(12) PATENT
(19) AUSTRALIAN PATENT OFFICE

(11) Application No. AU 199673328 B2
(10) Patent No. 708319

(54) Title

Scrambled information transmitting and receiving

(51)[6] International Patent Classification(s)
H04L 009/10 H04H 001/00
H04B 001/16 H04K 001/00

(21) Application No: 199673328 (22) Application Date: 1996.10.17

(87) WIPO No: WO97/15132

(30) Priority Data

(31) Number	(32) Date	(33) Country
7-271228	1995.10.19	JP

(43) Publication Date : 1997.05.07
(43) Publication Journal Date : 1997.07.03
(44) Accepted Journal Date : 1999.07.29

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(56) Related Art

EP 732813
INFO PROCESSING 89, PROC OF THE IFIP 11TH WORLD COM CONG, SAN FRAN, CA USA, 28AUG-1SEPT89, PP839-844, STORK,H.G ETAL

OPI DATE 07/05/97 APPLN. ID 73328/96
AOJP DATE 03/07/97 PCT NUMBER PCT/JP96/03006
AU9673328
CT)

(51) International Patent Classification ⁰ :
H04L 9/10, H04B 1/16, H04H 1/00, H04K 1/00

A1

(11) International Publication Number: WO 97/15132

(43) International Publication Date: 24 April 1997 (24.04.97)

(21) International Application Number: PCT/JP96/03006

(22) International Filing Date: 17 October 1996 (17.10.96)

(30) Priority Data:
7/271228 19 October 1995 (19.10.95) JP

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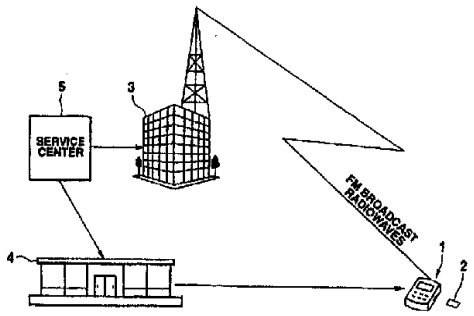
(81) Designated States: AU, CN, KR, NO, SG, US, European patent (AT, BE, CH, DE, ES, FR, GB, IT, NL, SE).

Published
With international search report.

(54) Title: SCRAMBLED INFORMATION TRANSMITTING AND RECEIVING



(57) Abstract

A service information receiving apparatus (1) for receiving scrambled charged service information transmitted as being multiplexed on an FM broadcast radio wave from an FM broadcasting station (3) causes a control section (43) to perform a predetermined arithmetic operation by using a variable key as one of descramble keys affixed to the scrambled charged service information received by a service information receiving section (40) and a half-fixed key as one of descramble keys, which is stored in an IC card (2) detachably attached to a receiving apparatus main body, thereby preparing a new descramble key, which is used to descramble the received charged service information.

DESCRIPTION

SCRAMBLED INFORMATION TRANSMITTING AND RECEIVING

Technical Field

The present invention relates to an information transmitting method of transmitting scrambled information, an information receiving method of receiving scrambled information, and a system and an apparatus used for performing those methods. More particularly, this invention is particularly suitable for use in an FM (Frequency Modulation) teletext broadcasting system, but is no way limited to such application.

Background Art

There is a service which uses FM broadcast radio waves as media to transmit service information, such as character information, multiplexed on an FM broadcast radio wave and display the service information on display means provided on a FM radio receiver. This service is called "FM teletext broadcasting" which has already been put to a practical use as visual information radio.

According to this FM teletext broadcasting, an FM teletext broadcast radio wave is acquired by frequency-multiplexing display information such as characters and/or numerals on an ordinary FM broadcast radio wave.

The acquired FM telecast broadcast radio wave is transmitted from an FM broadcasting station. The FM teletext broadcast radio wave is received by an FM radio receiver with a display like a liquid crystal display and is separated to audio information and display information. The display information is converted to character codes to be displayed on the display to allow a user to see this display information. Accordingly, the user can see information associated with broadcasting, such as the title of a broadcast music piece, the name of the artist, comments and/or the number of requests, and news, weather information, traffic information or the like, which is not directly associated with broadcasting, as character information.

In FM teletext broadcasting, there is specific service information which may be charged as well as charge-free service information. Such charged service information is scrambled on the FM broadcasting station and is transmitted. While a receiver of a subscriber for charged broadcast programs is provided with means for storing or inputting a descramble key to descramble (decode) scrambled information so that charged service information can be descrambled for visual purpose.

If anyone who is not subscribed for charged broadcasting decodes the descramble key to descramble charged service information, however, unauthorized

watching of the charged service information become possible.

Disclosure of Invention

According to the invention, therefore, there is provided an information receiving apparatus including:

reception means for receiving scrambled information; a receiving apparatus main body to and from which a storage medium having stored a descrambled key for descrambling said scrambled information is attachable and detachable;

descramble means for descrambling said scrambled information received by said reception means by using a plurality of descrambled keys including said descrambled key stored in said storage medium; and

display means for displaying said information descrambled by said descramble means.

Preferably said reception means receives said scrambled information multiplexed on an FM broadcast radio wave.

Preferably the information receiving apparatus further includes storage means provided in the receiving apparatus main body, for previously storing a fixed descrambled key; and

wherein said reception means further includes means for receiving a descrambled key, and

said descrambled means is used to descramble said scrambled information received by said reception means using the descrambled key stored in said storage medium, the descrambled key received by said reception means and the descrambled key stored in said storage means.

Preferably said descramble means includes descramble key preparing means for preforming a predetermined process by using two or more of said plurality of descramble keys to prepare a new descramble key; and

said descramble key prepared by said descramble key preparing means is used to descramble said scrambled information.

Preferably two or more of said plurality of descrambled keys include said descramble key stored in said storage medium.

Preferably the said reception means includes receiving means for receiving a descramble key;

at least one of said plurality of descramble keys is received by said receiving means; and

the two or more of said plurality of descrambled keys used when said descramble key preparing means prepares the new descramble key include the descramble key received by said receiving means.

Preferably the information receiving apparatus further includes storage means provided in a receiving apparatus main body, for previously storing descrambled keys wherein at least one of said plurality of descramble keys is a descramble key stored in said storage means, and said two or more of said plurality of descramble keys include said descramble key stored in said storage means.

The present invention also provides an information transmitting apparatus including:

scramble means for scrambling information by using a plurality of scramble keys; and

transmission means for transmitting scrambled information scrambled by said scramble means and transmitting scramble keys except for at least one of said scramble keys as a descramble key;

wherein at least one of the scramble keys which is not transmitted by said transmission means is a descramble key stored in a storage medium which is attachable and detachable with respect to information receiving apparatus used to receive the scrambled information transmitted by said transmission means and descramble keys, and the transmission means is used to transmit said scrambled information and said descrambled

key multiplexed on an FM broadcast radio wave.

Preferably at least one of the scramble keys which is not transmitted by said transmission means is a descramble key stored in a storage means provided in said information receiving apparatus used to receive the scrambled information by said transmission means and descramble keys.

Preferably the said scramble means includes scramble key preparing means for performing a predetermined process by using two or more of said plurality of scramble keys to prepare a new scramble key, for scrambling information.

The present invention still further provides a storage medium, attachable to and detachable from an information receiving apparatus for receiving scrambled information, including:

storage means for storing one or more descrambled keys except for at least one of a plurality of descramble keys used for descrambling said scrambled information received by said information receiving apparatus; and

interface means for interfacing with said information receiving apparatus;

wherein at least one of descramble keys which are not stored in said storage means is a descramble key received by said information receiving apparatus or a descramble key previously and fixedly stored in a main body of said information receiving apparatus, and the storage medium is attachable to and detachable from an FM multiplex broadcast receiving apparatus for receiving the scrambled information transmitted in such a form as to be multiplexed on an FM broadcast radio wave.

In yet another aspect the present invention provides an information transmitting and receiving system including:

an information transmitting apparatus for transmitting scrambled information;

a storage medium for storing a descramble key for

use in descrambling the scrambled information; and

an information receiving apparatus, to and from which said storage medium is attachable and detachable, for receiving the scrambled information transmitted from said information transmitting apparatus, wherein

said information transmitting apparatus includes (i) scramble means for scrambling information by using a plurality of scramble keys, and (ii) transmission means for transmitting scrambled information scrambled by said scramble means, and transmitting at least one of said plurality of scramble keys as a descramble key; and

said information receiving apparatus including (i) reception means for receiving said scrambled information and said at least one of said plurality of scramble keys, which are transmitted by said transmission means, (ii) descramble means for descrambling said scrambled information received by said reception means, by means of a plurality of descramble keys including said descramble keys stored in said storage medium and said at least one of said plurality of scramble keys which is received by said reception means; (iii) display means for displaying said information descrambled by said descramble means.

Preferably the said transmission means transmits said scrambled information and descramble keys multiplexed on an FM broadcast radio wave; and said reception means receives the scrambled information and descramble keys transmitted by said transmission means transmitted in such a form as to be multiplexed on the FM broadcast radio wave.

The present invention in still another aspect provides an information transmitting method for transmitting scrambled information to an information receiving apparatus to and from which a storage medium storing at least one descramble key is attachable and detachable, the method including the steps of:

scrambling information by using a plurality of scramble keys including a scramble key corresponding to a

descramble key stored in said storage medium;

transmitting said information scrambled by said scrambling step; and

transmitting, as a descramble key, at least one of said plurality of scramble keys except for at least a scramble key corresponding to the descramble keys stored in said storage medium.

Brief Description of the Drawings

In order that the present invention may be more clearly ascertained, preferred embodiments will now be described, by way of example, with reference to the accompanying drawing in which:

Fig. 1 is a diagram illustrating the general structure of an FM teletext broadcasting system according to the first embodiment of this invention;

Fig. 2 is a perspective view showing the external structures of a service information receiving apparatus and an IC card according to this embodiment.

Fig. 3 is a diagram depicting the internal structure of the IC card according to this embodiment;

Fig. 4 is a block diagram mainly showing the internal circuit structure of the service information receiving apparatus according to this embodiment;

Fig. 5 is a block diagram showing the circuit structure of a service information transmitting apparatus according to this embodiment, which is located in an FM broadcasting station;

FIG. 6 is a diagram showing the transmission signal format of charged service information which is multiplexed on an FM broadcast radio wave according to this embodiment;

FIG. 7 is a diagram showing the transmission signal format of charge-free service information which is multiplexed on an FM broadcast radio wave according to this embodiment;

FIG. 8 is a conceptual diagram illustrating a descrambling operation according to this embodiment;

FIG. 9 is a flowchart illustrating the operation of the service information receiving apparatus according to this embodiment;

FIG. 10 is a conceptual diagram illustrating a descrambling operation according to the second embodiment of this invention;

FIG. 11 is a flowchart illustrating the operation of a service information receiving apparatus according to this embodiment;

FIG. 12 is a conceptual diagram illustrating a descrambling operation according to the third embodiment of this invention;

FIG. 13 is a flowchart illustrating the operation of a service information receiving apparatus according to this embodiment;

FIG. 14 is a conceptual diagram illustrating a descrambling operation according to the fourth

embodiment of this invention;

FIG. 15 is a flowchart illustrating the operation of a service information receiving apparatus according to this embodiment;

FIG. 16 is a conceptual diagram illustrating a descrambling operation according to the fifth embodiment of this invention;

FIG. 17 is a flowchart illustrating the operation of a service information receiving apparatus according to this embodiment;

FIG. 18 is a conceptual diagram illustrating a scrambling operation according to this embodiment; and

FIG. 19 is a flowchart illustrating the operation of a service information transmitting apparatus according to this embodiment.

Best Modes for Carrying Out the Invention

First Embodiment

The first embodiment of the present invention as adapted to an FM teletext broadcasting system will now be described referring to the accompanying drawings.

FIG. 1 shows the structure of the entire system. This system includes an FM broadcasting station 3 which is a service provider to transmit FM broadcast radio waves on which charged and charge-free service information are multiplexed, a service information receiving apparatus 1 for receiving FM broadcast radio waves from the FM broadcasting station 3, an IC

(Integrated Circuit) card 2 as an information storage medium which is attachable to and detachable from the service information receiving apparatus 1 and is used at the time charged service information is received, and a store 4 like a convenience store which sells the IC cards 2. The store 4 has a predetermined contract or the like with a service center 5 for selling the IC cards 2.

The service center 5 is a company which produces charged programs or charged service information as well as a company which issues IC cards 2. Charge programs produced by this service center 5 are sent as charged service information to the FM broadcasting station 3, which transmits the charged programs together with charge-free programs or charge-free service information produced by the FM broadcasting station 3 or the like.

The transfer of charged service information to the FM broadcasting station 3 from the service center 5 can be accomplished by various ways, such as wire broadcasting, radio communication or by means of a magnetic tape on which such charged service information is recorded.

The structures of the service information receiving apparatus 1 and the IC card 2 will now be discussed using FIGS. 2 through 4.

FIG. 2 exemplifies the external structures of the service information receiving apparatus 1 and the IC

card 2. A key input section 6 and a display section 7 as display means to display service information or the like are provided on the top of an apparatus main body 1A having a nearly parallelepiped shape.

The key input section 6 has a character delete key 8, a function select key 9, an alphabet/numeral select key 10 for selecting alphabets or numerals, an icon key 11, alphabet/numeral input keys 12 for inputting alphabets "A" to "Z" or numerals "1" to "0" and mode keys 13 for selecting modes such as information bank, telephone, calculator and secret.

The apparatus main body 1A has a slot 14 provided in one side surface where the IC card 2 as an information storage medium is to be loaded, and has a reception tuning dial, a stereo headphone jack, a volume dial, a power switch, etc. provided on the opposite side (not shown).

FIG. 3 exemplifies the internal structure of the IC card 2. As illustrated in FIG. 2, a plurality of, e.g., nine connectors 15 are laid out at one end of the outer surface of the IC card 2 or the distal end side of the IC card 2 which is to be loaded into the service information receiving apparatus 1. The IC card 2 loaded into the service information receiving apparatus 1 exchanges data with the service information receiving apparatus 1 via the connectors 15.

An EEPROM (Electrically Erasable and Programmable

Read Only Memory) 16 which is a non-volatile memory is provided inside the IC card 2. A half-fixed key (to be discussed later), which is one of descramble keys used to descramble at the time of receiving charged service information, is stored in this EEPROM 16. This half-fixed key is read out to the service information receiving apparatus 1 via the connectors 15 of the IC card 2 loaded in the receiving apparatus 1.

Although this embodiment is so designed that the half-fixed key read from the EEPROM 16 is sent directly to the service information receiving apparatus 1 via the connectors 15, a CPU (Central Processing Unit) may be provided between the EEPROM 16 and the connectors 15 to control the reading of the half-fixed key.

FIG. 4 shows the internal circuit structure of the service information receiving apparatus 1. In this diagram, the service information receiving apparatus 1 has an FM broadcast receiving section 30, which receives FM broadcast radio waves and generates corresponding sounds, and a service information receiving section 40, which performs various processes with respect to the reception of charged and charge-free service information multiplexed on an FM broadcast radio wave received by the FM broadcast receiving section 30.

The FM broadcast receiving section 30 includes an antenna 31 for receiving FM broadcast radio waves,

an FM tuner 32 for tuning FM broadcast radio waves, an FM demodulator 33 for demodulating an FM signal acquired through the FM tuner 32, a stereo demodulator 34 for demodulating the demodulated FM signal to stereo signals, a pair of amplifiers 35a and 35b for amplifying the output signals of the stereo demodulator 34, and a pair of loudspeakers 36a and 36b which outputs sounds in response to the signals amplified by those amplifiers 35a and 35b. When a stereo headphones are connected to the stereo headphone jack, a user can listen to an FM stereo broadcast program through the headphones.

The service information receiving section 40 has an L-MSK (Level controlled Minimum Shift Keying) demodulator 41 connected to the FM demodulator 33, an error correction decoder 42 and a control section 43. The L-MSK demodulator 41 separates service information, digitally modulated in such a way that the levels of the multiplexed signals are changed by 4% to 10% in accordance with the modulation levels of the FM stereo signals L and R and multiplexed on an FM broadcast radio wave, and demodulates the separated service information. The control section 43 performs various processes including descrambling of the demodulated service information.

Connected to this control section 43 are a ROM (Read Only Memory) having stored processing programs

for the control section 43, the aforementioned key input section 6, the aforementioned display section 7, a card processing section 45 for executing information reading from the IC card 2, a reception data memory 47 for storing received data (received information), an input data memory 48 for storing input data (input information) from the key input section 6, a tone generating section 49 like a buzzer for generating an alarm in accordance with the results of the processing by the control section 43, and a reception control section 50 which performs reception tuning of the FM tuner 32 in accordance with the manipulation of the reception tuning dial.

The control section 43, constituted of a CPU or the like, performs a predetermined arithmetic operation using the half-fixed key read from the IC card 2 via the card processing section 45 and a variable key (to be discussed later), affixed to charged service information received via the L-MSK demodulator 41 and the error correction decoder 42, to thereby prepare a new descramble key for descrambling scrambled information. The control section 43 performs a process to descramble charged service information using this new descramble key and displays acquired charged descrambled information on the display section 7.

FIG. 5 shows the structure of a service information transmitting apparatus 70 located in the FM broadcasting

station 3. This service information transmitting apparatus 70 has a transmitting section 71, a data processing section 72 and a multiplexing section 73.

The transmitting section 71 includes a stereo modulator 74 for performing stereo modulation of voice information, an FM modulator 75 for FM modulation of modulated stereo signals, and a transmitter 76 for transmitting the modulated FM signals as FM broadcast radio waves from an antenna 77.

The data processing section 72 performs various processes, such as a process to affix predetermined data to input charged and charge-free service information and a process to scramble (encode) charged service information.

The multiplexing section 73 includes an error correction code adding unit 78 for affixing an error correction code to charged and charge-free service information, which has been processed by the data processing section 72, and an L-MSK modulator 79 for subjecting the service information affixed with the error correction code to digital modulation in which the levels of multiplexed signals are changed by 4% to 10% in accordance with the modulation levels of the FM stereo signals L and R, so that the service information is multiplexed on the stereo signals.

The transmission signal format of charged service information which is to be multiplexed on the FM

broadcast radio wave will be described with reference to FIG. 6. FIG. 6 shows the transmission signal format of charged service information; a packet number at the head indicates the number of a packet assigned to each service information.

In the data block in the packet with the packet number "0," a "program number" representing the type of service information, a "charge code" indicating charged service information and a variable key as one of descramble keys used to descramble scrambled information are provided.

Since the content of this variable key is variably set in accordance with, for example, the date and/or time, the descramble key to be prepared on the reception side can be altered. In packets whose packet number is "1" or more, actual charged service information, which is scrambled, is sequentially arranged in each data block of the packets.

FIG. 7 shows the transmission signal format of charge-free service information. A packet number at the head, like one in Fig. 6, indicates the number of a packet assigned to each service information.

In the data block in the packet with the packet number "0," a "program number" representing the type of service information, a "charge-free code" indicating charge-free service information are provided.

In packets whose packet number is "1" or more,

actual charge-free service information, which is not scrambled unlike the charged service information in FIG. 6, is sequentially arranged in each data block of the packets.

The operation of the first embodiment will be described below.

In this embodiment, at the time charged service information is received, as shown in FIG. 8, a predetermined arithmetic operation is performed using the half-fixed key read from the IC card 2 and the variable key (see FIG. 6) in the top packet of the received charged service information to prepare a new descramble key. And the charged service information is descrambled using this new descramble key to acquire descrambled charged service information. The sequence of procedures is illustrated in FIG. 9.

FIG. 9 exemplifies the operation that the control section 43 performs based on the processing programs stored in the ROM 44 at the time of receiving service information. At the beginning, the control section 45 waits for the reception of service information, regardless of whether it is charged or charge-free type (step A1). After the reception of service information is determined, it is then determined whether or not the service information is charged one by checking a charge code is present in the data block of the packet (step A2).

When it is determined that the charge code is not present in the associated field and a charge-free code is placed there instead so that the received service information is free, not charged, the service information is not scrambled. Therefore, the charge-free service information is sequentially sent directly to the display section 7 to be displayed and is also stored in the reception data memory 47 (step A7).

When it is determined in the aforementioned step A2 that the charge code is located at the associated position and the received service information is charged, it is then determined if the IC card 2 is loaded (step A3).

When it is determined that no IC card 2 is loaded, the half-fixed key cannot be read from the IC card 2, disabling the preparation of a descramble key to descramble the scrambled charged information, so that this reception process is terminated.

When it is determined that the IC card 2 is loaded, on the other hand, the half-fixed key is read from the IC card 2 via the card processing section 45 and a predetermined arithmetic operation is executed using this half-fixed key and the variable key in the top packet of the received charged service information, thereby preparing a new descramble key for descrambling the scrambled information (step A4).

Then, this prepared descramble key is used to

descramble the scrambled charged service information to acquire descrambled charged service information (step A5). Subsequently, the acquired charged service information is sequentially sent to the display section 7 to be displayed and is also stored in the reception data memory 47 (step A6).

In short, a predetermined arithmetic operation is performed using the half-fixed key read from the IC card 2 loaded into the service information receiving apparatus 1 and the variable key affixed to received charged service information to prepare a new descramble key, and the descrambling process is executed using this prepared descramble key to acquire descrambled charged service information. It is therefore possible to surely prevent unauthorized viewing of charged service information.

Second Embodiment

With reference to the accompanying drawings, a description will now be given of the second embodiment of this invention as adapted to an FM teletext broadcasting system.

The general system structure, the structure of the service information receiving apparatus, the structure of an IC card to be loaded into this apparatus, the structure of the service information transmitting apparatus which is located in an FM broadcasting station and the transmission signal format of service

information to be multiplexed on an FM broadcast radio wave are the same as those illustrated in FIGS. 1 through 7. To avoid the redundant description, therefore, like or same reference numerals are given to those components which are the same as the corresponding components of the first embodiment.

It is assumed that a fixed key 44a, one of descramble keys which is used together with the half-fixed key read from the IC card 2 and the variable key affixed to the received charged service information to descramble charged service information is stored in advance in the ROM 44 in the service information receiving apparatus 1 as indicated by a broken line in FIG. 4.

The operation of the second embodiment will be described below.

In this embodiment, at the time charged service information is received, as shown in FIG. 10, descrambling is performed step by step using the fixed key stored in the ROM 44, the half-fixed key read from the IC card 2 and the variable key in the top packet of the received charged service information to descramble the scrambled charged service information, thus yielding descrambled charged service information. The sequence of procedures is illustrated in FIG. 11.

FIG. 11 exemplifies the operation that the control section 43 performs based on the processing programs

stored in the ROM 44 at the time of receiving service information. At the beginning, the control section 45 waits for the reception of service information, regardless of whether it is charged or charge-free type (step B1). After the reception of service information is determined, it is then determined whether or not the service information is charged one by checking a charge code is present in the data block of the packet (step B2).

When it is determined that the charge code is not present in the associated field and a charge-free code is placed there instead so that the received service information is free, not charged, the service information is not scrambled. Therefore, the charge-free service information is sequentially sent directly to the display section 7 to be displayed and is also stored in the reception data memory 47 (step B8).

When it is determined in the aforementioned step B2 that the charge code is located at the associated position and the received service information is charged, it is then determined if the IC card 2 is loaded (step B3).

When it is determined that no IC card 2 is loaded, the half-fixed key cannot be read from the IC card 2, disabling the descrambling of the scrambled charged information, so that this reception process is terminated.

When it is determined that the IC card 2 is loaded, on the other hand, the half-fixed key is read from the IC card 2 via the card processing section 45 and a variable key following the charge code in the top packet of the received charged service information is fetched (step B4).

Then, a first descrambling process is performed on the received charged service information using the fixed key stored in the ROM 44 (step B5), and a second descrambling process is performed on the processed data using the half-fixed key read from the IC card 2 (step B6).

Further, a third descrambling process is performed on the processed data using the variable key affixed to the received charged service information to acquire completely descrambled charged service information (step B7). Next, the acquired charged service information is sequentially sent to the display section 7 to be displayed and is also stored in the reception data memory 47 (step B8), then this processing is terminated.

As apparent from the above, descramble processing is executed step by step using the fixed key prestored in the ROM 44, the half-fixed key read from the IC card 2 loaded into the service information receiving apparatus 1 and the variable key affixed to received charged service information to finally acquire

descrambled charged service information. It is therefore possible to surely prevent unauthorized viewing of charged service information.

Third Embodiment

With reference to the accompanying drawings, a description will now be given of the third embodiment of this invention as adapted to an FM teletext broadcasting system.

The general system structure, the structure of the service information receiving apparatus, the structure of an IC card to be loaded into this apparatus, the structure of the service information transmitting apparatus which is located in an FM broadcasting station and the transmission signal format of service information to be multiplexed on an FM broadcast radio wave are the same as those illustrated in FIGS. 1 through 7. To avoid the redundant description, therefore, like or same reference numerals are given to those components which are the same as the corresponding components of the first embodiment.

It is assumed that the fixed key 44a, one of descramble keys which is used together with the half-fixed key read from the IC card 2 and the variable key affixed to the received charged service information to descramble charged service information is stored in advance in the ROM 44 in the service information receiving apparatus 1 as indicated by a broken line in

FIG. 4.

The operation of the third embodiment will be described below.

In this embodiment, at the time charged service information is received, as shown in FIG. 12, a predetermined arithmetic operation is performed using the half-fixed key read from the IC card 2 and the variable key in the top packet of the received charged service information to prepare a new descramble key, and descrambling is executed step by step using this prepared descramble key and the fixed key stored in the ROM 44 to descramble the scrambled charged service information, thus obtaining descrambled charged service information. The sequence of procedures is illustrated in FIG. 13.

FIG. 13 exemplifies the operation that the control section 43 performs based on the processing programs stored in the ROM 44 at the time of receiving service information. At the beginning, the control section 45 waits for the reception of service information, regardless of whether it is charged or charge-free type (step C1). After the reception of service information is determined, it is then determined whether or not the service information is charged one by checking a charge code is present in the data block of the packet (step C2).

When it is determined that the charge code is not

present in the associated field and a charge-free code is placed there instead so that the received service information is free, not charged, the service information is not scrambled. Therefore, the charge-free service information is sequentially sent directly to the display section 7 to be displayed and is also stored in the reception data memory 47 (step C8).

When it is determined in the aforementioned step C2 that the charge code is located at the associated position and the received service information is charged, it is then determined if the IC card 2 is loaded (step C3).

When it is determined that no IC card 2 is loaded, the half-fixed key cannot be read from the IC card 2, disabling the preparation of a descramble key to descramble the scrambled charged information, so that this reception process is terminated.

When it is determined that the IC card 2 is loaded, on the other hand, the half-fixed key is read from the IC card 2 via the card processing section 45 and a variable key following the charge code in the top packet of the received charged service information is fetched (step C4).

Then, a predetermined arithmetic operation is executed using the acquired half-fixed key and variable key to prepare a new descramble key for descrambling the scrambled information (step C5), and a first

descrambling process is performed on the received charged service information using this prepared descramble key (step C6).

Further, a second descrambling process is performed on the processed data using the fixed key stored in the ROM 44 to acquire completely descrambled charged service information (step C7). Subsequently, the acquired charged service information is sequentially sent to the display section 7 to be displayed and is also stored in the reception data memory 47 (step C8), then this processing is terminated.

As apparent from the above, a new descramble key is prepared by using the half-fixed key read from the IC card 2 loaded into the service information receiving apparatus 1 and the variable key affixed to received charged service information, and descramble processing is executed step by step using the prepared descramble key and the fixed key stored in the ROM 44 to finally acquire descrambled charged service information. It is therefore possible to surely prevent unauthorized viewing of charged service information.

Fourth Embodiment

With reference to the accompanying drawings, a description will now be given of the fourth embodiment of this invention as adapted to an FM teletext broadcasting system.

The general system structure, the structure of the

service information receiving apparatus, the structure of an IC card to be loaded into this apparatus, the structure of the service information transmitting apparatus which is located in an FM broadcasting station and the transmission signal format of service information to be multiplexed on an FM broadcast radio wave are the same as those illustrated in FIGS. 1 through 7. To avoid the redundant description, therefore, like or same reference numerals are given to those components which are the same as the corresponding components of the first embodiment.

It is assumed that the fixed key 44a, one of descramble keys which is used together with the half-fixed key read from the IC card 2 and the variable key affixed to the received charged service information to descramble charged service information is stored in advance in the ROM 44 in the service information receiving apparatus 1 as indicated by a broken line in FIG. 4.

The operation of the fourth embodiment will be described below.

In this embodiment, at the time charged service information is received, as shown in FIG. 14, a predetermined arithmetic operation is performed step by step using the fixed key stored in the ROM 44, the half-fixed key read from the IC card 2 and the variable key in the top packet of the received charged service

information to prepare a new descramble key, a descrambling process is performed on scrambled charged service information by using the prepared descramble key, thus obtaining descrambled charged service information. The sequence of procedures is illustrated in FIG. 15.

FIG. 15 exemplifies the operation that the control section 43 performs based on the processing programs stored in the ROM 44 at the time of receiving service information. At the beginning, the control section 45 waits for the reception of service information, regardless of whether it is charged or charge-free type (step D1). After the reception of service information is determined, it is then determined whether or not the service information is charged one by checking a charge code is present in the data block of the packet (step D2).

When it is determined that the charge code is not present in the associated field and a charge-free code is placed there instead so that the received service information is free, not charged, the service information is not scrambled. Therefore, the charge-free service information is sequentially sent directly to the display section 7 to be displayed and is also stored in the reception data memory 47 (step D7).

When it is determined in the aforementioned step D2 that the charge code is located at the

associated position and the received service information is charged, it is then determined if the IC card 2 is loaded (step D3).

When it is determined that no IC card 2 is loaded, the half-fixed key cannot be read from the IC card 2, disabling the preparation of a new descramble key to be used to descramble the scrambled charged information, so that this reception process is terminated.

When it is determined that the IC card 2 is loaded, on the other hand, the half-fixed key is read from the IC card 2 via the card processing section 45 and a variable key following the charge code in the top packet of the received charged service information is fetched (step D4).

Then, a new descramble key for descrambling scrambled information is prepared by using the fixed key stored in the ROM 44 and the acquired half-fixed key and variable key (step D5), and descrambling of received charged service information is performed using the prepared descramble key to thereby acquire descrambled charged service information (step D6). Then, the thus acquired charged service information is sequentially sent to the display section 7 to be displayed and is also stored in the reception data memory 47 (step D7). This processing is then terminated.

In short, a new descramble key is prepared by

using the fixed key prestored in the ROM 44, the half-fixed key read from the IC card 2 loaded into the service information receiving apparatus 1 and the variable key affixed to received charged service information, and descramble processing is executed using this prepared descramble key to acquire descrambled charged service information. It is therefore possible to surely prevent unauthorized viewing of charged service information.

Fifth Embodiment

With reference to the accompanying drawings, a description will now be given of the fifth embodiment of this invention as adapted to an FM teletext broadcasting system.

The general system structure, the structure of the service information receiving apparatus, the structure of an IC card to be loaded into this apparatus, the structure of the service information transmitting apparatus which is located in an FM broadcasting station and the transmission signal format of service information to be multiplexed on an FM broadcast radio wave are the same as those illustrated in FIGS. 1 through 7 except that no IC card is used in this embodiment. To avoid the redundant description, therefore, like or same reference numerals are given to those components which are the same as the corresponding components of the first embodiment.

It is assumed that the fixed key 44a, one of descramble keys which is used together with the variable key affixed to the received charged service information to descramble charged service information is stored in advance in the ROM 44 in the service information receiving apparatus 1 as indicated by a broken line in FIG. 4. The fixed key 44a consists of a first fixed key and a second fixed key.

The operation of the fifth embodiment will be described below.

In this embodiment, at the time charged service information is received, as shown in FIG. 16, a predetermined arithmetic operation is performed using the first fixed key stored in the ROM 44 and the variable key in the top packet of the received charged service information to prepare a new descramble key, descrambling is executed step by step using this prepared descramble key and the second fixed key stored in the ROM 44 to descramble the scrambled charged service information. As a result, descrambled charged service information is acquired. The sequence of procedures is illustrated in FIG. 17.

FIG. 17 exemplifies the operation that the control section 43 performs based on the processing programs stored in the ROM 44 at the time of receiving service information. At the beginning, the control section 45 waits for the reception of service information,

regardless of whether it is charged or charge-free type (step E1). After the reception of service information is determined, it is then determined whether or not the service information is charged one by checking a charge code is present in the data block of the packet (step E2).

When it is determined that the charge code is not present in the associated field and a charge-free code is placed there instead so that the received service information is free, not charged, the service information is not scrambled. Therefore, the charge-free service information is sequentially sent directly to the display section 7 to be displayed and is also stored in the reception data memory 47 (step E8).

When it is determined in the aforementioned step E2 that the charge code is located at the associated position and the received service information is charged, the variable key following the charge code in the top packet of the received charged service information is fetched (step E3).

Then, a predetermined arithmetic operation is executed using the first fixed key stored in the ROM and the variable key to prepare a new descramble key (step E4), and a first descrambling process is performed on the received charged service information using this prepared descramble key (step E5).

Further, a second descrambling process is

performed using the second fixed key stored in the ROM 44 to acquire completely descrambled charged service information (step E6). Subsequently, the acquired charged service information is sequentially sent to the display section 7 to be displayed and is also stored in the reception data memory 47 (step E7), then this processing is terminated.

As apparent from the above, a new descramble key is prepared by using the first fixed key prestored in the ROM 44 and the variable key affixed to the received charged service information, and descramble processing is executed step by step using this prepared descramble key and the second fixed key stored in the ROM 44 to finally acquire descrambled charged service information. It is therefore possible to surely prevent unauthorized viewing of charged service information.

A process of transmitting charged service information in the service information transmitting apparatus 70 according to the fifth embodiment, though omitted in the foregoing description of the first to fourth embodiments, will be discussed below with reference to the accompanying drawings.

At the time scrambling of charged service information is executed by the data processing section 72 in the service information transmitting apparatus 70, the aforementioned variable, first fixed key and second fixed key are used as scramble keys.

At the time charged service information is transmitted in this embodiment, as shown in FIG. 18, scramble processing is executed step by step by using the second fixed key and a new scramble key, which has been prepared by performing a predetermined arithmetic operation using the first fixed key and the variable key, to descramble charged service information, and then the descrambled charged service information to which a variable key or the like is affixed is transmitted. The sequence of procedures is illustrated in FIG. 19.

FIG. 18 exemplifies the transmission of service information performed by the service information transmitting apparatus 70. At the beginning, first scramble processing is performed on charged service information input to the data processing section 72 using the second fixed key (step SF1).

Further, a predetermined arithmetic operation is performed using the first fixed key and variable key to prepare a new scramble key to scramble service information (step SF2), and second scramble processing is performed on the data processed in the first scramble processing by using the prepared scramble key (step SF3).

As shown in FIG. 6, after a program number, a charge code and a variable key are affixed to the head of charged service information undergone the scramble

processing and a packet number is affixed to the head of each packet, charged service information is transmitted as an FM broadcast radio wave via the multiplexing section 72 and the transmitting section 71 (step SF4), and then the transmission process is terminated.

In short, scramble processing is executed step by step by using the second fixed key and a new scramble key, which has been prepared by the first fixed key and variable key, a variable key is then affixed to the resultant service information to acquire scrambled charged service information to be transmitted. It is therefore possible to surely prevent unauthorized viewing of charged service information.

Although the foregoing description of the individual embodiments has been given with reference to the case where service information is multiplexed on an FM broadcast radio wave, this invention is not limited to this particular case but can be adapted to various communication and broadcasting systems using wire broadcasting and radio communication.

A storage medium to be installed in the main body of the receiving apparatus may take other forms than an IC card, such as a coin-like chip, a stamp-like IC chip and a card having a bar code printed thereon.

Although an arithmetic operation is performed using a plurality of descramble keys to prepare a new

descramble key in the above-described embodiments, a simple converting process or the like may be used as long as a plurality of descramble keys are used to prepare a new descramble key.

A descramble key to be affixed to scrambled charged service information which is to be transmitted from the transmission side may be altered not only in accordance with the date and time or the like but also in accordance with other various conditions. In this case, even if the descramble key is decoded through an unauthorized manner on the reception side, the transmission side can alter a descramble key to be affixed to scrambled charged service information to be transmitted, thus changing the descramble key on the reception side. This can prevent an unauthorized use of the descramble key.

The position of the descramble key in each packet of charged service information to be transmitted is not limited to the head of the packet, but may be changed as needed.

Therefore, the present examples and embodiments are to be considered as illustrative and not restrictive and the invention is not to be limited to the details given herein, but may be modified in various forms within the scope of the appended claims.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. An information receiving apparatus including:

reception means for receiving scrambled information;

a receiving apparatus main body to and from which a storage medium having stored a descramble key for descrambling said scrambled information is attachable and detachable;

descramble means for descrambling said scrambled information received by said reception means by using a plurality of descramble keys including said descramble key stored in said storage medium; and

display means for displaying said information descrambled by said descramble means.

2. An information receiving apparatus as claimed in claim 1, wherein said reception means receives said scrambled information multiplexed on an FM broadcast radio wave.

3. An information receiving apparatus as claimed in either claim 1 or 2, further including storage means provided in the receiving apparatus main body, for previously storing a fixed descramble key; and

wherein said reception means further includes means for receiving a descramble key, and

said descramble means is used to descramble said scrambled information received by said reception means using the descramble key stored in said storage medium, the descramble key received by said reception means and the descramble key stored in said storage means.

4. An information receiving apparatus as claimed in claim 1, wherein said descramble means includes descramble key preparing means for performing a predetermined process by using two or more of said plurality of descramble keys to prepare a new descramble key; and

said descramble key prepared by said descramble key preparing means is used to descramble said scrambled

information.

5. An information receiving apparatus as claimed in claim 4, wherein said two or more of said plurality of descramble keys include said descramble key stored in said storage medium.

6. An information receiving apparatus as claimed in either claim 4 or 5 wherein:

said reception means includes receiving means for receiving a descramble key;

at least one of said plurality of descramble keys is received by said receiving means; and

the two or more of said plurality of descramble keys used when said descramble key preparing means prepares the new descramble key include the descramble key received by said receiving means.

7. An information receiving apparatus as claimed in any one of claims 4 to 6, further including storage means provided in a receiving apparatus main body, for previously storing descramble keys wherein at least one of said plurality of descramble keys is a descramble key stored in said storage means, and said two or more of said plurality of descramble keys include said descramble key stored in said storage means.

8. An information transmitting apparatus including:

scramble means for scrambling information by using a plurality of scramble keys; and

transmission means for transmitting scrambled information scrambled by said scramble means and transmitting scramble keys except for at least one of said scramble keys as descramble key;

wherein at least one of the scramble keys which is not transmitted by said transmission means is a descramble key stored in a storage medium which is attachable and detachable with respect to information receiving apparatus used to receive the scrambled information transmitted by said transmission means and descramble keys, and said transmission means is used to

transmit said scrambled information and said descramble key multiplexed on an FM broadcast radio wave.

9. An information transmitting apparatus as claimed in claim 8, wherein at least one of the scramble keys which is not transmitted by said transmission means is a descramble key stored in a storage means provided in said information receiving apparatus used to receive the scrambled information transmitted by said transmission means and descramble keys.

10. An information transmitting apparatus as claimed in claim 8, wherein said scramble means includes scramble key preparing means for performing a predetermined process by using two or more of said plurality of scramble keys to prepare a new scramble key, for scrambling information.

11. An information transmitting apparatus as claimed in claim 10, wherein said transmission means transmits said two or more of said plurality of scramble keys as descramble keys.

12. A storage medium, attachable to and detachable from an information receiving apparatus for receiving scrambled information, including:

storage means for storing one or more descramble keys except for at least one of a plurality of descramble keys used for descrambling said scrambled information received by said information receiving apparatus; and

interface means for interfacing with said information receiving apparatus;

wherein at least one of descramble keys which are not stored in said storage means is a descramble key received by said information receiving apparatus or a descramble key previously and fixedly stored in a main body of said information receiving apparatus, and said storage medium is attachable to and detachable from an FM multiplex broadcast receiving apparatus for receiving the scrambled information transmitted in such a form as to be multiplexed on an FM broadcast radio wave.

13. An information transmitting and receiving system

including:

an information transmitting apparatus for transmitting scrambled information;

a storage medium for storing a descramble key for use in descrambling the scrambled information; and

an information receiving apparatus, to and from which said storage medium is attachable and detachable, for receiving the scrambled information transmitted from said information transmitting apparatus, wherein

said information transmitting apparatus includes (i) scramble means for scrambling information by using a plurality of scramble keys, and (ii) transmission means for transmitting scrambled information scrambled by said scramble means, and transmitting at least one of said plurality of scramble keys as a descramble key; and

said information receiving apparatus including (i) reception means for receiving said scrambled information and said at least one of said plurality of scramble keys, which are transmitted by said transmission means, (ii) descramble means for descrambling said scrambled information received by said reception means, by means of a plurality of descramble keys including said descramble keys stored in said storage medium and said at least one of said plurality of scramble keys which is received by said reception means; (iii) display means for displaying said information descrambled by said descramble means.

14. An information transmitting and receiving system as claimed in claim 13, wherein said transmission means transmits said scrambled information and descramble keys multiplexed on an FM broadcast radio wave; and said reception means receives the scrambled information and descramble keys transmitted by said transmission means transmitted in such a form as to be multiplexed on the FM broadcast radio wave.

15. An information transmitting and receiving system as claimed in claim 14, wherein said descramble means uses,

as said plurality of descramble keys, said plurality of scramble keys that are used when said scramble means scrambles said information.

16. An information transmitting method for transmitting scrambled information to an information receiving apparatus to and from which a storage medium storing at least one descramble key is attachable and detachable, the method including the steps of:

scrambling information by using a plurality of scramble keys including a scramble key corresponding to a descramble key stored in said storage medium;

transmitting said information scrambled by said scrambling step; and

transmitting, as a descramble key, at least one of said plurality of scramble keys except for at least a scramble key corresponding to the descramble key stored in said storage medium.

17. An information receiving apparatus substantially as hereinbefore described with reference to figures 1 to 9 or to figures 10 and 11 or to figures 12 and 13 or to figures 14 and 15 or to figures 16 to 19 of the accompanying drawing.

18. An information transmitting apparatus substantially as hereinbefore described with reference to figures 1 to 9 or to figures 10 and 11 or to figures 12 and 13 or to figures 14 and 15 or to figures 16 to 19 of the accompanying drawing.

19. A storage medium attachable to and detachable from an information receiving apparatus for receiving scrambled information substantially as hereinbefore described with reference to figures 1 to 9 or to figures 10 and 11 or to figures 12 and 13 or to figures 14 and 15 or to figures 16 to 19 of the accompanying drawing.

20. An information transmitting and receiving system substantially as hereinbefore described with reference to figures 1 to 9 or to figures 10 and 11 or to figures 12 and 13 or to figures 14 and 15 or to figures 16 to 19 of the

accompanying drawing.

21. An information receiving method substantially as hereinbefore described with reference to figures 1 to 9 or to figures 10 and 11 or to figures 12 and 13 or to figures 14 and 15 or to figures 16 to 19 of the accompanying drawing.

22. An information transmitting method substantially as hereinbefore described with reference to figures 1 to 9 or to figures 10 and 11 or to figures 12 and 13 or to figures 14 and 15 or to figures 16 to 19 of the accompanying drawing.

Dated this 28th day of May 1999
CASIO COMPUTER CO., LTD and
TOKYO FM BROADCASTING CO., LTD
By their Patent Attorneys
GRIFFITH HACK
Fellows Institute of Patent
Attorneys of Australia

FIG.1

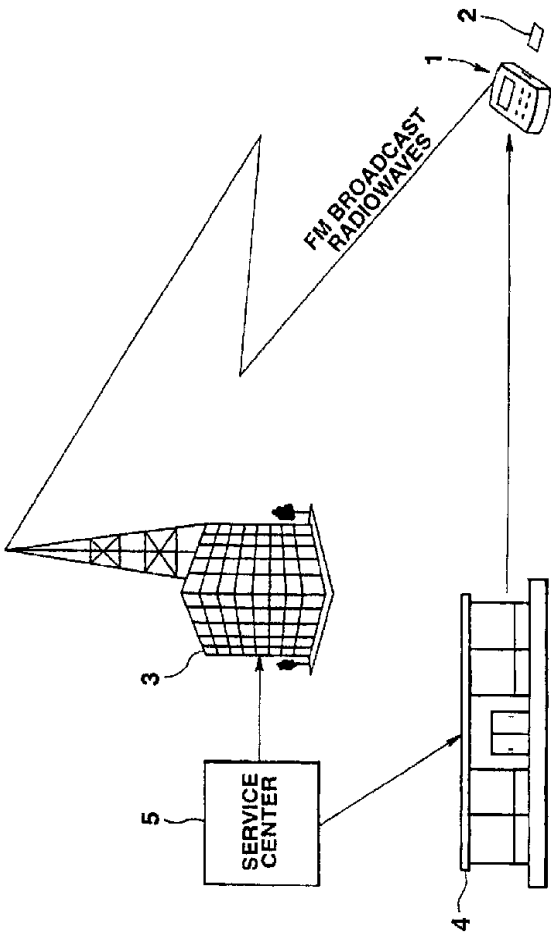


FIG.2

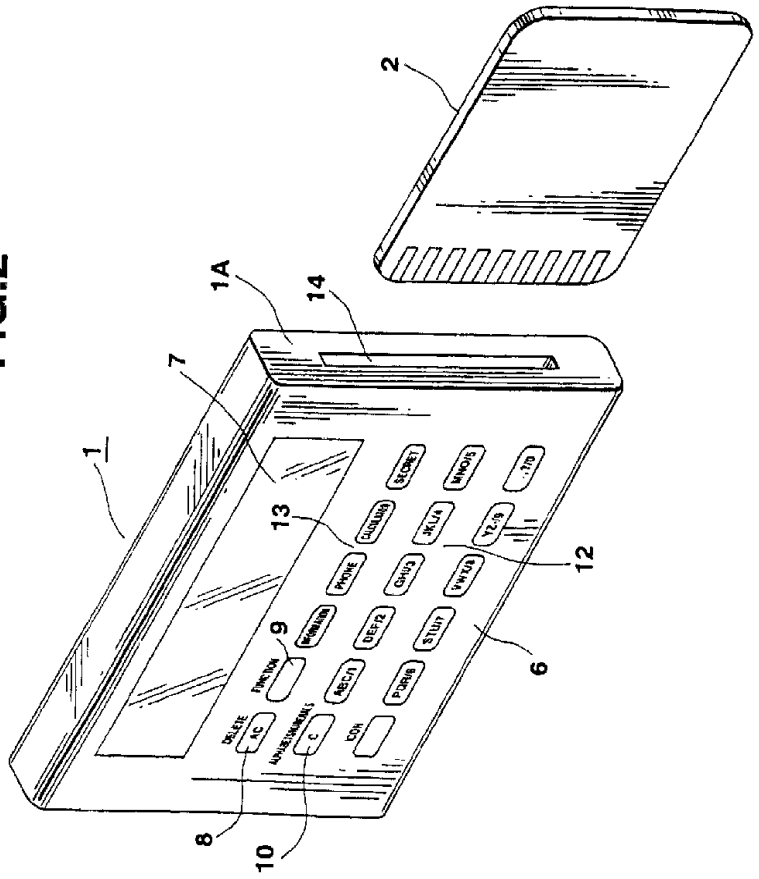


FIG.3

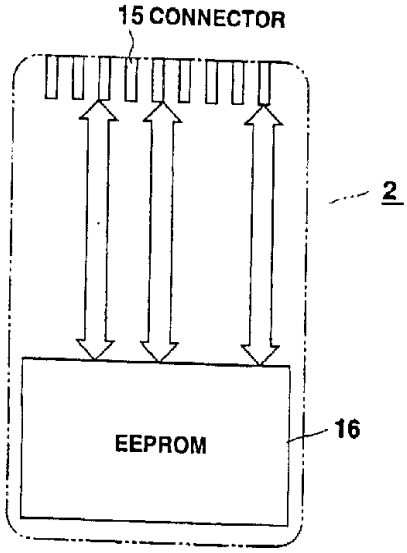


FIG.4

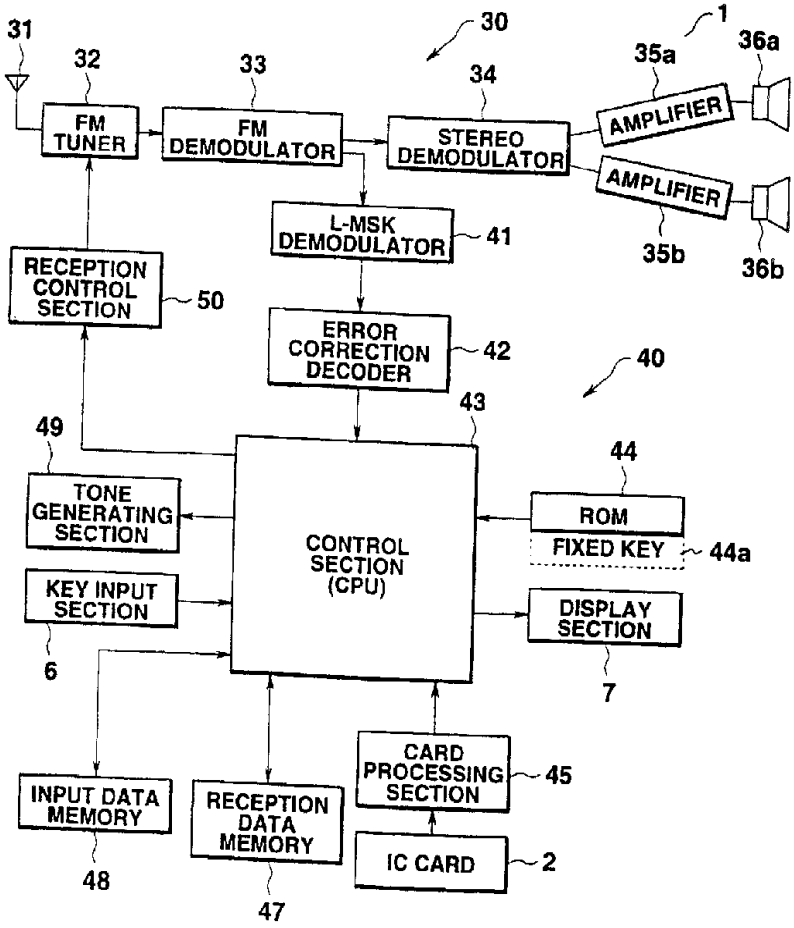

31
32
33
30
34
1
35a
36a
FM TUNER
FM DEMODULATOR
STEREO DEMODULATOR
AMPLIFIER
AMPLIFIER
35b
36b
L-MSK DEMODULATOR
41
RECEPTION CONTROL SECTION
50
ERROR CORRECTION DECODER
42
40
43
49
44
TONE GENERATING SECTION
CONTROL SECTION (CPU)
ROM
FIXED KEY
44a
KEY INPUT SECTION
6
DISPLAY SECTION
7
CARD PROCESSING SECTION
45
INPUT DATA MEMORY
48
RECEPTION DATA MEMORY
47
IC CARD
2

FIG.5

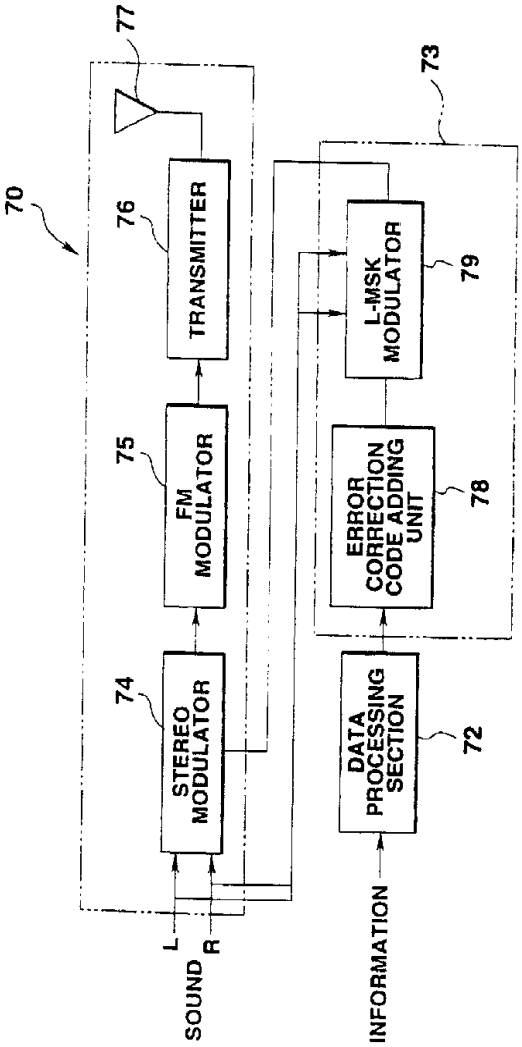

70
77
76
TRANSMITTER
75
FM MODULATOR
74
STEREO MODULATOR
L
R
SOUND
73
L-MSK MODULATOR
79
ERROR CORRECTION CODE ADDING UNIT
78
DATA PROCESSING SECTION
72
INFORMATION

FIG.6

CHARGED SERVICE INFORMATION

PACKET NUMBER	DATA BLOCK			
0	PROGRAM NUMBER	CHARGE CODE	VARIABLE CODE	
1	SCRAMBLED DATA			
2	SAME AS ABOVE			

:

FIG.7

CHARGE-FREE SERVICE INFORMATION

PACKET NUMBER	DATA BLOCK		
0	PROGRAM NUMBER	CHARGE -FREE CODE	
1			
2			

:

FIG.8

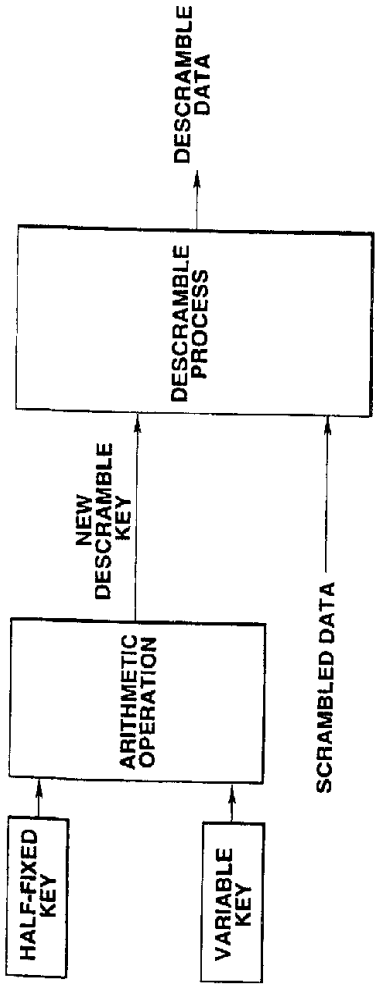

DESCRAMBLE DATA
DESCRAMBLE PROCESS
NEW DESCRAMBLE KEY
ARITHMETIC OPERATION
SCRAMBLED DATA
HALF-FIXED KEY
VARIABLE KEY

FIG.9

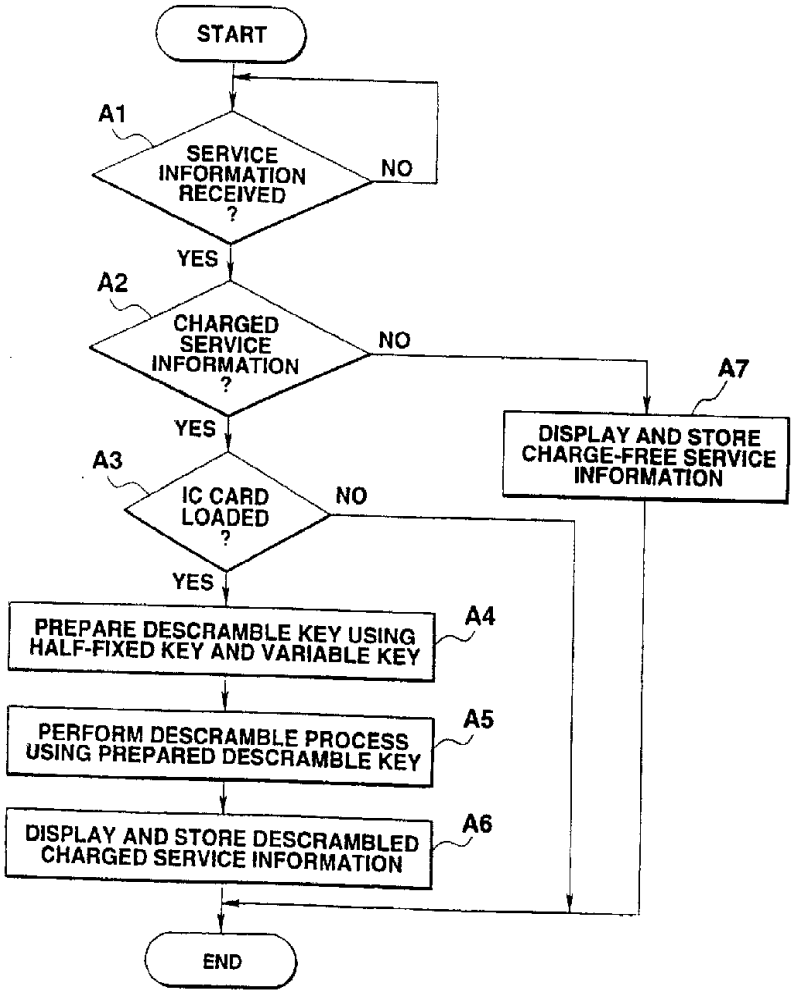

START
A1
SERVICE INFORMATION RECEIVED ?
NO
YES
A2
CHARGED SERVICE INFORMATION ?
NO
A7
DISPLAY AND STORE CHARGE-FREE SERVICE INFORMATION
YES
A3
IC CARD LOADED ?
NO
YES
PREPARE DESCRAMBLE KEY USING HALF-FIXED KEY AND VARIABLE KEY
A4
PERFORM DESCRAMBLE PROCESS USING PREPARED DESCRAMBLE KEY
A5
DISPLAY AND STORE DESCRAMBLED CHARGED SERVICE INFORMATION
A6
END

FIG.10

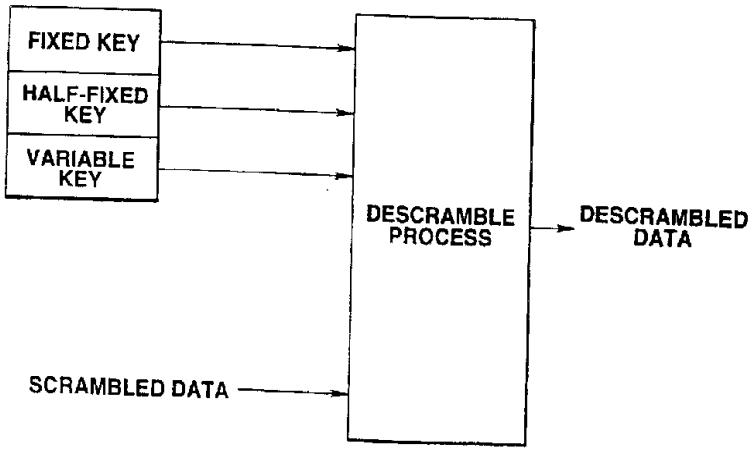

FIXED KEY
HALF-FIXED KEY
VARIABLE KEY
DESCRAMBLE PROCESS
DESCRAMBLED DATA
SCRAMBLED DATA

FIG.11

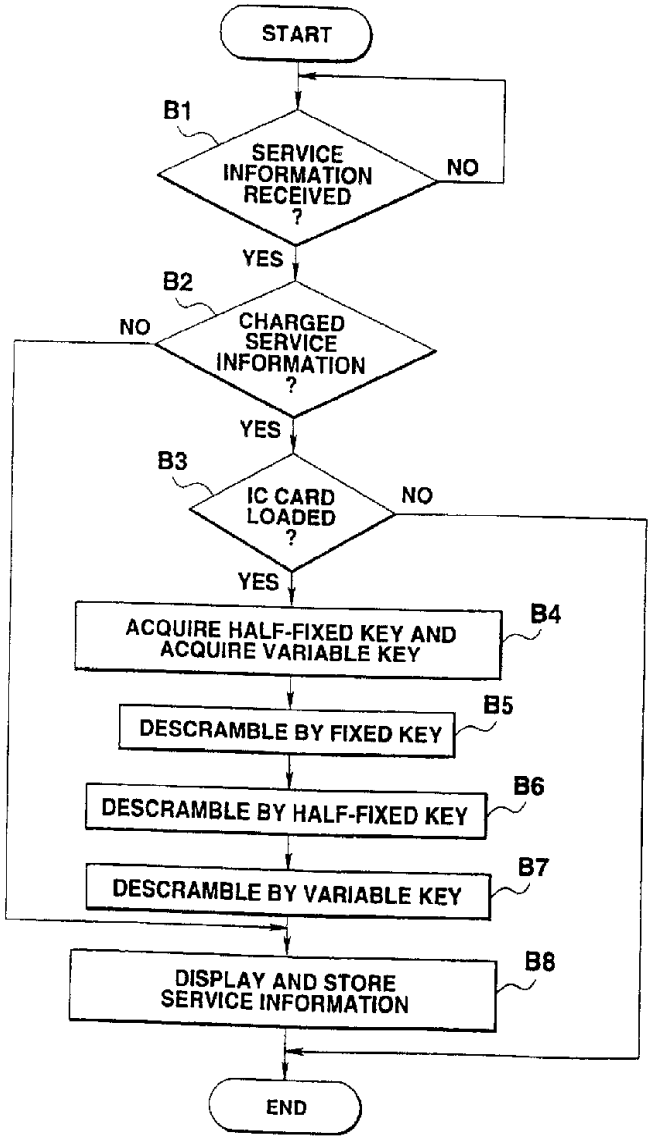

START
B1
SERVICE INFORMATION RECEIVED ?
NO
YES
B2
CHARGED SERVICE INFORMATION ?
NO
YES
B3
IC CARD LOADED ?
NO
YES
ACQUIRE HALF-FIXED KEY AND ACQUIRE VARIABLE KEY
B4
DESCRAMBLE BY FIXED KEY
B5
DESCRAMBLE BY HALF-FIXED KEY
B6
DESCRAMBLE BY VARIABLE KEY
B7
DISPLAY AND STORE SERVICE INFORMATION
B8
END

FIG.12

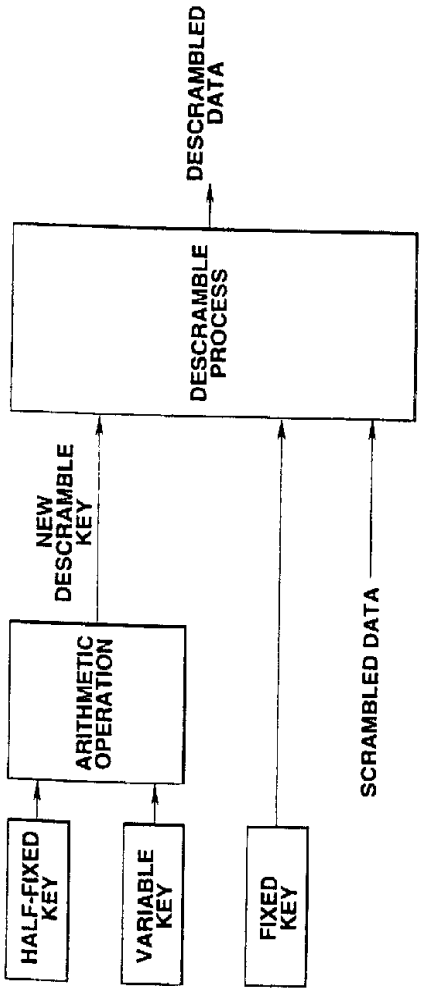

DESCRAMBLED DATA
DESCRAMBLE PROCESS
NEW DESCRAMBLE KEY
ARITHMETIC OPERATION
SCRAMBLED DATA
HALF-FIXED KEY
VARIABLE KEY
FIXED KEY

FIG.13

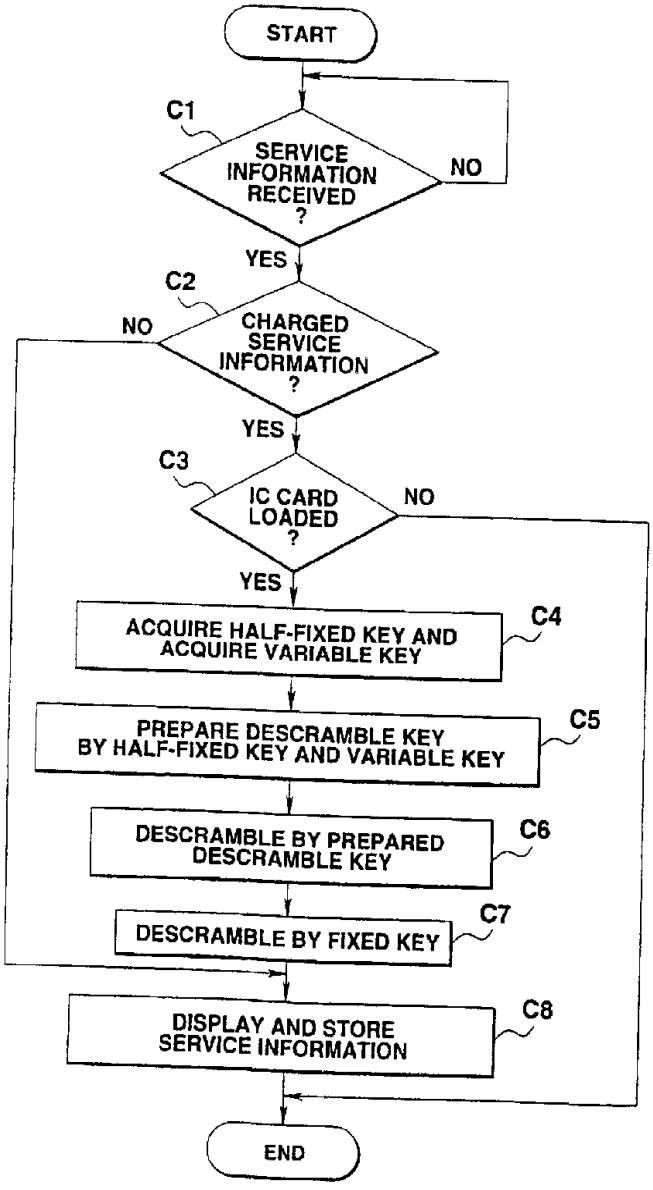

START
C1
SERVICE INFORMATION RECEIVED ?
NO
YES
C2
CHARGED SERVICE INFORMATION ?
NO
YES
C3
IC CARD LOADED ?
NO
YES
ACQUIRE HALF-FIXED KEY AND ACQUIRE VARIABLE KEY
C4
PREPARE DESCRAMBLE KEY BY HALF-FIXED KEY AND VARIABLE KEY
C5
DESCRAMBLE BY PREPARED DESCRAMBLE KEY
C6
DESCRAMBLE BY FIXED KEY
C7
DISPLAY AND STORE SERVICE INFORMATION
C8
END

FIG.14

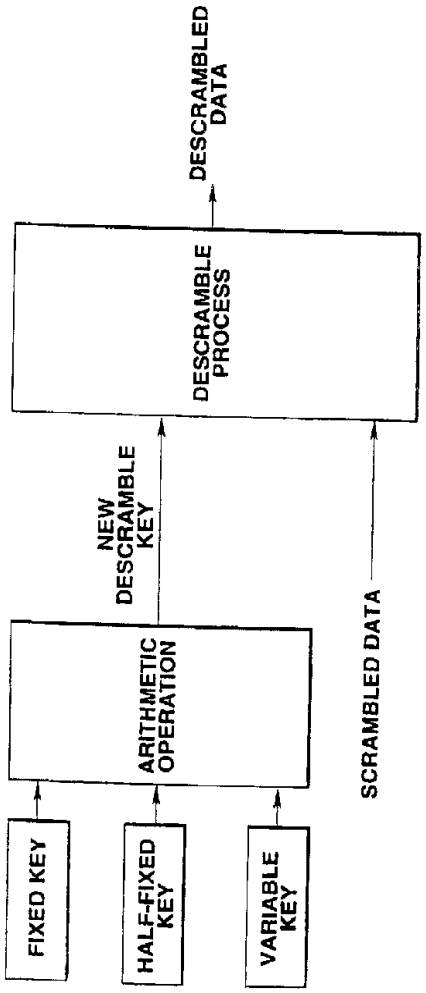

DESCRAMBLED DATA
DESCRAMBLE PROCESS
NEW DESCRAMBLE KEY
ARITHMETIC OPERATION
SCRAMBLED DATA
FIXED KEY
HALF-FIXED KEY
VARIABLE KEY

FIG.15

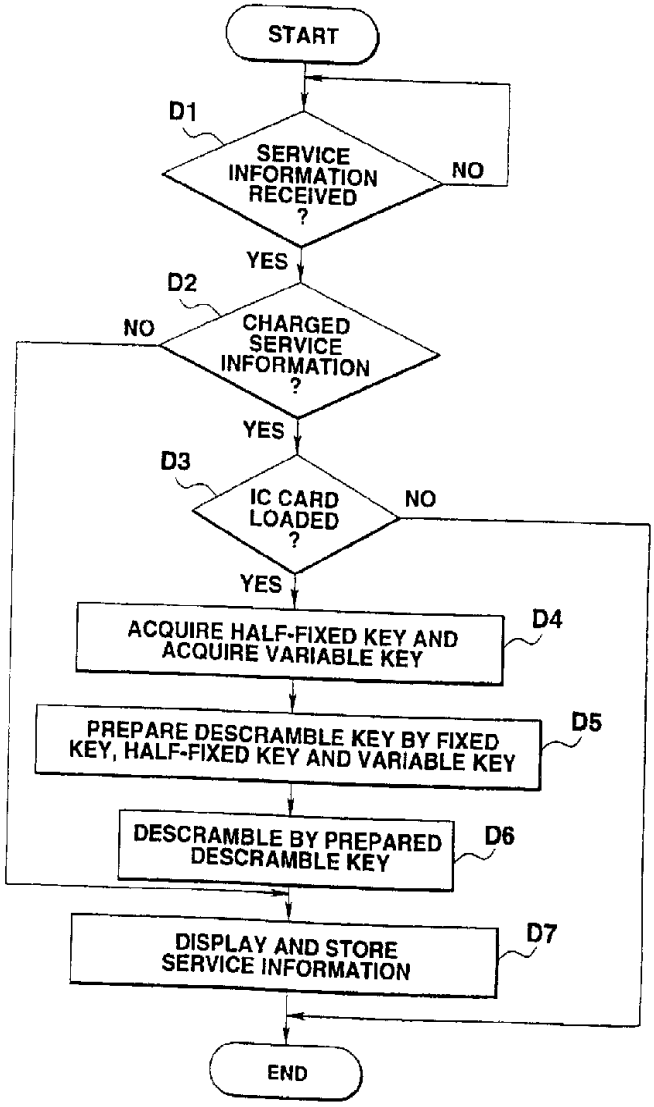

START
D1
SERVICE INFORMATION RECEIVED ?
NO
YES
D2
CHARGED SERVICE INFORMATION ?
NO
YES
D3
IC CARD LOADED ?
NO
YES
ACQUIRE HALF-FIXED KEY AND ACQUIRE VARIABLE KEY
D4
PREPARE DESCRAMBLE KEY BY FIXED KEY, HALF-FIXED KEY AND VARIABLE KEY
D5
DESCRAMBLE BY PREPARED DESCRAMBLE KEY
D6
DISPLAY AND STORE SERVICE INFORMATION
D7
END

FIG.16

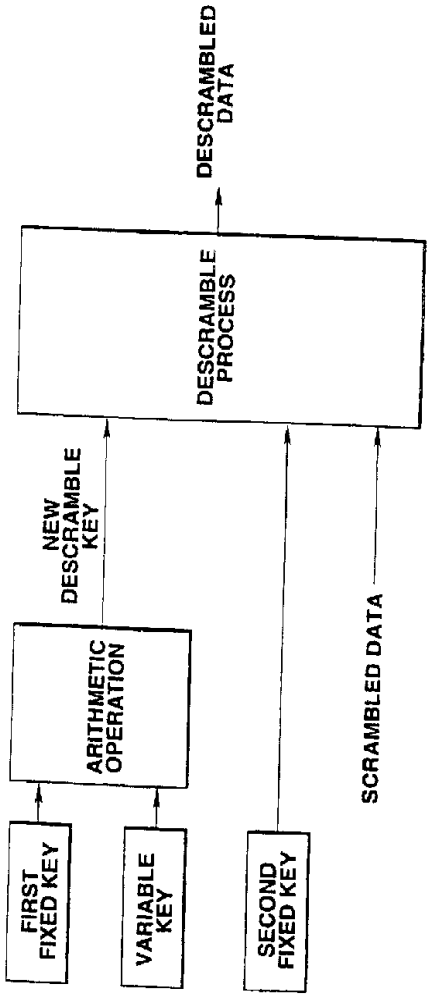

DESCRAMBLED DATA
DESCRAMBLE PROCESS
NEW DESCRAMBLE KEY
ARITHMETIC OPERATION
FIRST FIXED KEY
VARIABLE KEY
SECOND FIXED KEY
SCRAMBLED DATA

FIG.17

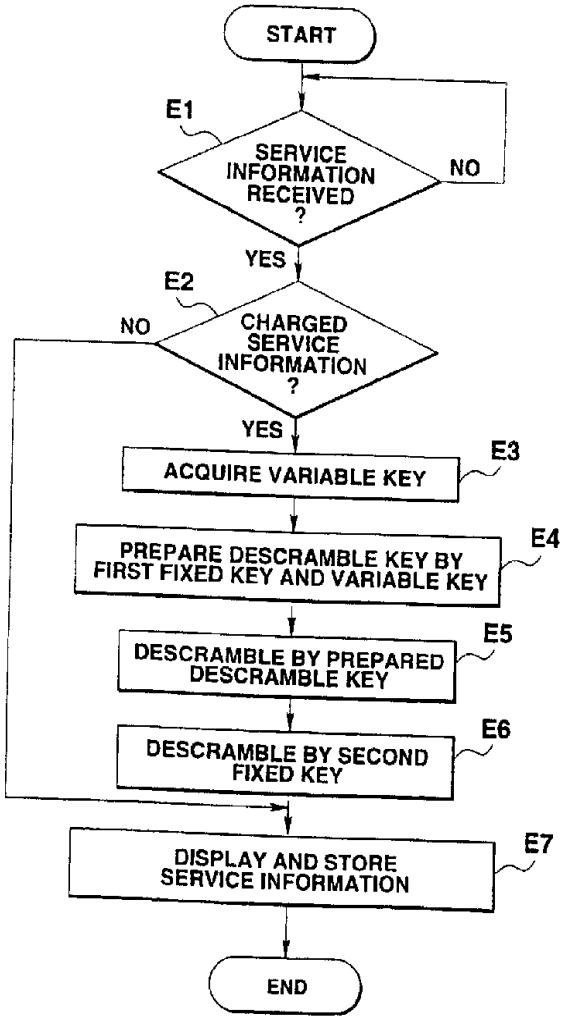

START
E1
SERVICE INFORMATION RECEIVED ?
NO
YES
E2
CHARGED SERVICE INFORMATION ?
NO
YES
E3
ACQUIRE VARIABLE KEY
E4
PREPARE DESCRAMBLE KEY BY FIRST FIXED KEY AND VARIABLE KEY
E5
DESCRAMBLE BY PREPARED DESCRAMBLE KEY
E6
DESCRAMBLE BY SECOND FIXED KEY
E7
DISPLAY AND STORE SERVICE INFORMATION
END

FIG.18

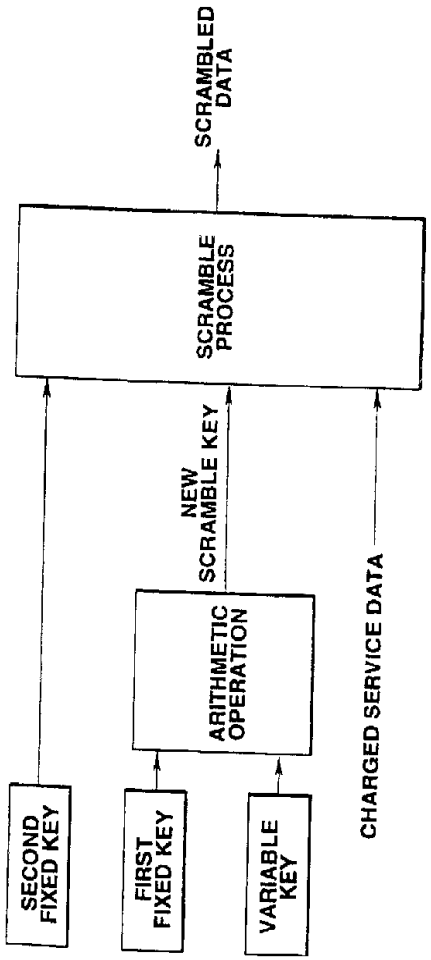
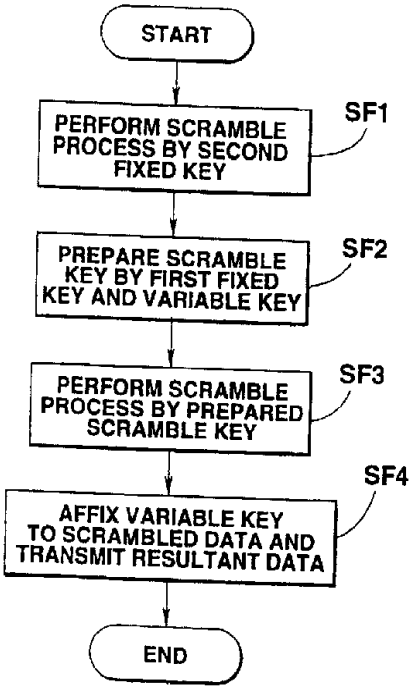

SCRAMBLED DATA
SCRAMBLE PROCESS
NEW SCRAMBLE KEY
ARITHMETIC OPERATION
CHARGED SERVICE DATA
SECOND FIXED KEY
FIRST FIXED KEY
VARIABLE KEY

FIG.19


START
PERFORM SCRAMBLE PROCESS BY SECOND FIXED KEY
SF1
PREPARE SCRAMBLE KEY BY FIRST FIXED KEY AND VARIABLE KEY
SF2
PERFORM SCRAMBLE PROCESS BY PREPARED SCRAMBLE KEY
SF3
AFFIX VARIABLE KEY TO SCRAMBLED DATA AND TRANSMIT RESULTANT DATA
SF4
END