommodated in the switching offices or switching centres, LS1 to LS3, each table having areas such, for example, as an

abbreviation code column CLM1, a subscriber code column CLM2 and a mutual registration verification column CLM3.

In the following description the respective data lines of the switching network are identified by reference to the terminals which are operatively connected thereto when the switching network is in use.

The following description will be given of operation of the switching network in a case in which switching centres LS1 to LS3 respectively have closed user group entry tables CT1 to CT3, each having a subscriber code column CLM2 and a mutual registration verification column CLM3 (for the moment columns CLM1 being absent).

For example, the switching centre LS1, which has received from terminal T1, *via* a respective data line, a request for the registration of terminals T2 and T3, connected to respective data lines, as its designated terminating terminals in a closed user group service, registers codes NT2 and NT3 (by means of such codes all the terminals connected to the data lines of the switching network can be individually identified), which identify the terminals T2 and T3, in the subscriber code column CLM2 of the closed user group entry table CT1 thereof corresponding to the terminal T1 (in respective rows of the entry table). Similarly, in a case of a request from the terminal T2 for the registration of the terminals T1 and T3 as designated terminating terminals in a closed user group service, and a request from the terminal T3 for registration of the terminal T2 as a designated terminating terminal, the switching centre LS2 registers codes NT1 and NT3 of the terminals T1 and T3 in respective rows of the closed user group entry table CT2, and the switching centre LS3 registers the code NT2 of the terminal T2 in the closed user group entry table CT3.

After having registered the code or codes of the terminating terminal or terminals in the closed user group entry tables of the switching centres, each switching centre enquires of the switching centre having accommodated therein such a registered terminating terminal (i.e. to which the data line of that terminal is connected) as to whether or not the terminal concerned, connected to a data line of the former switching centre, is registered in the closed user group entry table corresponding to the termination terminal of the latter switching centre, as indicated by broken lines Q1 to Q3. If the terminating terminal is verified as being registered as a result of such enquiry, this is indicated in the mutual registration verification columns CLM3 corresponding to the subscriber code columns CLM2 in the closed user group entry tables of both switching centres concerned. In the illustrated example, "1" is written in CLM3, in the appropriate row, to indicate that mutual registration has been verified.

Accordingly, after the registration of the codes NT2 and NT3 of the terminals T2 and T3 in the subscriber code column CLM2 of the closed user group entry table CT1, relating to terminal T1, of the switching centre LS1, and after the registration of the code NT1 of the terminal T1 in the subscriber code column CLM2 of the closed user group entry table CT2, relating to terminal T2, of the switching centre LS2, the switching centre LS2 enquires of the switching centre LS1 having accommodated therein the terminal T1 (i.e. to which the data line of terminal T1 is connected) as to whether or not the code NT2 of the terminal T2 has been registered in the closed user group entry table CT1 corresponding to the terminal T1. In this case, since it can be discovered from an answer from the switching centre LS1 that the code NT2 of the terminal T2 has already been so registered, the switching centre LS2 writes "1" in the mutual registration verification column CLM3 of the closed user group entry table CT2 in the row corresponding to the row of the subscriber code column CLM2 having registered therein the code NT1. On the other hand, based on information from the switching centre LS2, the switching centre LS1 writes "1" in the mutual registration verification column CLM3 in the row of the closed user group entry table CT1 corresponding to the subscriber code column CLM2 having registered therein the code NT2.

In a similar manner, "1" is written in the mutual registration verification column CLM3 of the closed user group entry table CT2, in the appropriate row, corresponding to the subscriber code column CLM2 having registered therein the code NT3, and in the mutual registration verification column CLM3 of the closed user group entry table CT3, in the appropriate row, corresponding to the subscriber code column CLM2 having registered therein the code NT2. For transmission between terminals, it is necessary that their codes are mutually registered in the closed user group entry tables relating to both terminals. Consequently, in the illustrated embodiment, transmission is possible between the terminals T1 and T2, and between the terminals T2 and T3, but it is impossible between the terminals T1 and T3 because the code NT1 of the terminal T1 has not been registered in the closed user group entry table CT3.

Thus, the terminals T1 and T2, and the terminals T2 and T3, form respective closed user groups. If the code NT1 of the terminal T1 is registered in the closed user group entry table CT3 of the terminals T3, the

terminals T1, T2 and T3 together form one closed user group to permit a closed user group service among them.

Next, a description will be given of the procedure involved in transmission between the terminals. When the terminal T1 has requested, *via* its data line, the switching centre LS1 for transmission to the terminal T2, the switching centre LS1 checks the closed user group entry table CT1 of the terminal T1, and in this case, since the code NT2 of the terminal T″ has already been registered and since "1" has also been written in the appropriate row of the mutual registration verification column CLM3, the switching centre LS1 achieves control such that data from the terminal T1 may be transmitted to the terminal T2 through the switching centre LS2. Also, in the case of a request for transmission from the terminal T2 to T1, the switching centre LS2 follows the same procedure as described above in order to transmit data from the terminal T2 to T1 through the switching centre LS1.

On the other hand, in the case of a request for transmission between terminals which do not belong to the same closed user group, for example, in the case of a request for transmission from terminal T1 to terminal T3, the switching centre LS1 checks the closed user group entry table CT1 of the terminal T1, and in this case, finds that the code NT3 of the terminal T3 has been registered, but that since "1" has not been written in the mutual registration verification column CLM3 in the row corresponding to the code NT3, the terminal T3 does not belong to the closed user group of the terminal T1, and as a result of this, the switching centre LS1 does not permit data transmission from the terminal T1 to T3.

Also, in the case of a request for transmission from the terminal T3 to T1, the switching centre LS3 refuses the request of terminal T3, since the code NT1 of the terminal T1 has not been registered in the closed user group entry table CT3 of the terminal T3.

Fig. 2 is a diagram explanatory of another embodiment of this invention, but in Fig. 2 the same reference characters as are used in Fig. 1 identify similar items. In the embodiment of Fig. 2, the code of a terminating terminal in transmission between terminals is registered in an originating centre in correspondence to an abbreviation code used in the originating terminal in relation to that terminating terminal. For instance, where the terminal T1 has requested the switching centre LS1 to register the terminal T2 as the terminating terminal in the form of an abbreviation code "2", the switching centre LS1 writes the code NT2 of the terminal T2 in the subscriber code column CLM2 in the second row of the closed user group entry table CT1 which relates to terminal T1. Thereafter, when the terminal T1 designates the terminal T2, the code NT2 of the terminal T2 need not be designated by terminal T1 but instead the abbreviation code "2" is designated thereby. The abbreviation code "2" signifies that the code NT2 of the terminal T2 has been registered in the "second row" of the closed user group entry table CT1 of the terminal T1.

Likewise, when requested by the terminal T1 to register the terminal T3 as a terminating terminal with an abbreviation code "4", the switching centre LS1 registers the code NT3 of the terminal T3 in the subscriber code column CLM2 in the fourth row of the closed user group entry table CT1.

When the switching centre LS2 has received from the terminal T2 a request for the registration of the terminals T1 and T3 with abbreviation codes "3" and "4", respectively, the switching centre LS2 writes the codes NT1 and NT3 of the terminals T1 and T3 in the subscriber code column CLM2 in the third and fourth rows of the closed user group entry table CT2 relating to terminal T2, respectively.

After the registration of the code NT1 of the terminal T1 in the closed user group entry table CT2, the switching centre LS2 enquires of the switching centre LS1 having accommodated therein the terminal T1 as to whether or not the terminal T2 has been registered in respect of terminal T1 for closed user group service. In the present embodiment, since the terminal T2 has already been so registered in the switching centre LS1, as described previously, "1" is written in the mutual registration verification column CLM3 in the third row of the closed user group entry table CT2 in the switching centre LS2. Further, the abbreviation code "2", defined by the terminal T1 with respect to the terminal T2, is written in the third row of abbreviation code column CLM1 of table CT2. The abbreviation code "2" is transferred from switching centre LS1 to LS2, together with the information that the terminal T2 has been registered as a terminating terminal with respect to terminal T1.

Further, in the switching centre LS1, it is learned from a notice from the switching centre LS2 that mutual registration of the terminals T1 and T2 has been completed, so that "1" is indicated in the mutual registration verification column CLM3 in the second row of the closed user group entry table CT1, and based on information from the terminal LS2, the abbreviation code "3", defined by the terminal T2 with respect to the terminal T1, is written in the second row of abbreviation code column CLM1 of CT1.

In a similar manner, between the ter-

minals T2 and T3, the terminal T2 defines the terminal T3 with an abbreviation code "4", and the terminal T3 defines the terminal T2 with an abbreviation code "5". This is shown in Fig. 2.

What is written in the abbreviation code column CLM1 of a closed user group entry table of each terminal is the abbreviation code which the terminal written in the subscriber code column of the same row as the abovesaid abbreviation code column has defined with respect to the terminal that corresponds to the abovesaid closed user group entry table. Accordingly, in the case where "3" has been written in the subscriber code column CLM1 in the second row of the closed user group entry table CT1, it is indicated that the abbreviation code for the designation of the terminal T1 by the terminal T2 is "3".

The abbreviation codes employed by one terminal for the other terminals are each defined with respect to each terminal alone. In other words, the terminal T1 designates the terminal T2 with the abbreviation code "2", but the abbreviation code for the designation of the terminal T2 by the terminal T3 is not "2" but "4" in the illustrated embodiment.

Next, a description will be made of procedures involved in closed user group service employing such abbreviation codes.

In the case of transmission from terminal T1 to T2, it is sufficient for the terminal T1 to designate only the abbreviation code "2" at the switching centre LS1. Based on the abbreviation code "2" notified from the terminal T1, the switching centre LS1 reads out the second row of the closed user group entry table CT1 to learn from the second row of the subscriber code column CLM2 of CT1 that the abbreviation code "2" indicates the terminal NT2 as a desired terminating terminal, and also finds out that mutual registration has been completed, based on the fact that the mutual registration verification column CLM3 holds "1" in the second row. As a result of this, the switching centre LS1 immediately notifies the switching centre LS2 having accommodated therein the terminating terminal T2 of the code NT2 of the terminal T2 and the abbreviation code "3" entered in the second row of the abbreviation code column CLM1 of CT1.

The switching centre LS2 checks the closed user group entry table CT2 corresponding to the terminal T2, based on the terminal code NT2 notified from the switching centre LS1. Further, based on the abbreviation code "3" notified from the switching centre LS1, the switching centre LS2 reads the third row of the closed user group entry table CT2 corresponding to terminal T2 to learn that the request for transmission comes from the terminal T1. This eliminates the necessity for searching rows of the closed user group entry table CT2 one after another, thus alleviating the processing load in the switching centre LS2.

When notifying the terminal T2 of a call from the terminal T1, the switching centre LS2 sends to the terminal T2 the abbreviation code "3" sent from the switching centre LS1, thereby enabling the terminal T2 readily to discover from the abbreviation code "3" that the call has originated from the terminal T1.

Fig. 3 is a block diagram of line switching equipment embodying the present invention. The illustrated line switching equipment comprises a speech path 10, a central processor 20, an input/output device 30 and a closed user group service adapter 40. The speech path 10 has accommodated therein terminals 1*a*, 1*b*, 1*c*, ... , i.e. has data lines for connection to those respective terminals. The central processor 20 is composed of a central processor unit 201 and a data channel 202, and the input/output device 30 is comprised of receiver-drivers 301 and 302 used for inter-office signalling between switching centres, and input/output units 303 and 304. The speech path 10 and the closed user group service adapter 40 are interconnected through the central processor 20, an address bus 101 and an answer bus 102.

Fig. 4 is a block diagram illustrating in detail the line switching equipment depicted in Fig. 3. The speech path 10 comprises the address bus 101, the answer bus 102, a line link network 103 having accommodated therein subscriber data lines, a trunk link network 104 having accommodated therein a speech trunk and a signal trunk, an intra-office trunk (IOT) 105 for intra-office connection within one switching centre, a trunk 106 accommodated in the trunk link network 104, an originating register trunk (ORT) 107 generally indicating a dial signal receiver for a rotary dial and a touch tone dial, a line scanner (LSCN) 108, a line switch controller (LSC) 109, a trunk switch controller (TSC) 110, a trunk scanner (TSCN) 111, a relay controller (RC) 112, a signal distributor (SD) 113, and a signal receiver and distributor (SRD) 114 serving as an interface for information transmission and reception with respect to the central processor unit 201.

The input/output device 30 comprises an inter-office signal transmitter-receiver (SGU) 305, modems 306 and 307, a magnetic drum controller (DRC) 308, a magnetic drum unit (DRU) 309, a typewriter controller (TPC) 310 and a typewriter (TYP) 311. The parenthesized letters above are abbreviations used in respect of the designated parts.

The closed user group service adapter 40 comprises a cable receiver/driver 401, a

memory control circuit 402, a read-write circuit 403, an address circuit 404 and registration memories 405 used for forming the closed user group entry tables described previously in connection with Figs. 1 and 2.

The illustrated line switching equipment has features of construction which are similar to previously proposed line switching equipment, excepting the closed user group service adapter 40. Operation of one previously-proposed form of switching equipment is set forth in detail, for instance, in U.S. Patent No. 3,569,939 and "THE BELL SYSTEM TECHNICAL JOURNAL", Vol. 43, No. 5, September 1964. Accordingly, no description will be given of ordinary switching and connecting operations.

A call from the terminal 1 is detected by monitoring the DC levels of the subscriber data lines by means of periodic scanning of the lines by the line scanner 108. Upon detection of the call, the line scanner 108 sends the detected information to the central processor unit 201 together with information relating to subscriber accommodation position (i.e., the identity of the subscriber data line concerned). The central processor unit 201 applies commands to the line switch controller 109 and the trunk switch controller 110 to interconnect the calling terminal data line and the originating register trunk 107 to make preparations for the reception of a dial signal from the calling terminal.

The originating register trunk 107 receives and stores therein the dial signal (a rotary dial signal, a touch tone (Registered Trade Mark) a dial signal or an ordinary character dial signal, e.g. a character signal from a data terminal keyboard) delivered out from the calling terminal *via* its data line.

In this case, the terminal employs different formats of dial signal for notifying the switching equipment whether the call is a request for the registration of a subscriber of a closed user group, or for actual closed user group service, or a request for other ordinary transmission. For example, in the case of the request for closed user group entry "α, X_1, X_2, X_3, X_4, ... X_n" is used as the format of the dial signal, α being a character indicative of the registration of the terminating terminal of the closed user group service, and not being used in a request for ordinary transmission service, and X_1 to X_n being the numbers used to designate the terminating terminals of the closed user group service.

In the case of the request of registration of a terminating terminal for closed user group service, the request is first recognised by α leading the aforesaid dial signal, and the central processor unit 201 commands the registration memory 405 to write therein the code of the designated terminating terminal of the closed user group service. This command is received by the cable receiver driver 401 to control the address circuit 404 with the memory control circuit 402, by means of which the code of the terminal is written in an address of the registration memory 405 designated by the address circuit 404 from the read-write circuit 403. The central processor unit 201 enquires of the switching equipment having accommodated therein the terminating terminal just registered as to whether or not the code of the registration requesting terminal has been entered in the registration memory of that equipment relating to the desired terminating terminal, and if registered, an indication of verification, for example, "1", is written in the mutual registration verification columns of both terminals. Such an interconnection of the switching equipments is achieved through the inter-office signalling equipment 305.

The inter-office signalling equipment 305 is for transmission and reception of switching network control signals, terminal connecting signals, charging signals and other signals between switching equipment in different switching centres. In this embodiment, it is based on the specification of Signalling System No. 6 given in the Geneva Convention of the International Telegraph and Telephone Consultative Committee, 1972.

Where a dial signal from the calling terminal is X_1, X_2, X_3, ... X_n, since this signal does not include α at its head, the central processor unit 201 decides that the signal is a request for closed user group service with a terminal having the terminal code X_1, X_2, X_3, ... X_n. Then the central processor unit 201 issues a command to the closed user group service adapter 40 to search the closed user group registration memory 405 corresponding to the originating terminal to check whether or not the code of the terminating terminal has been registered in the memory 405 and whether or not "1" has been indicated in the mutual registration verification column relating thereto. As a result of this, where the mutual registration has already been completed, the switching equipment performs operations for connecting the originating terminal to that terminating terminal which corresponds to the dial signal of the former.

In the case where a designated terminating terminal of the closed user group service is accommodated by the same switching equipment as the originating terminal, they are interconnected through the intra-office trunk 105. Where the terminating terminal is accommodated in switching equipment different from that of the originating terminal, the originating switching equipment

sends information for connection to intermediate switching equipment and to terminating switching equipment through the inter-office signalling equipment 305. Upon receipt of this information, the intermediate switching equipment and the terminating switching equipment actuate the line switch controller to connect the originating terminal to the terminating terminal.

Fig. 5 is a block diagram of a closed user group service adapter. The cable receiver-driver 401 in Fig. 4 is shown to be composed of a cable receiver 406 and a cable driver 407. The memory control circuit 402 comprises a register 408 including a data register 408*a*, a control information register 408*b* and a unit number register 408*c*, a selector 409, an operation analysis circuit 410 and a matcher 411. The read-write circuit 403 comprises a read-write buffer 312 and a read-write control circuit 413. As for the construction of each of the abovesaid parts, it is possible to adopt, for example, the construction of a memory control circuit intended for use in an information processor unit.

The units connected to the address bus 101 are respectively assigned unit numbers, and designed so that a signal delivered out from the central processor unit to the address bus 101 is selectively received only by the unit whose unit number is designated by the central processor unit.

In the case of registration of a terminating terminal, the unit number of the closed user group service adapter, control information and the code of the terminal requesting registration are delivered out from the central processor unit to the address bus 101, and set in the register 408 through the cable receiver 406. The control information is to indicate that the content set in the data register 408*a* is the code of the registration requesting terminal, and in the operation analysis circuit 410, the control information is analyzed and identified. As a result of analysis of the control information in the operation analysis circuit 410, signals are applied to the selector 409 and the read-write control circuit 413 to send the terminal code set in the data register 408*a* to the address circuit 404 through the selector 409 and the read-write control circuit 413, thereby selecting the closed user group registration memory 405 corresponding to the registration requesting terminal. The read-write control circuit 413 searches the selected registration memory 405 for a vacant entry (a row of subscriber code column CLM2 in which no terminal code has yet been registered).

Next, since the terminating terminal code is sent out from the central processor unit together with a unit number and control information, the control information is analyzed by the operation analysis circuit 410 to detect that the content set in the data register 408*a* is the code of the terminating terminal, and the terminating terminal code is sent to the read-write buffer 412 through the selector 409 to write the terminating terminal code in the selected registration memory 405 by means of circuits 413 and 404. Upon completion of this write, the read-write control circuit 413 informs the answer bus 102 of the completion of the write opeartion through the cable driver 407. The central processor unit receives this information through the answer bus 102, and enquires of the switching equipment having accommodated therein the registered terminating terminal verification as to whether or not the registration requesting terminal has already been registered in the registration memory corresponding to the terminating terminal.

In the case where an answer is obtained to the effect that the registration requesting terminal has already been registered, "1" is written in the mutual registration verification column CLM3 of the relevant entry table of the registration memory 405 (in the row thereof concerned).

In the case of request for closed user group service, the central processor unit delivers out the code of the originating terminal (identified by terminal call detection in the central processor unit) to the address bus 101. Based on the code of the originating terminal, the registration memory 405 corresponding to the originating terminal is searched. Then, the central processor unit sends out to the address bus 101 the code of the terminating terminal dialled by the originating terminal. The code of the terminating terminal is held in the data register 408*a*, and the subscriber code column CLM2 and the mutual registration verification column CLM3 of the registration memory 405 corresponding to the originating terminal are read out entry by entry. In the matcher 411, the terminal code held in the data register 408*a* is matched with each of the terminal codes of the subscriber code columns CLM2 sequentially read out as mentioned, and if a coincidence is found the matcher 411 checks the mutual registration verification column CLM3 as to whether it holds a "1" or not. In the case of "1" being held, information is sent to the central processor unit through the answer bus 102. Upon receipt of this information, the central processor unit starts a switching operation for actuation of closed user group service.

When the mutual registration verification colum CLM3 holds a "0", or in the event that the code of the terminating terminal held in the data register 408*a* is not coincident with any of the terminal codes read

out from all the subscriber code columns CLM2 of the registration memory 405 corresponding to the originating terminal, the central processor unit is informed of this. In this case, the central processor unit refuses the request for the closed user group service.

Next, an example of the employment of abbreviation codes will be described with reference to Figs. 3, 4 and 5.

In the case of a request for closed user group entry, the dial signal format used is α, β, X_1, X_2, X_3, ... X_n. α is a character indicative of registration of the terminating terminal of the closed user group service, and is not employed for requests for ordinary transmission services. β is an abbreviation code and X_1 to X_n designate the code of the terminating terminal of the closed user group service. For instance, in a case where the terminal T2 having a terminal code X_1, X_2, X_3, ... X_n is registered in the form of an abbreviation code "2", it is designated by a dial signal format α, 2, X_1, X_2, X_3, ... X_n.

From the leading character α of the dial signal, the central processor unit 201 learns that the dial signal is a request for the registration of a terminating terminal for closed user group service, and then sends out the unit number of the closed user group service adapter 40, control information, and the code of the terminal requesting registration, to the address bus 101. The closed user group service adapter 40 sets the unit number, the control information and the code of the registration requesting terminal in the register 408 through the cable receiver 406. Then the registration memory 405 corresponding to the registration requesting terminal is selected as is the case with the foregoing embodiment.

Next, the abbreviation code and the code of the terminating terminal are delivered out from the central processor unit 201 to the address bus 101, together with a unit number and control information. The closed user group service adapter 40 sets the above-said information from the central processor unit 201 in the register 408 through the cable receiver 406. The control information is analyzed by the operation analysis circuit 410 to detect that the content set in the data register 408*a* is the abbreviation code and the terminating terminal code, and the terminating terminal code and the abbreviation code are respectively sent to the read-write buffer 412 and the read-write control circuit 413 through the selector 409. With this abbreviation code, the address circuit 404 designates a row of the previously selected registration memory 405. For example, in the case of the abbreviation code being "2", the second row of the registration memory 405 is designated. Under the control of the read-write control circuit 413, the terminating terminal code is written in the subscriber column CLM2 in the designated row of the registration memory 405.

Upon completion of the above write operation, the switching centre having accommodated therein the terminating terminal thus registered is asked to verify the registration of the registration requesting terminal in the registration memory corresponding to the terminating terminal.

When an answer to the effect that the registration requesting terminal has already been registered is obtained, "1" is written in the mutual registration verification column CLM3 of the registration memory 405, and the abbreviation codes mutually designated by the terminals are transferred between the switching centres, and then written in the abbreviation code columns CLM1 of the respective registration memories 405. For instance, in a case where the terminal T1 registers the terminal T2 with the abbreviation code "2" and the terminal T2 registers the terminal T1 with the abbreviation code "3", as described previously with reference to Fig. 2, the abbreviation code "3", the code NT2 of the terminal T2 and the mutual registration verification indication "1" are written in the second row of the registration memory corresponding to the terminal T1, and the abbreviation code "2", the code NT1 of the terminal T1 and the mutual registration verification indication "1" are written in the third row of the registration memory corresponding to the terminal T2.

When closed user group service is desired, the originating terminal sends the abbreviation code of the registered terminating terminal to the switching centre. The switching centre identifies the code of the originating terminal based on information concerning the accommodated position (the identity) of the originating terminal, and selects the registration memory 405 corresponding to the originating terminal. The registration memory 405 is read out, for example when the abbreviation code sent from the originating terminal is "2", the second row of the selected registration memory 405 is designated by the address circuit 404, and the abbreviation code column CLM1, the subscriber code column CLM2 and the mutual registration verification column CLM3 are read out, and set in the read-write buffer 412.

When the content of the mutual registration verification column CLM3 has been detected by the matcher 411 to be "1", the central processor unit 201 transfers the abbreviation code and the code of the terminating terminal now set in the read-write buffer 412 to the terminating centre.

The terminating centre performs an opera-

tion for the connection to the terminal corresponding to the transferred terminal code. In this case, since the row of the registration memory corresponding to the terminating terminal is immediately known from the transferred abbreviation code, the identity of the originating terminal can be readily found by reading out the subscriber code column of the abovesaid row.

The information passed between the swtiching centres in this case is transmitted and received through the data channel 202 (Fig. 3), the inter-office signalling equipment 305 and the modems 306 and 307, and processing of the information takes place in the central processor unit 201. In a case where the terminating terminal is accommodated in the same switching centre as the originating terminal, this is detected by the central processor unit 201 from the terminating terminal code read out from the registration memory 405 by the abbreviation code from the originating terminal, and as described above, if the mutual registration verification column CLM3 is "1", a control for the connection between the originating terminal and the terminating one is achieved through the intra-office trunk (IOT) 105.

Although the foregoing description has been given in connection with a case in which the closed user group service adapter 40 is connected to the central processor unit 201 through the address bus 101 and the answer bus 102, it is also possible to provide in the central processor 20 the function of performing the closed user group service by achieving therein the registration of the terminating terminals of the closed user group service and verification of mutual registration.

In the above-described embodiments of the present invention, since functions such as verification and selection of a terminating terminal of a closed user group service and so on are all performed by the switching network, it is possible to eliminate ineffective reservation of a subscriber line and a terminal in the closed user group service, such as can be experienced in the identification code method and since the terminals are not required to have a decision function, the implementation of the terminals can be made more economical.

Further, in the above-described embodiments of the present invention, the switching network does not permit mutual transmission between terminals unless both of them have been registered as the terminating terminal designated by the other. Accordingly, the terminals of each closed user group cannot achieve transmission between themselves and the terminals of other closed user groups. This eliminates the possibility of incidental or accidental jamming or interference between the closed user groups in the closed user group service, and hence permits each terminal user of a certain closed user group to utilize the closed user group service as if there were a switching network provided for the exclusive use of the group.

Moreover, in the illustrated embodiments of this invention, in connection with the terminals of the closed user group, verification of mutual registration, which indicates permission by the switching network for transmission between two terminals, is previously achieved. This eliminates the necessity that at each request for use of the closed user group service, the originating switching centre enquires of the terminating switching centre as to whether or not the the same closed user group, and consedesignated terminating terminal belongs to the same closed user group, and consequently the processing load in the switching centre is reduced.

Further, registration procedures relating to the closed user group service, such as registration in or withdrawal from the closed user group, can be achieved merely by entry or erasure in desired columns of the closed user group entry tables by the switching network in accordance with registration requests from the terminals. Maintenance and management of a closed user group need not be carried out by the switching centre, unlike the conventional group code method, and may be effected by the terminal users independently. Accordingly, administrative processing at the switching centre attendant upon maintenance and management of the closed user groups is reduced, and the occurrence of disagreements, which can occur between users and the switching centres owing to delay or error in administrative processing, can be markedly reduced.

Thus, there can be provided a closed user group facility in a communications switching network, which group facility provides a closed user group of terminals accommodated in a switching network formed together for transmission therebetween, and in respect of which group, based on a request for registration of a designated terminating terminal from another one of the terminals, the switching network registers the terminating terminal corresponding to the latter terminal by means of one of a number of codes by means of which all the terminals accommodated in the switching network can be individually identified, and in a case of transmission data (including voice data) from an originating terminal to a terminating terminal, the switching network exercises control so as to permit the transmission of the data from the originating terminal to the terminating terminal when

the switching network has verified that the originating and terminating terminals have already been mutually registered as distant terminals belonging to one closed user group.

WHAT WE CLAIM IS:—

1. A communications switching network for passing data between a plurality of communications terminals, connected to respective data lines of the network when it is in use, by means of respective terminal designation codes associated individually with the said data lines, the network including group registration means, operable to store in respect of any selected one of the said data lines the terminal designation code individually associated with the or each other data line of the network that belongs to a closed user group of the said respective data lines that includes the selected one data line, and group membership verification means operable to examine whether a terminal designation code received by way of a data line, from any data-sending one of such terminals, and individually associated with a selected second data line, is stored in the registration means in respect of the sending data line, being the data line to which the data-sending terminal is connected, and whether the terminal designation code individually associated with the said sending data line is stored in the registration means in respect of the selected second data line, the network being such as to enable data to be passed from such a sending data line to such a selected second data line in dependence upon the results of such examination.

2. A network as claimed in claim 1, in combination with such terminals connected respectively to the said data lines.

3. A network as claimed in claim 1 or 2, wherein at least one such terminal connected to a data line of the network is operable selectively to cause the group registration means to store in respect of that data line the terminal designation code individually associated with a selected further data line of the network that is to be included with the former data line in a closed user group.

4. A network as claimed in any preceding claim, wherein the group registration means comprise respective group entry stores associated individually with the said data lines of the network, each of which stores is employed to hold in respect of the data line individually associated therewith the terminal designation code individually associated with the or each other data line of the network that belongs to a closed user group including the data line individually associated with the group entry store concerned.

5. A network as claimed in any preceding claim, wherein the said group registration means comprise verification indicating means for storing in individual association with such a terminal designation code, stored in respect of any chosen one of the data lines and individually associated with a different one of those lines, an indication of the result of an examination carried out by the group membership verification means as to whether the terminal designation code individually associated with the chosen data line is stored in the registration means in respect of the said different one of the data lines.

6. A network as claimed in claim 5, operable to enable data to be passed from such a sending data line to such a selected second data line in dependence upon such an indiaction stored in the verification indicating means in individual association with the terminal designation code that is stored in the group registration means, in respect of the sending data line, and is individually associated with the selected second data line.

7. A network as claimed in any preceding claim, wherein the terminal designation code individually associated with the or each other data line of the network that belongs to the said closed user group that includes the selected one data line is stored at a respective storage location of the group registration means that can be designated by means of an abbreviated code designation supplied from the communications terminal connected to the selected one data line when the network is in use.

8. A network as claimed in claim 7 read as appended to claim 4, wherein the group entry store provided in respect of the selected one data line is operable to store, in respect of each terminal designation code therein individually associated with the or each other data line that belongs to the said closed user group, such an abbreviation code designation which, when supplied from the communications terminal connected to the other data line concerned, designates a storage location, in the group entry store for the other data line con-

cerned, at which the terminal designation code individually associated with the selected one data line is stored.

9. A communications switching network for passing data between a plurality of communications terminals, substantially as hereinbefore described with reference to Figure 1, Figure 1, 3 and 4, or Figures 1, 3, 4 and 5, or substantially as described with reference to Figure 2, Figures 2, 3 and 4, or Figures 2, 3, 4 and 5, of the accompanying drawings.

HASELTINE, LAKE & CO.,
Chartered Patent Agents,
28, Southampton Buildings,
Chancery Lane,
London, WC2A 1AT.
— and —
Temple Gate House,
Temple Gate,
Bristol BS1 6PT
— and —
9 Parks Square,
Leeds LS1 2LH.
Agents for the Applicants.

Printed for Her Majesty's Stationery Office by The Tweeddale Press Ltd., Berwick-upon-Tweed, 1980.
Published at the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

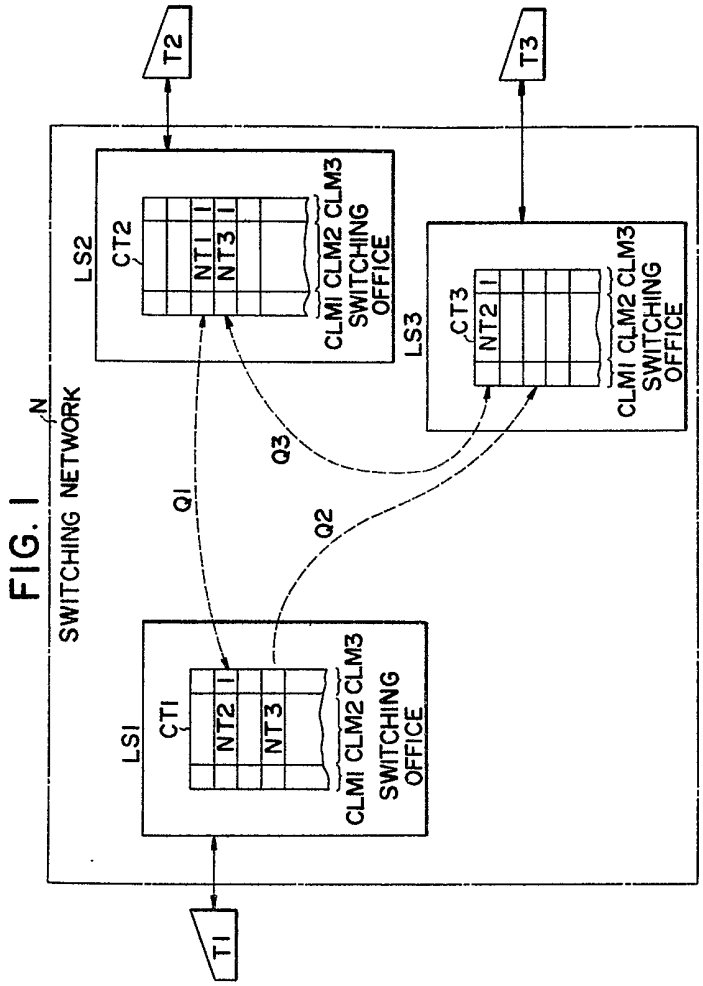

T2
T3
LS2
CT2
NT1
NT3
CLM1 CLM2 CLM3
SWITCHING OFFICE
LS3
CT3
NT2
CLM1 CLM2 CLM3
SWITCHING OFFICE
N
SWITCHING NETWORK
Q1
Q2
Q3
LS1
CT1
NT2
NT3
CLM1 CLM2 CLM3
SWITCHING OFFICE
T1

FIG. 1

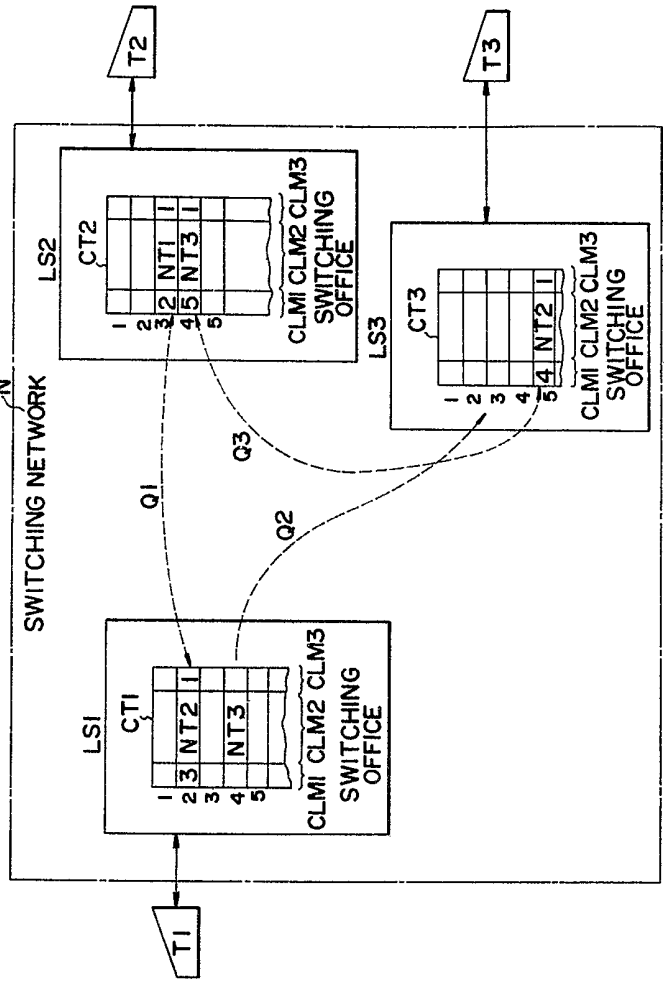

T2
T3
LS2
CT2
NT1
NT3
CLMI CLM2 CLM3
SWITCHING OFFICE
LS3
CT3
NT2
N
SWITCHING NETWORK
Q3
Q1
Q2
LS1
CT1
NT2
NT3
T1

FIG. 2

FIG. 3

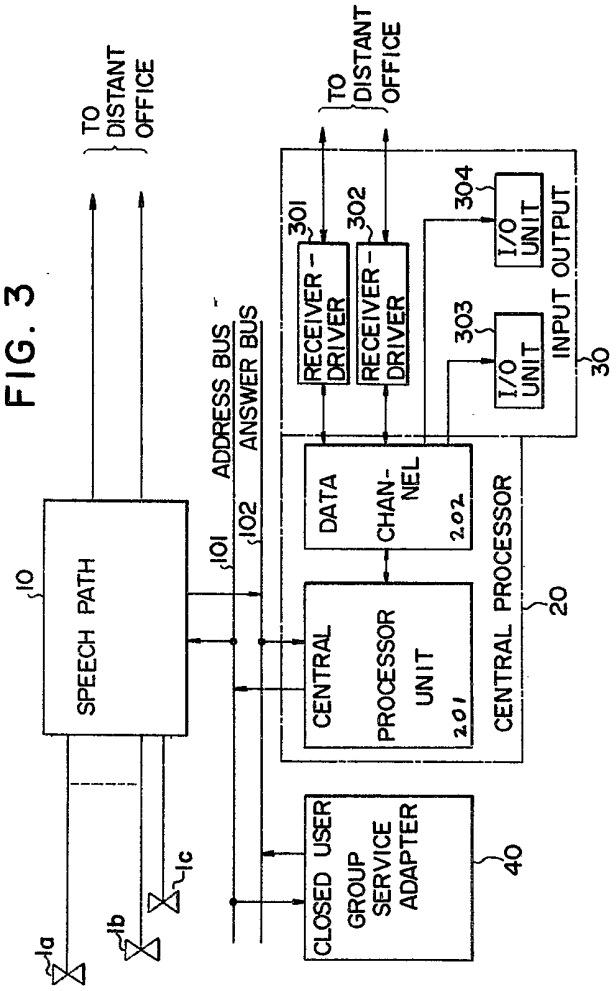

TO DISTANT OFFICE
TO DISTANT OFFICE
SPEECH PATH
10
ADDRESS BUS
101
ANSWER BUS
102
1a
1b
1c
RECEIVER-DRIVER
301
RECEIVER-DRIVER
302
I/O UNIT
304
I/O UNIT
303
INPUT OUTPUT
30
DATA CHANNEL
202
CENTRAL PROCESSOR UNIT
201
CENTRAL PROCESSOR
20
CLOSED USER GROUP SERVICE ADAPTER
40

FIG. 4

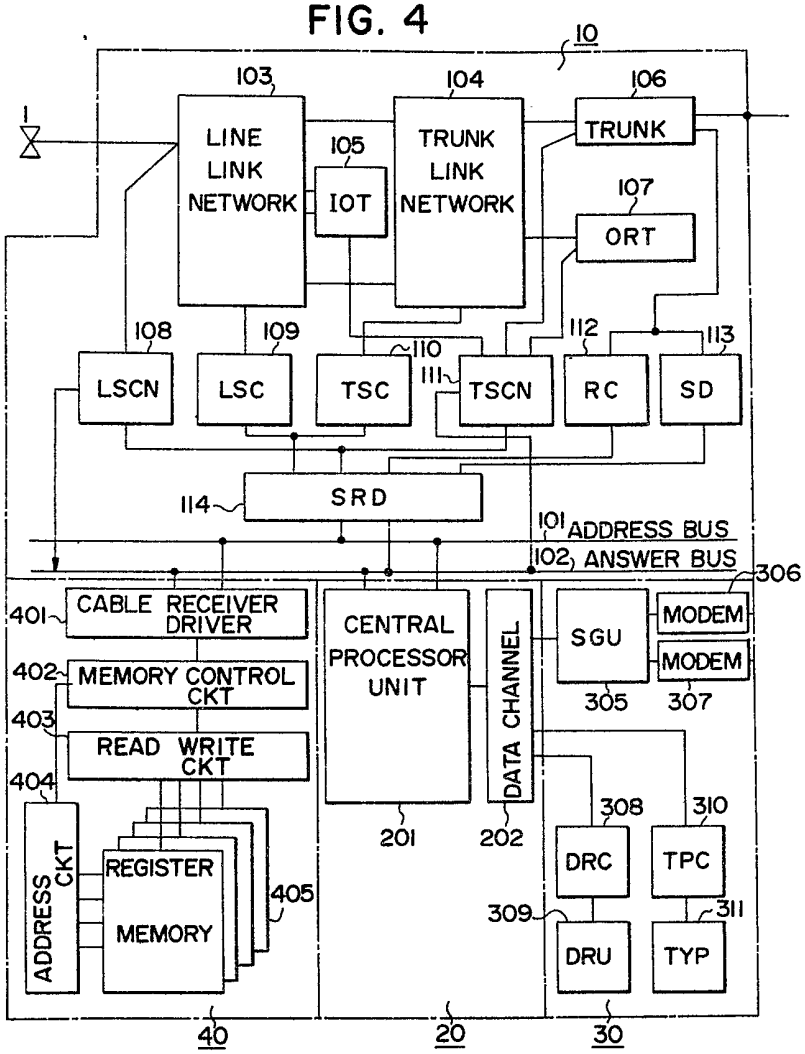
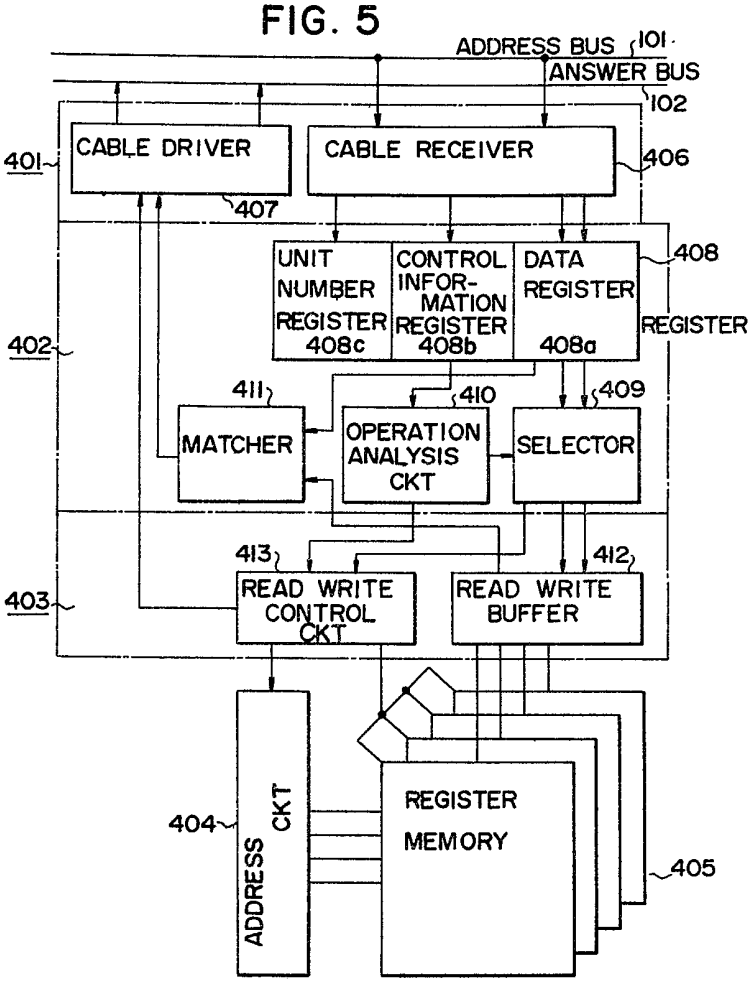

10
1
103
LINE LINK NETWORK
105
IOT
104
TRUNK LINK NETWORK
106
TRUNK
107
ORT
108
LSCN
109
LSC
110
TSC
111
TSCN
112
RC
113
SD
114
SRD
101 ADDRESS BUS
102 ANSWER BUS
306
401
CABLE RECEIVER DRIVER
402
MEMORY CONTROL CKT
403
READ WRITE CKT
404
ADDRESS CKT
REGISTER
MEMORY
405
CENTRAL PROCESSOR UNIT
201
DATA CHANNEL
202
SGU
305
MODEM
MODEM
307
308
DRC
310
TPC
309
DRU
311
TYP
40
20
30

FIG. 5


ADDRESS BUS
101
ANSWER BUS
102
401
CABLE DRIVER
407
CABLE RECEIVER
406
UNIT NUMBER REGISTER 408c
CONTROL INFOR-MATION REGISTER 408b
DATA REGISTER 408a
408
REGISTER
402
411
410
409
MATCHER
OPERATION ANALYSIS CKT
SELECTOR
413
412
403
READ WRITE CONTROL CKT
READ WRITE BUFFER
404
ADDRESS CKT
REGISTER MEMORY
405