



(11) (21) (C) **2,192,923**
(22) 1996/12/13
(43) 1997/06/16
(45) 2000/02/08

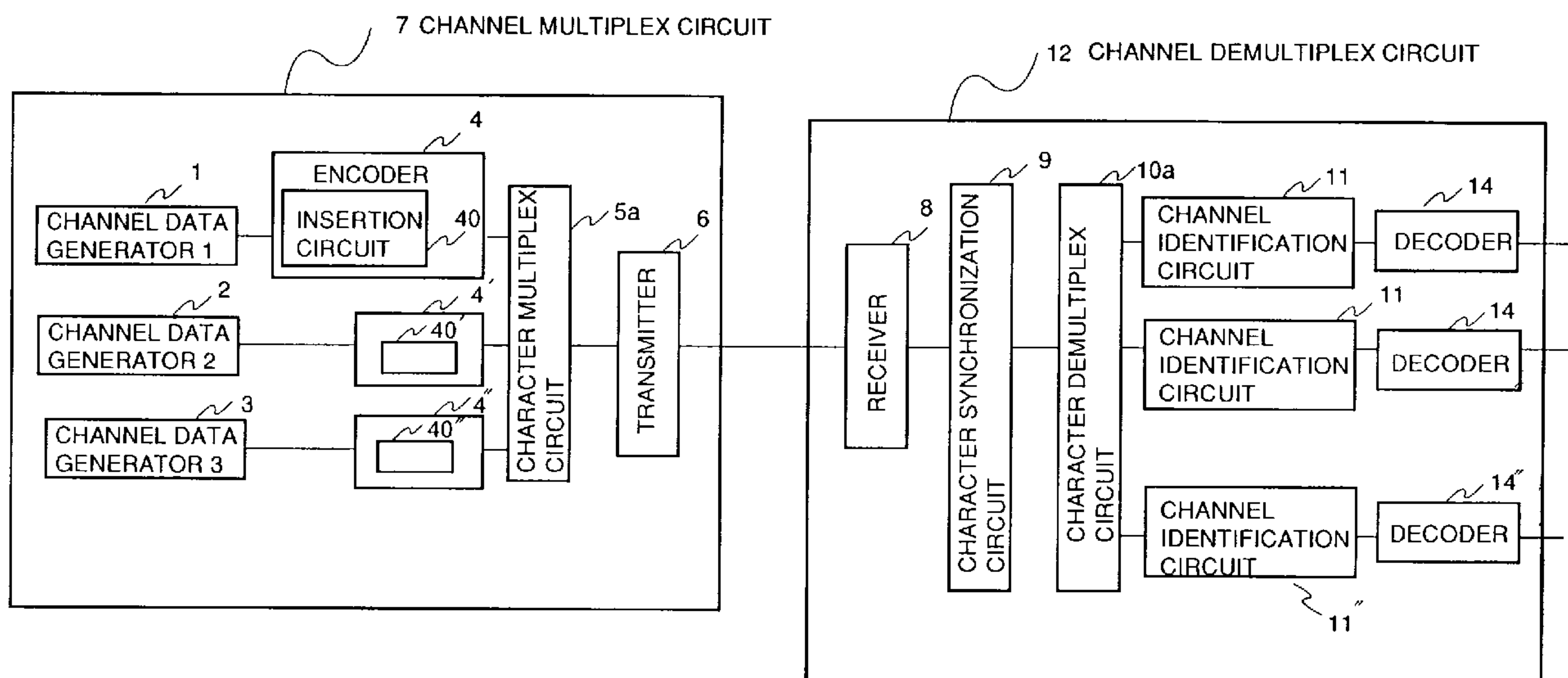
(72) Ishikawa, Hajime, JP

(73) NEC CORPORATION, JP

(51) Int.Cl.⁶ H04J 3/06, H04L 5/02

(30) 1995/12/15 (7-347706) JP

(54) **METHODE ET APPAREIL DE MULTIPLEXAGE-
DEMULTIPLEXAGE POUR CANAUX DE COMMUNICATION**
(54) **CHANNEL MULTIPLEX DEMULTIPLEX METHOD AND
CHANNEL MULTIPLEX DEMULTIPLEX UNIT**



(57) At a transmission side, an encoder 4 codes data of each channel and inserts a special character attributing to each channel. A character multiplex circuit 5a byte multiplex each channel for outputting. At a reception side, a character synchronization circuit 9 synchronized with a character by detecting the special character. A character demultiplex circuit 10a demultiplexes a signal by a character byte and obtains data of each channel. A channel identification circuit 11 identifies each channel by detecting the special character attributing to the channel without bit rotating for synchronization. A decoder 14 executes decoding without bit rotating and outputs a signal from a channel demultiplex circuit.

2192923

ABSTRACT

At a transmission side, an encoder 4 codes data of each channel and inserts a special character attributing to each channel. A character multiplex circuit 5a byte multiplex each channel for outputting. At a reception side, a character synchronization circuit 9 synchronized with a character by detecting the special character. A character demultiplex circuit 10a demultiplexes a signal by a character byte and obtains data of each channel. A channel identification circuit 11 identifies each channel by detecting the special character attributing to the channel without bit rotating for synchronization. A decoder 14 executes decoding without bit rotating and outputs a signal from a channel demultiplex circuit.

15

20

25

CHANNEL MULTIPLEX DEMULTIPLEX METHOD AND

CHANNEL MULTIPLEX DEMULTIPLEX UNIT

BACKGROUND OF THE INVENTION

This invention relates to an art of channel multiplex transmission by which a plurality of channels are multiplexed and transmitted, and particularly, to an art of channel multiplex demultiplex in a system for selecting particular data that have been received after multiplexing and transmission of a plurality of data.

10 Fig. 9 shows a conventional channel multiplex demultiplex unit of the above-described type. It is assumed that four channels are multiplexed. Referring to Fig. 9, a transmission unit 108 at a transmission side combines an 8 bit parallel video signal 101 and a 1 bit serial frame signal 103 at each bit parallel into one channel signal. Then the resultant 9 bit parallel signal is converted into 10 bit parallel signal by a 9B10B coding circuit 102.

 A frame signal generator 104 for generating a frame signal 103 is provided for each channel. The frame signal 103
20 has a common frame pattern containing a data signal.

 The frame signal 103 is used for synchronization as well as for identification of each channel.

A

The 10 bit parallel signal of a channel output from the 9B10B encoder 102 is converted into a serial signal by 10:1 parallel/serial conversion circuit 105. The converted serial signal is further multiplexed among
5 channels by 4:1 parallel/serial conversion circuit 106 and then input to a transmitter 107 from which the resultant transmission signal is sent to a transmission path. In a reception unit 11b, a receiver 109 receives the transmission signal, which is shifted to a
10 serial/parallel conversion circuit 110 by a clock signal output from a hunting circuit 115. The 10 bit parallel signal corresponding to each channel is sequentially input to 10B9B decoder 111 corresponding to the channel.

A 9 bit parallel signal output from the 10B9B decoder
15 111 is separated into an 8 bit parallel video signal and a 1 bit frame signal. The frame signal of each channel is input to a corresponding synchronous detection circuit 112 and subjected to frame detection. The synchronous detection circuit 112 compares, for example,
20 an input bit sequence (9 bit) with a predetermined synchronous pattern. When those patterns accord with each other, a synchronous detection signal is output. When the synchronous pattern is not detected, a report of detecting no synchronous pattern is sent to a
25 synchronous protection circuit 114.

Among signals output from each synchronous detection circuit 112, those signals selected by a channel selection circuit 113 are input to the synchronous protection circuit 114 for frame synchronization.

5 When the frame synchronization is not executed in the synchronous protection circuit 114, the hunting circuit 115 shifts a phase of the clock driving the serial/parallel conversion circuit 110 by a predetermined amount. This operation is continued until
10 the 10 bit parallel signal output from the serial/parallel conversion circuit 110 corresponds to each channel.

As aforementioned, in the conventional transmission system through channel multiplexing, 1 bit frame signal
15 is added accompanied with a byte parallel signal of the data. The resultant coded byte becomes irregular, thus requiring its own coding.

As the decoded frame signal is serial, the frame signal is parallel converted and bit rotated (shifting
20 the bit location in a cyclic manner, for example, inserted from LSB (low-order bit) overflowing from the MSB (high-order bit) side by the synchronous detection circuit at a reception side for comparing the bit pattern. The processing until detection of
25 synchronization takes much time as well as requiring

2192923

double bit rotate function (10B9B decoding and frame signal extraction in pattern detection for synchronous detection).

SUMMARY OF THE INVENTION

5 It is an object of the present invention to solve the aforementioned problems.

 It is another object of the present invention to provide a channel multiplex demultiplex method allowing for channel selection with a simple circuit construction
10 using a coding method in order to realize a stable circuit operation in a channel multiplex demultiplex unit for multiplexing and transmitting a channel.

 The above object of the present invention is achieved by a channel multiplex demultiplex method for
15 multiplexing and demultiplexing a plurality of channels comprising steps of: coding each channel using a coding method coding m bit to n bit (each m , n is predetermined integer but $m < n$) and setting n bit as 1 byte, inserting into each channel at least one bit string of n bit that
20 has not been used for coding said m bit to said n bit as a channel identification byte for channel identification into each channel and multiplexing a plurality of channels; and identifying each channel from data in
25 which a plurality of channels are multiplexed based on said channel identification byte.

2192923

The object of the present invention is achieved by a channel multiplex demultiplex method for multiplexing and demultiplexing a plurality of channels comprising steps of: coding each channel using a coding method
5 coding m bit to n bit (each m, n is predetermined integer but $m < n$) and setting n bit as 1 byte; inserting at least one bit string of n bit that has not been used for coding said m bit to said n bit as a channel identification byte for identifying each channel into
10 each channel; multiplexing channels to which said channel identification byte is inserted; and identifying each channel from data in which a plurality of channels are multiplexed based on said channel identification byte.

15 The object of the present invention is achieved by a channel multiplex demultiplex method for multiplexing and demultiplexing a plurality of channels comprising steps of: inserting identification data into each channel for channel identification; multiplexing a
20 plurality of channels to which said identification data are inserted; coding data in which a plurality of channels are multiplexed using a coding method coding m bit to n bit (each m, n is predetermined integer but $m < n$) and setting n bit as 1 byte and converting said
25 identification data into 1 byte channel identification

2192923

byte containing bit strings of n bit that has not been
used for coding said m bit to said n bit; and
identifying each channel from data in which a plurality
of channels are multiplexed based on said channel
5 identification byte.

The object of the present invention is further
achieved by a channel multiplex demultiplex unit for
multiplexing and demultiplexing a plurality of channels
comprising: a multiplex circuit for coding each channel
10 using a coding method coding m bit to n bit (each m , n
is predetermined integer but $m < n$) and setting n bit as 1
byte, inserting at least one bit string of n bit that
has not been used for coding said m bit to said n bit as
a channel identification byte for channel identification
15 and byte synchronization into each channel and
multiplexing a plurality of channels; and a demultiplex
circuit for identifying each channel from data in which
a plurality of channels are multiplexed based on said
channel identification byte and demultiplexing each
20 channel.

The characteristic of the present invention is coding
data of a channel using a coding method for coding m bit
to n bit (each m , n is predetermined integer but $m < n$)
setting the n bit as 1 byte. The n bit string that has
25 not been used for coding the m bit to n bit is used as

2192923

an identification byte for identifying the channel and as characters for byte synchronization.

Assuming that 1 bit is coded to 2 bit, the 1 bit takes the bit string either 0 or 1. The 2 bit takes the bit string 00, 01, 10 or 11. For example, when coding the 1 bit string "0" to the 2 bit string "00" and coding the 1 bit string "1" to the 2 bit string "01", those 2 bit strings "10" and "11" cannot be used for coding. Therefore those 2 bit strings "10" and "11" can be used as identification bytes for channel identification and as characters for byte synchronization. The term "byte" used herein refers to a set of certain bit string.

BRIEF DESCRIPTION OF THE DRAWINGS

This and other objects, features and advantages of the present invention will become more apparent upon a reading of the following detailed description and drawings, in which:

Fig. 1 is a block diagram of a channel multiplex transmission demultiplex unit of a first embodiment;

Fig. 2 is a block diagram of a channel multiplex transmission demultiplex unit of a second embodiment;

Fig. 3 is a block diagram of a channel multiplex transmission demultiplex unit of a third embodiment;

Fig. 4 is a block diagram of a channel demultiplex unit of a fourth embodiment;

Fig. 5 is a block diagram of a channel demultiplex unit of a fifth embodiment;

Fig. 6 is an explanatory view representing a channel multiplex demultiplex method of the present invention;

5 Fig. 7 is an explanatory view representing a channel multiplex demultiplex method of the present invention;

Fig. 8 is an explanatory view representing a channel multiplex demultiplex method of the present invention; and

10 Fig. 9 is a block diagram of a conventional channel demultiplex unit.

BRIEF DESCRIPTION OF THE EMBODIMENTS

The principle of a channel multiplex demultiplex method of the present invention is explained referring
15 to a timing chart of Fig. 6. It is assumed that 2 channels are multiplexed herein.

First coded channel data a and second coded channel data b are output at every byte, setting an effective character n bit for coding as 1 byte. A channel
20 identification byte (hereinafter referred to as a special character) is inserted into this effective character string for synchronization and identification when executing character synchronization at a reception side. As the inserted special character, a first special
25 character 20 is assigned to the first coded channel data

2192923

a. A second special character 21 that is different from the first special character 20 is assigned to the second coded channel data b.

Two coded channel data are byte multiplexed at every character byte (n bit) into character multiplexed data c.

The reception side receives the character multiplexed data c and detects either one or both bit patterns of the above two special characters through bit rotation or other operation for character synchronization.

In case each of the coded channel data a, b and special characters 20 and 21 corresponding to the respective channels are inserted at a cyclic interval, character synchronization is protected. In case of no cyclic insertion, each byte phase of n kinds of characters is monitored for character synchronization at a phase where the bit pattern of the special character has been detected.

The first and second channel data a and b can be obtained through demultiplex at each byte by synchronizing with character and identifying the character byte (n bit).

The special characters inserted to the channel data a and b are synchronized with character, which can be easily detected for channel identification.

It is well known that a time slot a byte each channel on the character multiplexed data c for character synchronization by detecting either one or both of two special characters. So the reception side is allowed to demultiplex each byte for two channels after identifying each of two channels at every character byte.

In the present invention using N (integer equal to or more than 3) channels, it is necessary to detect at least (N-1) special characters. Alternatively it is required to identify the order of multiplexing in advance at the transmission side so as to identify the time slot for all other channels from the time slot of the channel in which the special character has been detected.

In Fig. 6, multiplexing is executed after coding each channel. However, the data can be formed into m bit parallel before coding each channel data. The m bit parallel data are byte multiplexed as 1 byte and then coded. Fig. 7 shows a timing chart of the above-described case. It is assumed that 2 channels are multiplexed.

A first special character 20a before coding and a second special character 21a before coding are inserted into a first m bit parallel channel data d and a second m bit parallel channel data e, respectively.

The channel data are byte multiplexed, setting m bit as 1 byte to form byte multiplex data f .

Each byte of the byte multiplex data f is independent at every channel. Even when the byte multiplexed data f are coded at every m bit 1 byte, independence of the character byte (n bit) at every channel is assured.

As a result, data g derived from coding the byte multiplexed data f become almost the same as the character multiplexed data as c shown in Fig. 6.

The reception side receives the coded data g and synchronizes with character by detecting either one or both of the first special character 20 or/and the second special character 21 through bit rotation and decoding at each character, thus providing byte multiplexed data f .

In case that each of special characters is inserted into the respective channel data in a cyclic manner, character synchronization is protected.

In case of no cyclic insertion, each byte phase of n types is monitored and character synchronization is executed at a phase where the bit pattern of the special character has been detected.

As the byte multiplexed data f are multiplexed by, setting m bit as 1 byte, the byte multiplexed data f is demultiplexed at every byte provides a first m bit

2192923

parallel channel data d and second m bit parallel
channel data e.

Each special character before coding that has been
inserted to the respective channel data d and e can be
5 easily detected because of synchronized byte, thus
allowing for channel identification.

It is well known that a time slot has a byte of the
character forming each channel on the coded data g since
either one of two special characters is detected for
10 character synchronization. It is, accordingly, well
known that the time slot has a byte of the character
forming each channel on the coded data g in order to
execute character synchronization by detecting either
one of two special characters. The reception side is
15 allowed to demultiplex each channel after identifying
each of two channels, respectively.

In the present invention using N (N is an integer
equal to or more than 3), at least (N-1) special
characters should be detected, Alternatively the order
20 of multiplexing is identified in advance at the
transmission side and the time slot for all other
channels has to be identified from the time slot of the
channel in which the special character has been
detected.

25 In Fig. 6 and Fig. 7, each channel is multiplexed at

2192923

every character ultimately used in accordance with a coding method. However Fig. 8 shows another multiplexing method such as bit multiplexing in which multiplexing is not executed at each character. It is assumed that two
5 channels are multiplexed.

The coded first channel data a and the coded second channel data b are multiplexed into bit multiplexed data h.

The reception side receives the bit multiplexed data h
10 and obtains the coded first channel data a and coded second channel data b which have been demultiplexed at every channel.

The bit pattern of the special character (8 bit) inserted into each channel data is detected through bit
15 rotation operation. Character synchronization is executed as well as identification of each channel based on the detected special character.

In this case, assuming that N channels are used, the special characters of at least (N-1) channels should be
20 detected. Alternatively the order of multiplexing at the transmission side is obtained in advance and the channel is identified by detecting the special character inserted into the channel. Then the time slot for all other channels should be identified from the above time
25 slot.

In the present invention, a special character can be assigned to each channel. However a plurality of characters can be combined in order to represent one channel.

5 For example, 4 special characters, A, B, C and D, are prepared and any two of those characters are combined to represent 6 channels, for example, (AB), (AC), (AD), (BC), (BD) and (CD).

10 Then a construction of the channel multiplex transmission unit is described.

Fig. 1 is a block diagram of a construction of the channel multiplex transmission unit of a first embodiment of the present invention. In Fig. 1, 3 channels are multiplexed at the transmission side.

15 In a channel multiplex circuit 7 as a transmission side, channel data are output from the respective channel data generators 1 to 3, which are input to the corresponding encoders 4 to 4" for coding. At this point, each special character attributing to the
20 respective channels is inserted by insertion circuits 40 to 40" like the coded first and the second channel data a and b as shown in Fig. 6. The channel data generators 1 to 3 can be provided outside the channel multiplex circuit 7.

25 Each output of the encoders 4 to 4" is composed of n

2192923

bit parallel signal.

Each output of the encoders 4 to 4" is input to a character multiplex circuit 5a and time division multiplexed with a byte, setting n bit character as 1 byte for outputting. The above-obtained signal is then input to a reception side 6. The signal input to the reception side 6 is usually a serial signal.

An output of the character multiplex circuit 5a is transmitted to a transmission path by the transmitter 6. This is the construction of the channel multiplex circuit 7.

In a channel demultiplex circuit 12 at a reception side, a transmitted signal is received by a receiver 8 and then input to a character synchronization circuit 9 where character synchronization is executed by detecting a special character and a signal is output at every byte of the character. This output is recognized as an n bit parallel signal at every character.

The output signal of the character synchronization circuit 9 is input to a character demultiplex circuit 10a where the output signal is demultiplexed into three signals each for a byte of the character forming 3 channels for outputting.

Each of 3 output signals of the character demultiplex circuit 10a is input to the respective channel

identification circuits 11 to 11" where channel
identification is executed based on a bit pattern of the
special character that has been inserted to the channel.
Each of the output signals is then decoded by the
5 respective decoders 14 to 14" where the respective
channel data are output upon termination of the special
character.

This is the explanation of the channel demultiplex
circuit 12.

10 Next a second embodiment is described.

Fig. 2 is a block diagram of the second embodiment of
the present invention. It is assumed that 3 channels are
multiplexed at a transmission side.

In a channel multiplex circuit 7 at the transmission
15 side, each output of a first to a third channel data
generators 1 to 3 is input to a byte multiplex circuit
5b for m bit parallelizing the respective channel data.
The obtained data as 1 byte are time division byte
multiplexed. The number of the bit "m" of the parallel
20 signal is equal to the number of the bit for forming 1
byte before coding according to the coding method in
use.

The time division byte multiplexed signal is input to
an encoder 4. As coded data g of Fig. 7 shows, the
25 respective special character attributing to each time

division byte multiplexed signal is inserted thereto.

The channel data generators 1 to 3 can be provided outside the channel multiplex circuit 7. An output of the encoder 4 is input to a transmitter 6 for

5 transmitting the output signal to a transmission path. The output of the encoder 4 is preferably a serial signal. This is the explanation of the channel multiplex circuit 7.

10 In a channel demultiplex circuit 12 at a reception side, a transmitted signal is received by a receiver 8. An output signal of the receiver 8 is input to a character synchronization circuit 9 where character synchronization is executed by detecting a special character. An output signal of the character
15 synchronization circuit 9 is normally recognized as an n bit parallel signal at every byte of a character.

The n bit parallel signal is input to a decoder 14 for decoding and outputting the decoded m bit parallel signal.

20 As the decoder 14 requires to output a flag indicating decoding of the special character at a time slot of decoding the special character, 1 bit is output for the flag accompanied with the output of m bit parallel signal.

25 As the output of m bit parallel signal is obtained by

2192923

byte multiplexing each channel, setting m bit as 1 byte,
each channel data can be obtained by byte demultiplexing
the m bit parallel signal. An output signal of the
decoder 14 is input to a byte demultiplex circuit 10b
5 where the output signal is demultiplexed at a time slot
of the m bit parallel signal. At the same time, the
output for the flag is also demultiplexed at the
respective time slots.

Each of the demultiplexed m bit parallel output is
10 input to the respective channel identification circuits
11 to 11" where channel identification is executed. At
this time, each channel is identified based on a bit
pattern of the m bit parallel signal at a time slot
accorded with the timing for the flag indicating
15 decoding of the special character.

As each of the m bit parallel signal at this time slot
contains no data, it is subjected to channel
identification in the respective channel identification
circuits 11 to 11" and then termination in the
20 respective termination circuits 17 to 17". The m bit
parallel signal other than those at the above time slot
passes through the termination circuits 17 to 17", which
is output from the channel demultiplex circuit 12. This
is the explanation on the construction of the channel
25 demultiplex circuit 12.

Compared with the first embodiment, as the encoder 4 in the channel multiplex circuit 7 and the decoder 14 in the channel demultiplex circuit 12 of the second embodiment can be commonly used by the respective channels, the circuit size can be reduced. This is effective particularly for multiplexing many channels.

Additionally as the second embodiment codes multiplexed data for each channel, the signal for transmission is allowed to preserve the coding rule in use.

Referring to Figs. 1 and 2, the channel multiplex circuit 7 is compatible with the channel demultiplex circuit 12. Therefore the combination of the channel multiplex circuit 7 of Fig. 1 and the channel demultiplex circuit 12 of Fig. 2 or the channel multiplex circuit 7 of Fig. 2 and the channel demultiplex circuit 12 of Fig. 1 can be used.

A third embodiment is described. A construction of the third embodiment of the present invention is shown by a block diagram. In Fig. 3, it is assumed that 3 channels are multiplexed at the transmission side.

In a channel multiplex circuit 7 at the transmission side, each output of channel data generators 1 to 3 is input to the respective encoders 4 to 4" for coding. Additionally the special character is inserted as shown

2192923

by coded first and the second channel data a and b of Fig. 8.

Each output of the encoder 4 to 4" is input to a bit multiplex circuit 5c for time division bit multiplexing with no character synchronization and outputting a signal to a transmission path through a transmitter 6.

The channel data generators 1 to 3 can be provided outside the channel multiplex circuit 7. This is the explanation of the channel multiplex circuit 7.

In a channel demultiplex circuit 12 at a reception side, a receiver 8 receives a signal sent through the transmission path and outputs a signal to a demultiplex circuit 10c for demultiplexing the output signal in a manner corresponding to the multiplex process used in the bit multiplex circuit 5c.

Each of the signal demultiplexed to the respective channels is input to the respective character synchronization circuits 9 to 9" where character synchronization is executed by detecting the special character. Each of the resultant signals is further input to channel identification circuits 11 to 11" and subjected to channel identification based on the bit pattern of the special character detected by the channel identification circuits 11 to 11". Each of the output signals is further decoded by the respective decoders 14

to 14" where the special character is terminated. This is the explanation on the construction of the channel demultiplex circuit 12.

A fourth embodiment is described.

5 Fig. 4 shows a construction of the fourth embodiment of the present invention. Fig. 4 is a block diagram representing the construction of a channel demultiplex circuit of a channel multiplex demultiplex unit according to the present embodiment. It is assumed that
10 3 channels are multiplexed at the transmission side. The construction of the channel multiplex circuit 7 at the transmission side is the same as that shown in Fig. 1 or Fig. 2.

Referring to Fig. 4, in a channel demultiplex circuit
15 12 of the present embodiment, a receiver 8 receives a signal, which is input to a character synchronization circuit 9. The character synchronization circuit 9 synchronizes with a character by detecting a special character as well as detects the special character of at
20 least $(n-1)$ channels (n is the total number of channels; $n=3$ in the drawings) so that information on the character detected at a time slot forming each channel is supplied to a channel identification circuit 11.

The channel identification circuit 11 identifies each
25 channel based on information on the special character

supplied from the character synchronization circuit 9 and inputs information on time slot where the character byte forming each channel locates to a character demultiplex circuit 10a.

5 The character demultiplex circuit 10a demultiplexes each channel at every time slot and outputting signal indicating the channel of the demultiplexed signal respectively. One time slot consists of one character.

Each output signal of the character demultiplex
10 circuit 10a is decoded by the respective decoders 14 to 14".

When the order of multiplexing the channels in the channel multiplex circuit 7 has been already known to the channel demultiplex circuit 12, the channel
15 identification circuit 11 identifies the channel contained in the time slot detected by the character synchronization circuit 9 based on the special character contained in the above-described time slot. As a result, the channels contained in all the time slots can be
20 identified sequentially in the order of multiplexing.

A fifth embodiment is described.

Fig. 5 is a block diagram representing a channel demultiplex circuit of a channel multiplex demultiplex unit of the fifth embodiment of the present invention.
25 It is assumed that 3 channels are multiplexed at the

transmission side. The construction of the channel multiplex circuit 7 at the transmission side is the same as that shown either in Fig. 1 or Fig. 2.

Referring to Fig. 5, in the channel demultiplex circuit 12 of the present embodiment, a receiver 8 receives a signal, which is subjected to character synchronization in a character synchronization circuit 9 by detecting the special character. The synchronization circuit 9 detects special characters of at least (n-1) channels (n is the total number of channels; n=3). The information on the special characters detected for each time slot forming each channel is input to a channel identification circuit 11.

The channel identification circuit 11 identifies each channel based on the information of the special character supplied from the character synchronization circuit 9 and inputs information on the time slot where the character byte forming each channel locates.

An output of the character synchronization circuit 9 is normally formed as an nbit parallel signal, setting n bit at every character as 1 byte. The n bit parallel signal is decoded by a decoder 14, which is input to a byte demultiplex circuit 10b as m bit parallel signal, setting the m bit as 1 byte.

When the delay in decoding is negligible, information

2192923

on the time slot where the character byte forming each channel supplied from the channel identification circuit 11 to the byte demultiplex circuit 10b becomes effective even for the m bit parallel signal after decoding.

5 The byte demultiplex circuit 10b determines that the byte of the m bit parallel signal at a timing accorded with the time slot information where the character byte forming each channel output from the channel identification circuit 11 is regarded as the byte
10 forming each channel, and then outputs each signal at each channel separately.

 An output of the byte demultiplex circuit 10b is input to termination circuits 17 to 17" accompanied with the respective flag outputs, which is output from the
15 channel demultiplex circuit 12 by terminating the time slot data after decoding the special character.

 When the order of channel multiplexing in the channel multiplex circuit 7 has been already known to the channel demultiplex circuit 12, the channel contained in
20 the time slot detected by the character synchronization circuit 9 can be identified by the channel identification circuit 11 based on the special character contained in the above time slot. Although the present embodiment assumes that 3 channels are multiplexed, 4 or
25 more channels can be multiplexed in the present

invention.

In the channel multiplex demultiplex unit of the present invention, coding is executed in order to reduce low frequency component of the multiplex signal. Channel
5 synchronization is executed by changing the special character by each channel when decoding at the reception side and channel identification is executed simultaneously. Compared to a conventional receiver which executes channel identification by executing frame
10 synchronization apart from the character synchronization, the present invention requires only one stage of bit rotate circuit accompanied with the synchronization. Therefore the circuit size within the reception demultiplex unit can be decreased to 60% of
15 the conventional one, resulting in compact and low power consumption unit.

20

25

What is claimed is:

1 A channel multiplex demultiplex method for multiplexing and demultiplexing a plurality of channels comprising steps of:

5 coding each channel using a coding method coding m
bit to n bit (each m, n is predetermined
integer but $m < n$) and setting n bit as 1 byte,
inserting into each channel at least one bit
string of n bit that has not been used for
10 coding said m bit to said n bit as a channel
identification byte for channel identification
into each channel and multiplexing a plurality
of channels; and
identifying each channel from data in which a
15 plurality of channels are multiplexed based on
said channel identification byte.

2 The channel multiplex demultiplex method of claim 1,
wherein a plurality of bit strings of n bit that has not
been used for coding said m bit to said n bit are
20 combined into one channel identification byte.

3 A channel multiplex demultiplex method for multiplexing and demultiplexing a plurality of channels comprising steps of:

coding each channel using a coding method coding m
25 bit to n bit (each m, n is predetermined

integer but $m < n$) and setting n bit as 1 byte;
inserting at least one bit string of n bit that has
not been used for coding said m bit to said n
bit as a channel identification byte for
5 identifying each channel into each channel;
multiplexing channels to which said channel
identification byte is inserted; and
identifying each channel from data in which a
plurality of channels are multiplexed based on
10 said channel identification byte.

4 The channel multiplex demultiplex method of claim 3,
wherein said step of multiplexing channels is a step of
byte multiplexing.

5 The channel multiplex demultiplex method of claim 3,
15 wherein said step of multiplexing channels is a step of
bit multiplexing.

6 The channel multiplex demultiplex method of claim 3,
wherein a plurality of bit strings of n bit that has not
been used for coding said m bit to said n bit are
20 combined into one channel identification byte.

7 A channel multiplex demultiplex method for
multiplexing and demultiplexing a plurality of channels
comprising steps of:

inserting identification data into each channel for
25 channel identification;

multiplexing a plurality of channels to which said
identification data are inserted;

coding data in which a plurality of channels are
multiplexed using a coding method coding m bit
5 to n bit (each m, n is predetermined integer
but $m < n$) and setting n bit as 1 byte and
converting said identification data into 1 byte
channel identification byte containing bit
strings of n bit that has not been used for
10 coding said m bit to said n bit; and

identifying each channel from data in which a
plurality of channels are multiplexed based on
said channel identification byte.

8 The channel multiplex demultiplex method of claim 7,
15 wherein said step of multiplexing channels comprises a
step of byte multiplexing.

9 The channel multiplexing demultiplex method of claim
7, wherein said step of multiplexing channels comprises
a step of bit multiplexing.

20 10 A channel multiplex demultiplex unit for
multiplexing and demultiplexing a plurality of channels
comprising:

a multiplex circuit for coding each channel using a
coding method coding m bit to n bit (each m, n
25 is predetermined integer but $m < n$) and setting n

2192923

bit as 1 byte, inserting at least one bit
string of n bit that has not been used for
coding said m bit to said n bit as a channel
identification byte for channel identification
5 and byte synchronization into each channel and
multiplexing a plurality of channels; and
a demultiplex circuit for identifying each channel
from data in which a plurality of channels are
multiplexed based on said channel
10 identification byte and demultiplexing each
channel.

11 The channel multiplex demultiplex unit of claim 10,
wherein said multiplex circuit comprising:

coding means for coding data of each channel using
15 a coding method coding m bit to n bit (each m,
n is predetermined integer but $m < n$) and setting
n bit as 1 byte;

insertion means for using a bit string of n bit
that has not been used for coding said m bit to
20 said n bit as a special character, inserting at
least one said bit string of n bit as a channel
identification byte into data of each channel
that has been coded by said coding means and
outputting an n bit parallel signal of each
25 channel; and

multiplex means for time division byte multiplexing
said n bit parallel signals of a plurality of
channels, setting said n bit parallel signal as
1 byte.

5 **12** The channel multiplex demultiplex unit of claim 11,
wherein said demultiplex circuit comprising:

synchronization means for synchronizing with a byte
by detecting a channel identification byte from
output signals of said multiplex circuit and
10 outputting an n bit parallel signal as 1 byte
from said output signals;

demultiplex means for demultiplexing said plurality
of n bit parallel signals for each channel
which has been time division byte multiplexed
15 setting n bit as 1 byte;

a plurality of channel identification means for
identifying a channel based on a channel
identification byte that has been inserted into
said demultiplexed channel; and

20 a plurality of decoding means for decoding outputs
of said demultiplex means.

13 The channel multiplex demultiplex unit of claim 11,
wherein said demultiplex means comprising:

synchronization means for synchronizing with a byte
25 by detecting a channel identification byte from

output signals of said multiplex circuit and
outputting an n bit parallel signal as 1 byte
from said output signal;

decoding means for outputting a m bit parallel

5 signal by decoding said n bit parallel signal;

demultiplex means for demultiplexing said plurality
of m bit parallel signal for each channel that
has been time division byte multiplexed setting
m bit as 1 byte;

10 a plurality of channel identification means for
decoding each output sent from said demultiplex
means and identifying a channel based on a
decoded special character; and

a plurality of termination means for terminating
15 said channel identification byte from an output
of said demultiplex means.

14 The channel multiplex demultiplex unit of claim 11,
wherein said demultiplex circuit comprising:

synchronization means for synchronizing with a byte
20 by detecting a channel identification byte from
output signals of said multiplex circuit and
outputting n bit parallel signal as 1 byte from
said output signal;

channel identification means for identifying a time
25 slot of a byte of each channel based on said

detected channel identification byte;
distribution means for distributing said n bit
parallel signal for a corresponding channel
based on said channel identification means; and
5 a plurality of decoding means for decoding said
distributed n bit parallel signal.

15 The channel multiplex demultiplex unit of claim 11,
wherein said demultiplex circuit comprising:

synchronization means for synchronizing with a byte
10 by detecting a channel identification byte from
output signals of said multiplex circuit and
outputting n bit parallel signal as 1 byte from
said output signal;

channel identification means for identifying a time
15 slot of a byte of each channel based on said
detected channel identification byte;

decoding means for decoding said n bit parallel
signal to m bit parallel signal;

distribution means for distributing said m bit
20 parallel signal for a corresponding channel
based on information on said channel
identification means; and

a plurality of termination means for terminating
said channel identification byte from said
25 distributed m bit parallel signal.

16 The channel multiplex demultiplex unit of claim 10,
wherein said multiplex circuit comprising:

insertion means for inserting a precoding special
character for channel identification into data
of each channel;

multiplex means for time division byte multiplexing
m bit parallel signal of data of each channel
to which said precoding special character is
inserted; and

coding means for coding said multiplexed data using
a coding method coding m bit to n bit (each m,
n is a predetermined integer but $m < n$) and
setting n bit as 1 byte and, at a time for
coding, converting said precoding special
character into a special character as channel
identification byte formed of bit string of n
bit that has not been used for coding said m
bit to said n bit.

17 The channel multiplex demultiplex unit of claim 16,
wherein said demultiplex circuit comprising:

synchronization means for synchronizing with a byte
by detecting a channel identification byte from
output signals of said multiplex circuit and
outputting n bit parallel signal as 1 byte from
said output signal;

demultiplex means for demultiplexing said plurality
of n bit parallel signals for each channel that
has been time division byte multiplexed setting
n bit as 1 byte;

5 a plurality of channel identification means for
identifying a channel based on a channel
identification byte inserted to said
demultiplexed channel; and

10 a plurality of decoding means for decoding an
output of said demultiplex means.

18 The channel multiplex demultiplex unit of claim 16,
wherein said demultiplex circuit comprising:

15 synchronization means for synchronizing with a byte
by detecting a channel identification byte from
output signals of said multiplex circuit and
outputting n bit parallel signal as 1 byte from
said output signal;

decoding means for outputting m bit parallel signal
by decoding said n bit parallel signal;

20 demultiplex means for demultiplexing said plurality
of said n bit parallel signals for each channel
that has been time division byte multiplexed
setting said m bit as 1 byte;

25 a plurality of channel identification means for
decoding each output of said demultiplex means

and identifying a channel based on a decoded
special character; and

a plurality of termination means for terminating
said channel identification byte from an output
of said demultiplex means.

19 The channel multiplex demultiplex unit of claim 16,
wherein said demultiplex circuit comprising:

synchronization means for synchronizing with a byte
by detecting a channel identification byte from
output signals of said multiplex circuit and
outputting n bit parallel signal as 1 byte from
said output signal;

channel identification means for identifying a time
slot of a byte of each channel based on said
detected channel identification byte;

distribution means for distributing said n bit
parallel signal for a corresponding channel
based on information on said channel
identification means; and

a plurality of decoding means for decoding said
distributed n bit parallel signal.

20 The channel multiplex demultiplex unit of claim 16,
wherein said demultiplex circuit comprising:

synchronization means for synchronizing with a byte
by detecting a channel identification byte from

output signals of said multiplex circuit and
outputting n bit parallel signal as 1 byte from
said output signal;

channel identification means for identifying a time
5 slot of a byte of each channel based on said
detected channel identification byte;

decoding means for decoding said n bit parallel
signal to m bit parallel signal;

distribution means for distributing said m bit
10 parallel signal for a corresponding channel
based on information on said channel
identification means; and

a plurality of termination means for terminating
said channel identification byte from said
15 distributed m bit parallel signal.

21 The channel multiplex demultiplex unit of claim 10,
wherein said multiplex circuit comprising:

coding means for coding data of each channel using
a coding method coding m bit to n bit (m, n: a
20 predetermined integer, $m < n$) and setting n bit
as 1 byte;

insertion means for inserting at least one bit
string of n bit that has not been used for
coding said m bit to said n bit as a channel
25 identification byte into data of each channel

coded by said coding means; and
multiplex means for time division bit multiplexing
data of each channel to which said channel
identification byte is inserted.

5 **22** The channel multiplex demultiplex unit of claim 21,
wherein said demultiplex circuit comprising:

demultiplex means for demultiplexing an output
signal of said multiplex circuit for each
channel;

10 a plurality of synchronization means for
synchronizing with a byte setting n bit as 1
byte by detecting said channel identification
byte from said demultiplexed signal;

15 a plurality of channel identification means for
identifying a channel of a signal output from
said synchronization means based on said
detected channel identification byte; and
decoding means for decoding a signal from said
demultiplex means.

20

**Smart & Biggar
Ottawa, Canada
Patent Agents**

25

2192923

FIG.1

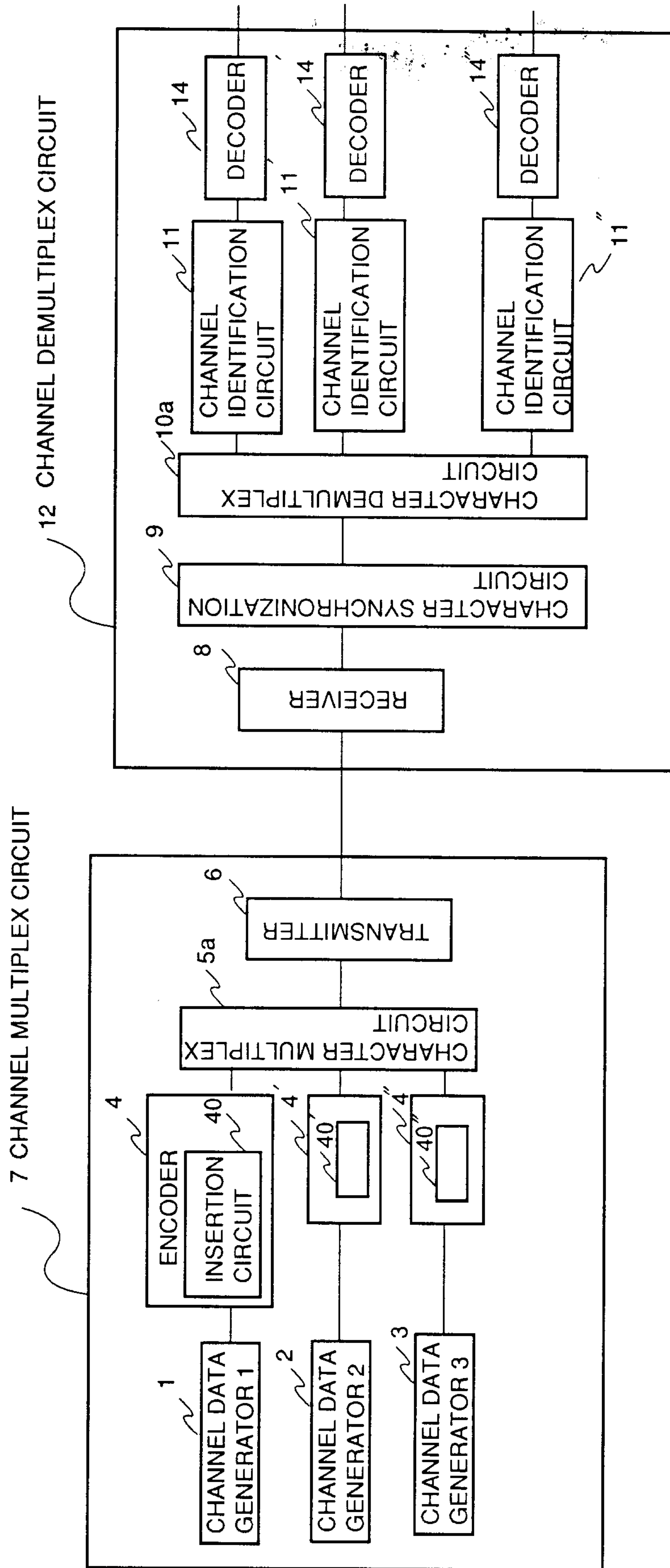


FIG.2

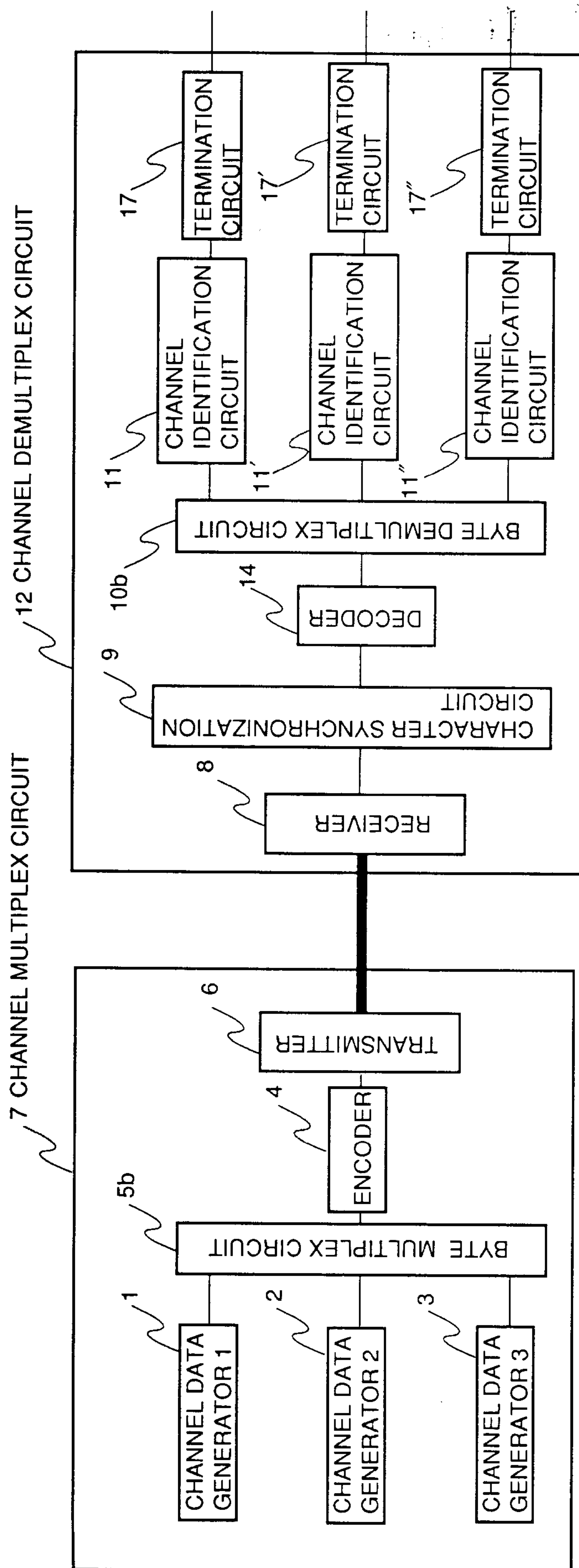
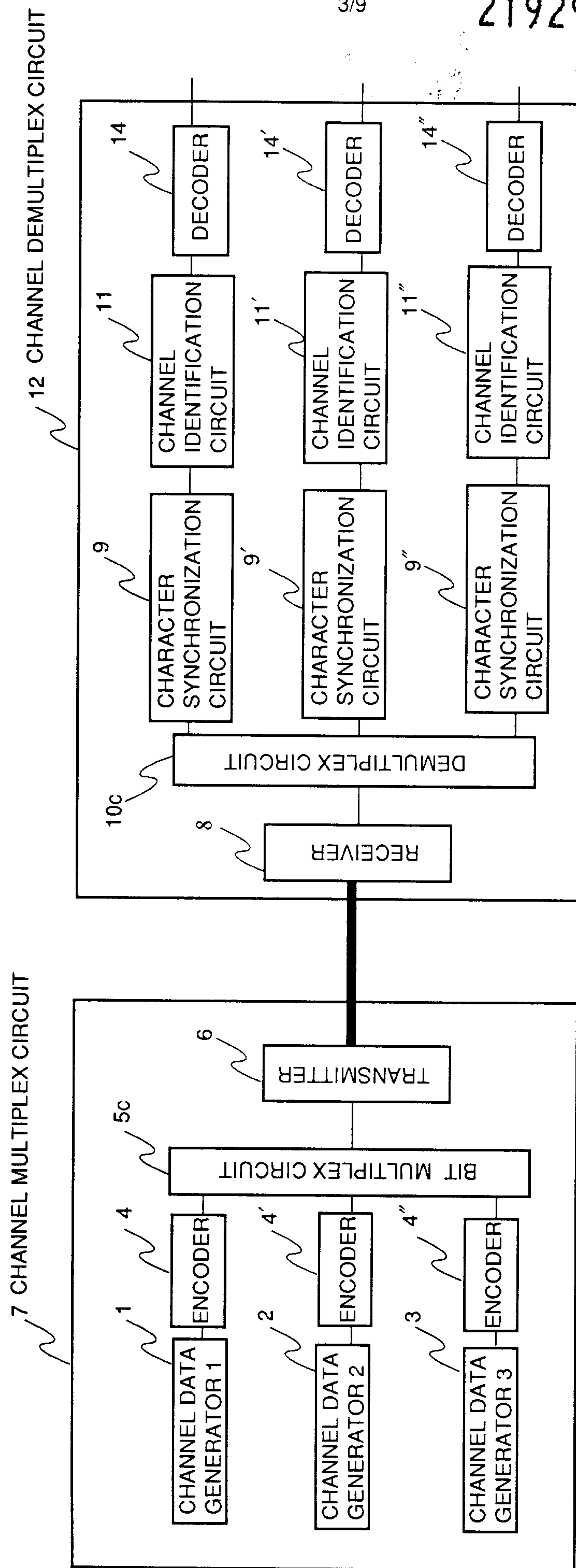


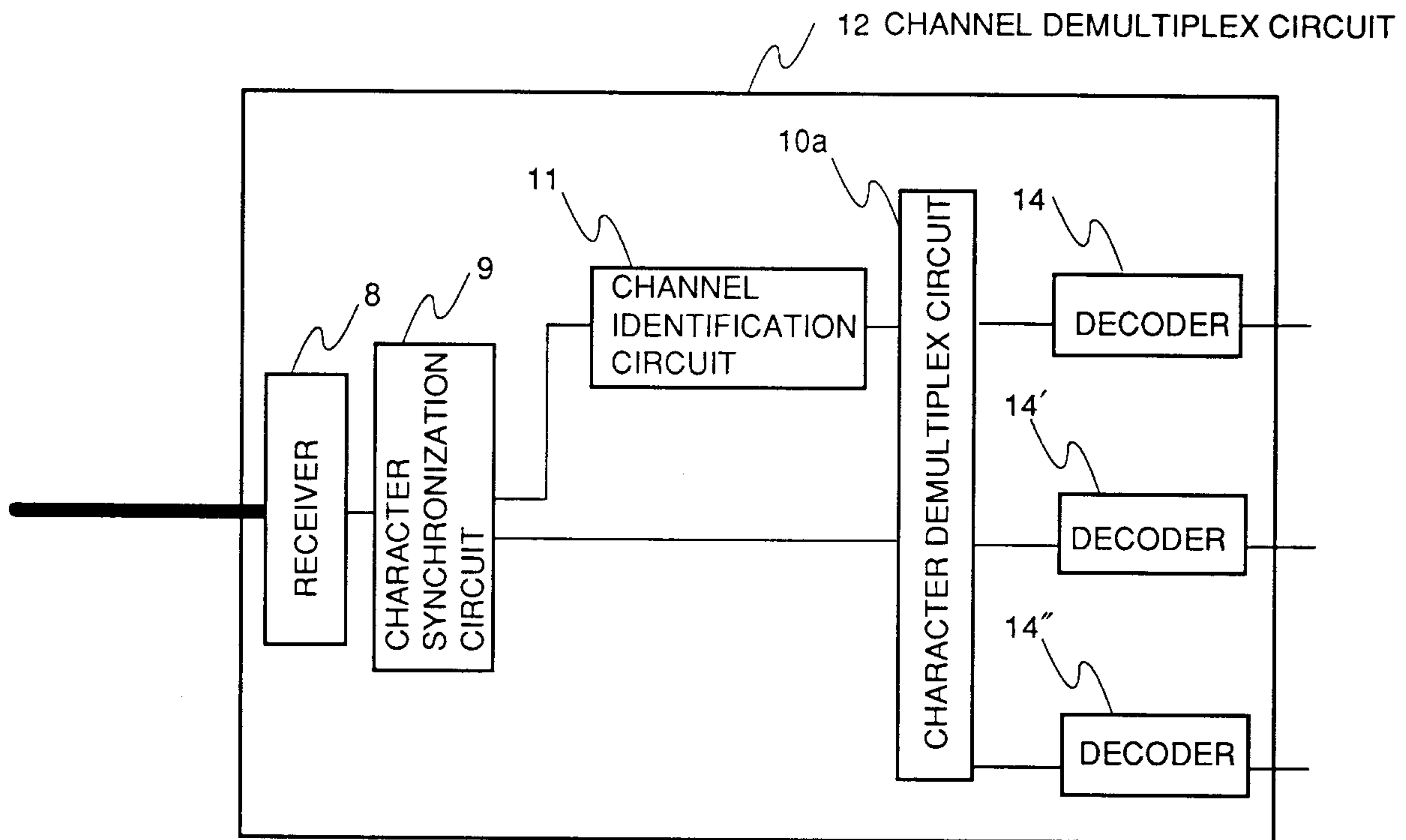
FIG.3



2192923

4/9

FIG.4



Patent Agents
Smart & Biggar

2192923

5/9

FIG.5

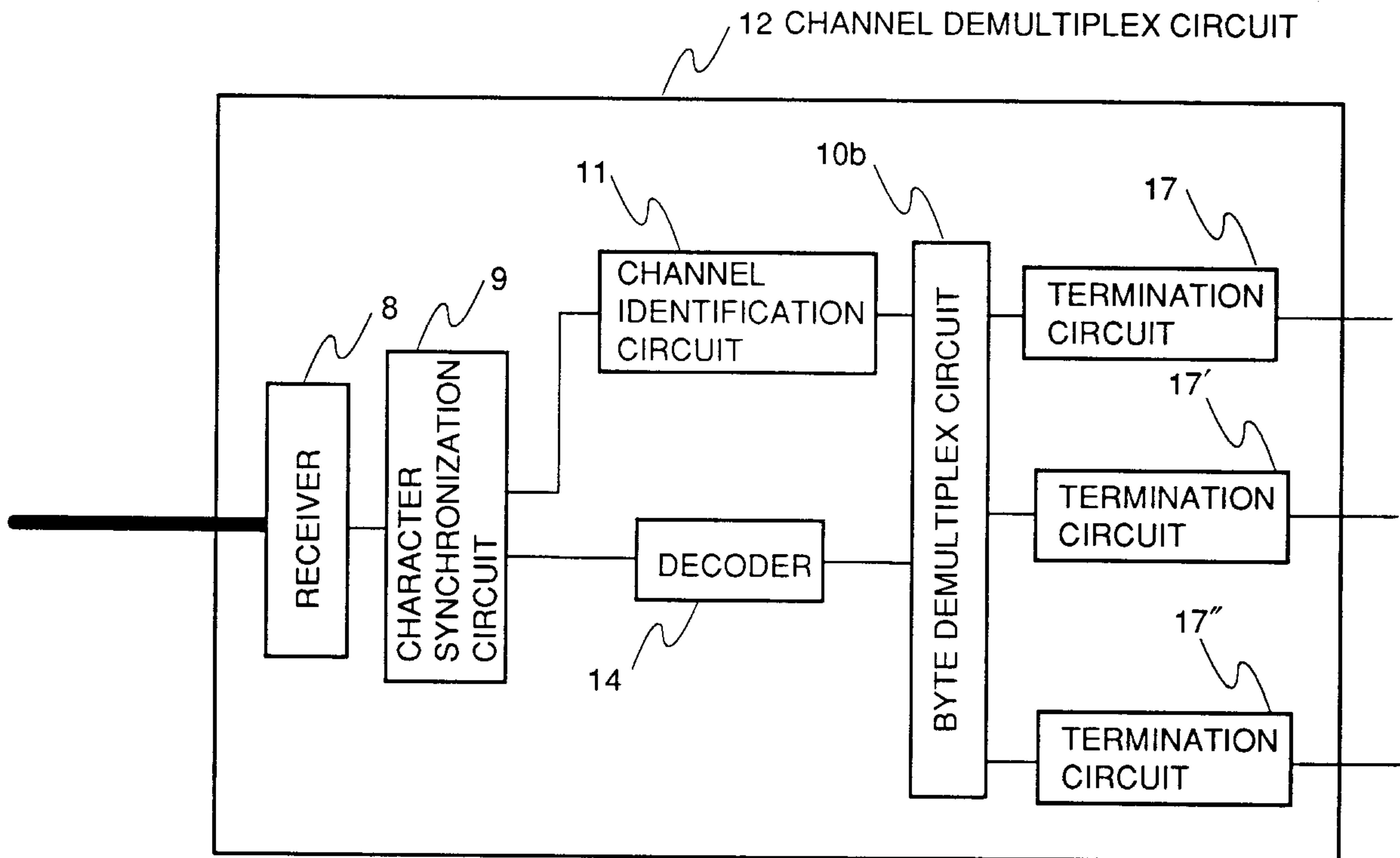


FIG.6

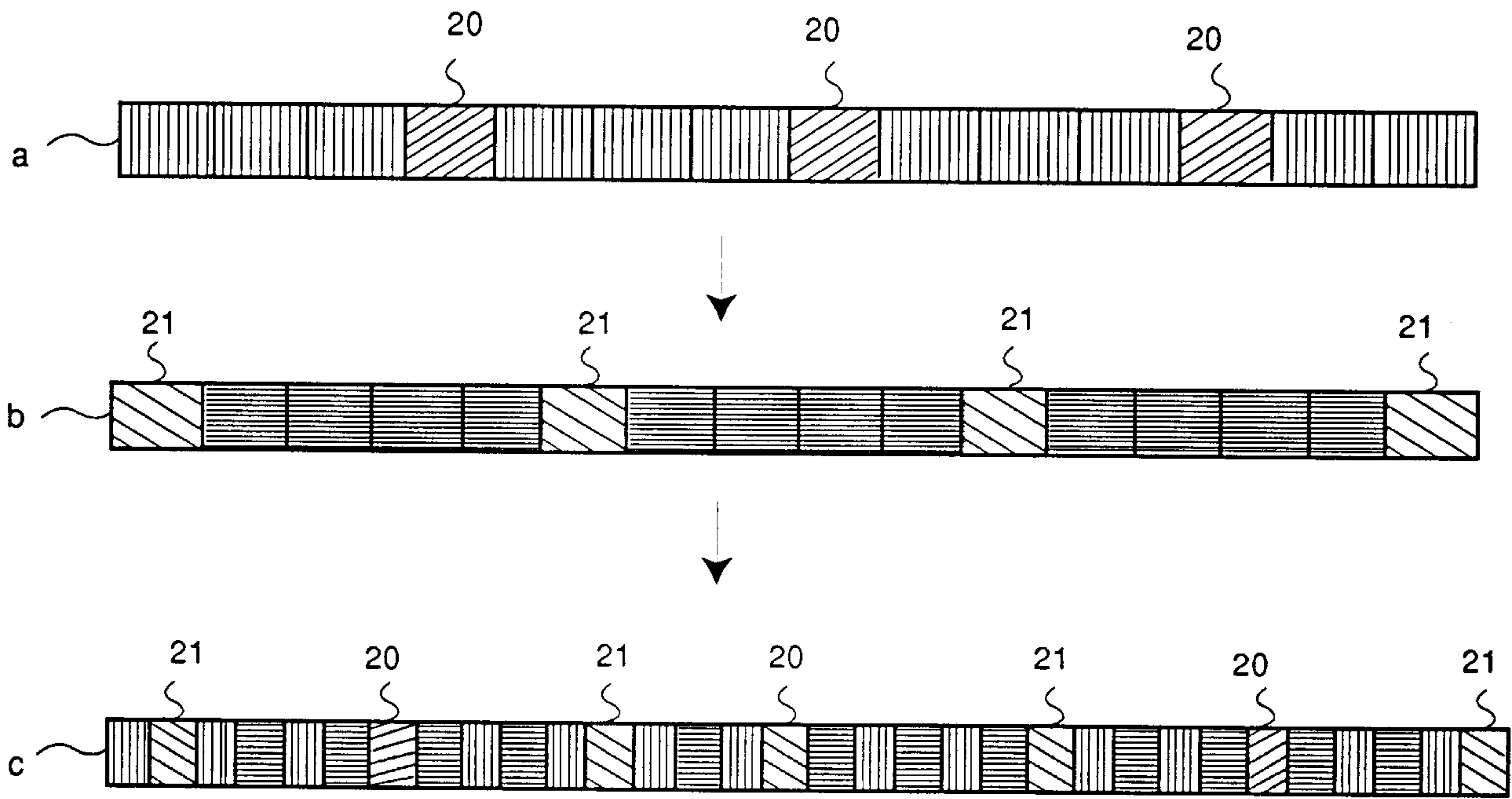


FIG. 7

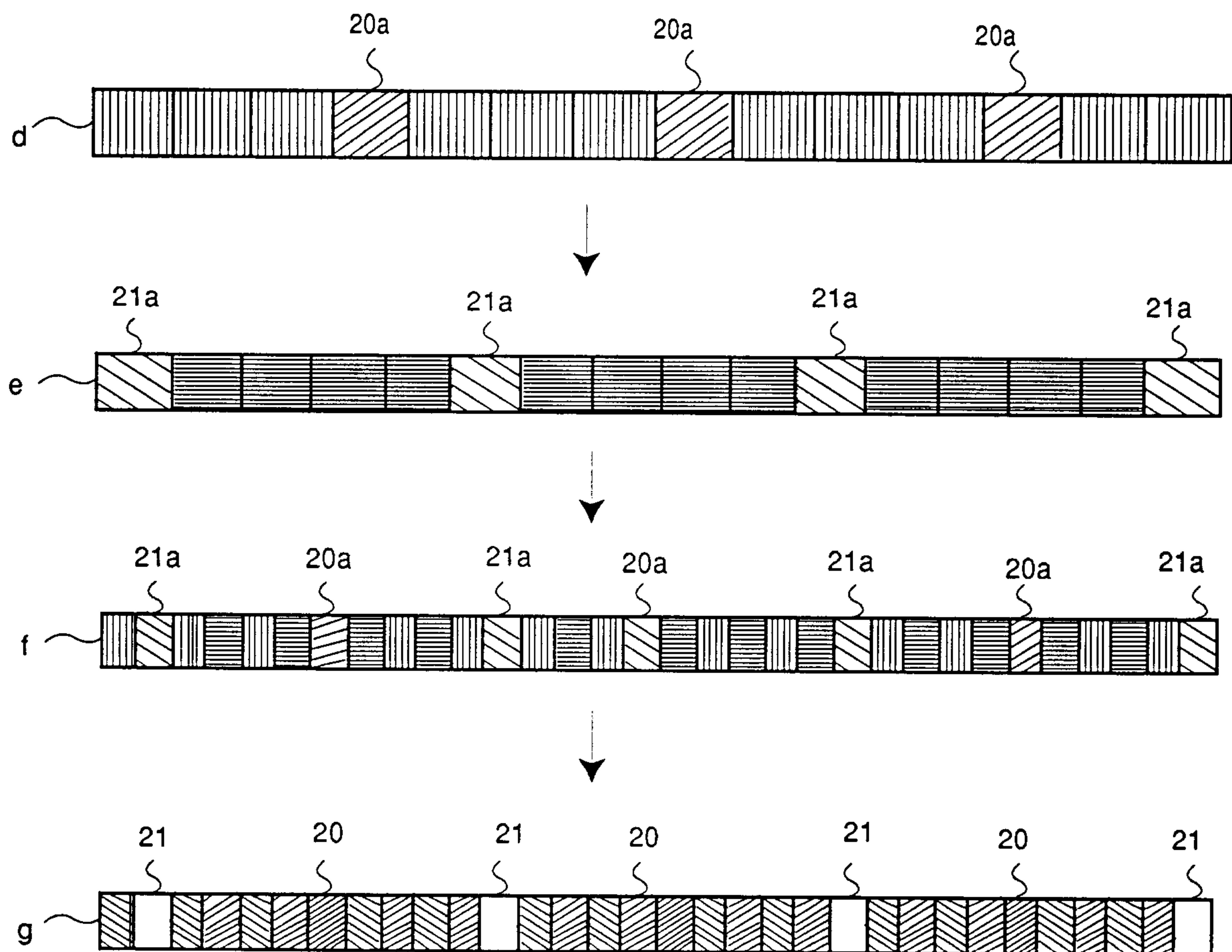


FIG.8

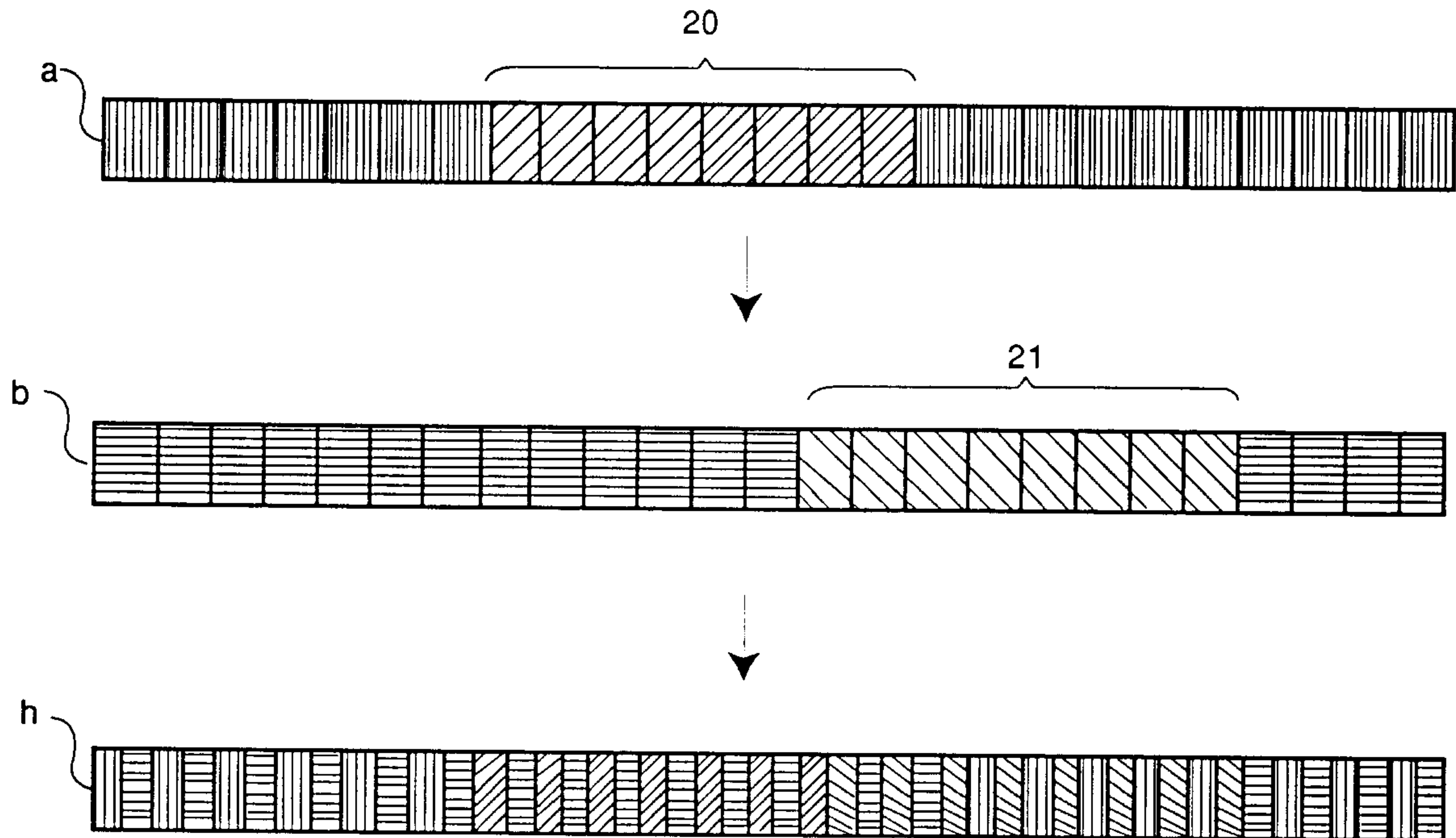


FIG. 9
PRIOR ART