

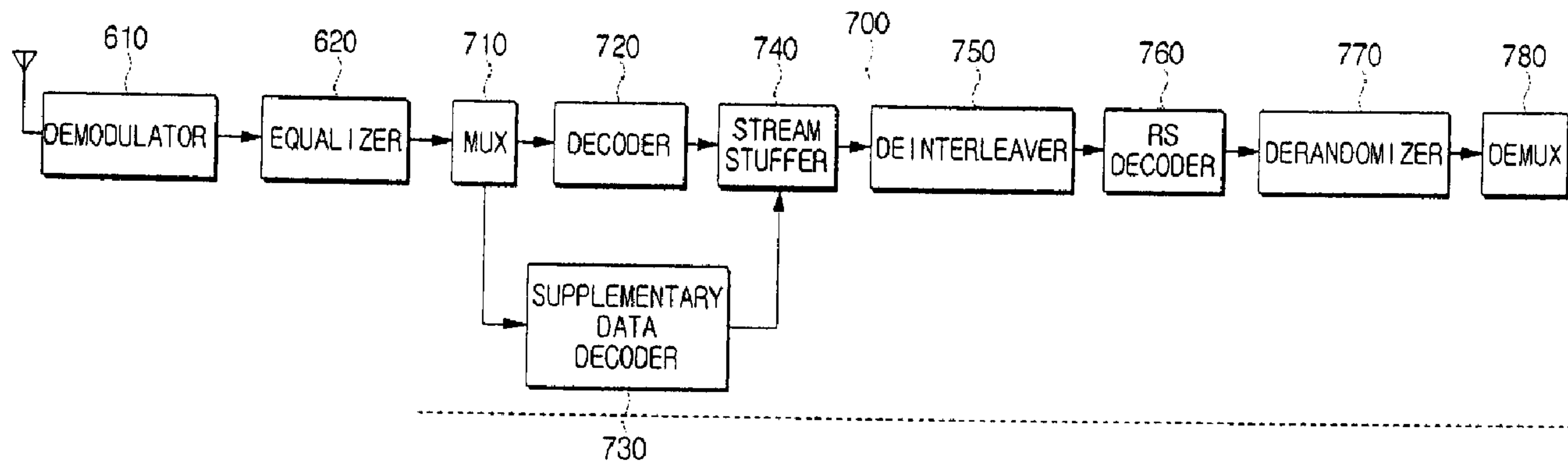


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(54) Titre : DISPOSITIF DE GENERATION DE FLUX DE TRANSMISSION POUR GENERER UN FLUX DE TRANSMISSION DANS LEQUEL DES DONNEES SUPPLEMENTAIRES SONT CHARGES DANS UNE CHARGE UTILE D'UN PAQUET, DISPOSITIF D'EMISSION/RECEPTION DE DIFFUSION NUMERIQUE POUR EMETTRE/RECEV

(54) Title: TRANSMISSION STREAM GENERATING DEVICE FOR GENERATING TRANSMISSION STREAM WHICH ADDITIONAL DATA IS STUFFED IN A PAYLOAD AREA OF A PACKET, DIGITAL BROADCAST TRANSMITTING/RECEIVING DEVICE FOR TRANSMITTING/RECEIVING THE TRANSMISSION STREAM, AND METHODS THEREOF



(57) **Abrégé/Abstract:**

A digital broadcast receiving apparatus comprises a demodulator for receiving and demodulating a stream transmitted from a digital broadcast transmitting apparatus, an equalizer for equalizing the demodulated stream, and a data processing unit for decoding the equalized stream. The stream is interleaved in a state that supplementary data which are processed to be robust against errors are inserted into the entire payload region of at least one packet constituting the stream, and is transmitted from the digital broadcast transmitting apparatus.

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Abstract

A digital broadcast receiving apparatus comprises a demodulator for receiving and demodulating a stream transmitted from a digital broadcast transmitting apparatus, an equalizer for equalizing the demodulated stream, and a data processing unit for decoding the equalized stream. The stream is interleaved in a state that supplementary data which are processed to be robust against errors are inserted into the entire payload region of at least one packet constituting the stream, and is transmitted from the digital broadcast transmitting apparatus.

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Description

TRANSMISSION STREAM GENERATING DEVICE FOR GENERATING TRANSMISSION STREAM WHICH ADDITIONAL DATA IS STUFFED IN A PAYLOAD AREA OF A PACKET, DIGITAL BROADCAST TRANSMITTING/RECEIVING DEVICE FOR TRANSMITTING/RECEIVING THE TRANSMISSION STREAM, AND METHODS THEREOF

This is a divisional of Canadian National Phase Patent Application Serial No. 2,645,533 filed June 18, 2007.

Technical Field

- [1] The present invention relates to a transmission stream (TS) generating device, a digital broadcast transmitting/receiving device for transmitting/receiving the TS, and methods thereof, and more particularly, to a TS generating device for stuffing in supplementary data by utilizing a payload area of a packet, and generating a TS, a digital broadcast transmitting/receiving device for transmitting/receiving the generated stream, and methods thereof.

Background Art

- [2] The advent of electronic and communication technologies brought in digitalization of broadcast system, and as a result, a variety of digital broadcast standards are being offered. Examples of such broadcast standards are U.S.-oriented ATSC VSB standard, and Europe-oriented DVB-T standard. These two standards vary from each other in many ways, such as ways of audio compression, channel bands, number of carrier waves, etc.
- [3] The U.S.-oriented 8-VSB system defines that a VSB data frame includes two fields, and each field includes one field sync segment, which is the first segment, and 312 other data segments. One segment of VSB data frame corresponds to one MPEG-2 packet, and one segment includes 4 symbols of segment sync and 828 data symbols.
- [4] Under this frame standard, it is necessary to use a private field within an adaptation field, in order to transmit data other than normal data. In this cases, a 2-byte-long adaptation field header has to be provided to define an adaptation field within a packet.
- [5] As a result, the amount of data transmission decreases as much as the adaptation field header occupies the portion, and data transmission efficiency degrades.

Disclosure of Invention

Technical Problem

- [6] The present invention has been provided to overcome the problems mentioned above, and accordingly, it is an object of the present invention to provide a

transmission stream (TS) generating device for stuffing in supplementary data by utilizing a payload area of a packet in generating a TS, and is thus capable of improving data transmission efficiency which would be degraded if an adaptation field header is used, a digital broadcast transmitting/receiving apparatus for transmitting/receiving the generated TS, and methods thereof.

Technical Solution

[7]

[8] According to one exemplary embodiment of the present invention to accomplish the above objects, a transmission stream (TS) generating device is provided, including an adapter unit to receive normal data, to construct a stream having a plurality of packets, and to provide adaptation fields in some of the plurality of packets, and a stuffing unit to stuff supplementary data to the entire payload region of some of the plurality of the packets that do not have the adaptation fields.

[9] The stuffing unit may divide and stuff a plurality of supplementary data packets into the entire payload region of the packets that do not have the adaptation fields.

[10] The stuffing unit may divide and stuff a plurality of supplementary data packets into the entire payload region of first packets from among the packets that do not have the adaptation fields, and may insert one supplementary data packet into the entire payload region of second packets from among the packets that do not have the adaptation fields.

[11] The adapter unit may define a packet having a new PID, and may generate a stream having the defined packet, wherein the stuffing unit stuffs the supplementary data into the entire payload region of the defined packet.

[12] The adapter unit may provide an adaptation field of a predetermined size on a packet in which the normal data are written in a payload region, the adaptation field including an adaptation field header and an adaptation field payload.

[13] Preferably, the stuffing unit may stuff the supplementary data in a manner such that the plurality of packets constituting the stream are in the same pattern at an interval corresponding to a predetermined number of packets, the predetermined number corresponding to one of the divisors of number 12.

[14] More preferably, the supplementary data may include turbo coding data.

[15] A digital broadcast transmitting apparatus according to an exemplary embodiment of the present invention includes a transmission stream (TS) generating device to receive normal data, to generate a stream having a plurality of packets, and to stuff supplementary data in payload regions of some of the plurality of packets, a randomizer to randomize the stream, a supplementary reference signal (SRS) stuffer to stuff SRS in each packet of the randomized stream, and a transmission signal processor

to modulate the stream and output the result.

- [16] Meanwhile, a transmission stream (TS) generating method according to an exemplary embodiment of the present invention may include (a) receiving normal data, generating a stream having a plurality of packets, and providing adaptation fields in some of the plurality of packets, and (b) stuffing supplementary data in the entire payload regions of the packets that do not have the adaptation fields.
- [17] The step (b) may divide and stuff a plurality of supplementary data packets in the entire payload regions of the packets that do not have the adaptation fields.
- [18] The step (b) may divide and stuff a plurality of supplementary data packets in the entire payload regions of first packets from among the packets that do not have the adaptation fields, and may stuff one supplementary data packet in the entire payload regions of second packets from among the packets that do not have the adaptation fields.
- [19] The step (a) may define a packet having a new PID and generates a stream having the defined packet, and the step (b) may stuff the supplementary data in the entire payload region of the defined packet.
- [20] The step (a) may provide an adaptation field of a predetermined size on a packet in which the normal data are written in a payload region, the adaptation field including an adaptation field header and an adaptation field payload.
- [21] The step (b) may stuff the supplementary data in a manner such that the plurality of packets constituting the stream are in the same pattern at an interval corresponding to a predetermined number of packets, the predetermined number corresponding to one of the divisors of number 12. The supplementary data may include turbo coding data.
- [22] A digital broadcast receiving apparatus according to an exemplary embodiment of the present invention may include a demodulator to receive a transmission stream (TS) having a plurality of packets, and supplementary data stuffed in the entire payload regions of some of the plurality of packets, an equalizer to equalize the demodulated TS, and a data processor to detect normal data stream and supplementary data stream from packet payload regions of the equalized TS, and to decode the detected streams to recover the normal data and the supplementary data.
- [23] The demodulator may receive a transmission stream (TS) in which a plurality of supplementary data packets are divided and stuffed in the entire payload regions of the packets that do not have the adaptation fields.
- [24] The demodulator may receive a transmission stream (TS) in which a plurality of supplementary data packets are divided and stuffed in the entire payload regions of first packets from among the packets that do not have the adaptation fields, and in which one supplementary data packet is stuffed in the entire payload regions of second packets from among the packets that do not have the adaptation fields.

- [25] The demodulator may receive a transmission stream (TS) in which the supplementary data are stuffed in a manner such that the plurality of packets constituting the stream are in the same pattern at an interval corresponding to a predetermined number of packets, the predetermined number corresponding to one of the divisors of number 12.
- [26] The data processor may include a MUX to detect the normal data stream and the supplementary data stream from the equalized TS, a decoder to decode the detected normal data stream, a supplementary data decoder to decode the detected supplementary data stream, a stream stuffer to stuff the supplementary data stream decoded at the supplementary data decoder into a decoding stream output from the decoder, a de-interleaver to de-interleave the TS processed at the stream processor, a RS decoder to reed-solomon decode the de-interleaved TS, a de-randomizer to de-randomize the RS-decoded TS, and a de-MUX to de-multiplex the de-randomized TS to recover the normal data and the supplementary data.
- [27] The data processor may include a MUX to detect the normal data stream and the supplementary data stream from the equalized TS, a first processor to decode the detected normal data stream to recover the normal data, and a second processor to decode the detected supplementary data stream to recover the supplementary data.
- [28] The first processor may include a decoder to perform error correction on normal data stream within the equalized TS, and to decode the error-corrected normal data stream, a first de-interleaver to de-interleave the stream output from the decoder, a reed-solomon (RS) decoder to RS-decode the de-interleaved stream, and a first de-randomizer to de-randomize the RS-decoded stream to recover the normal data.
- [29] The second processor may include a supplementary data decoder to decode supplementary data stream within the equalized transmission stream (TS), a second de-interleaver to de-interleave the stream output from the supplementary data decoder, a parity remover to remove parities from the de-interleaved stream from the second de-interleaver, a second de-randomizer to de-randomize the parity-removed TS, and a data recovery unit to recover the supplementary data from the de-randomized stream.
- [30] A digital broadcast receiving method according to an exemplary embodiment of the present invention may include (a) receiving a transmission stream (TS) having a plurality of packets and in which supplementary data are stuffed in the entire payload regions of some packets, and demodulating the received TS, (b) equalizing the demodulated TS, (c) detecting normal data stream and supplementary data stream from the payload regions of the packets of the equalized TS, and (d) decoding the detected streams to recover normal data and supplementary data.
- [31] The step (a) may receive a transmission stream (TS) in which a plurality of supplementary data streams are divided and stuffed in the entire payload regions of the

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packets that do not have the adaptation fields.

[32] The step (a) may receive a transmission stream (TS) in which a plurality of supplementary data packets are divided and stuffed in the entire payload regions of first packets from among the packets that do not have the adaptation fields, and in which one supplementary data packet is stuffed in the entire payload regions of second packets from among the packets that do not have the adaptation fields.

[33] The step (a) may receive a transmission stream (TS) in which the supplementary data are stuffed in a manner such that the plurality of packets constituting the stream are in the same pattern at an interval corresponding to a predetermined number of packets, the predetermined number corresponding to one of the divisors of number 12.

Summary of the Invention

[33a] According to an aspect of the present invention, there is provided a digital broadcast receiving apparatus, comprising: a demodulator to receive and demodulate a stream transmitted from a digital broadcast transmitting apparatus; an equalizer to equalize the demodulated stream; and a data processing unit to decode the equalized stream, wherein the stream is interleaved in a state that supplementary data which are processed to be robust against errors are inserted into the entire payload region of at least one packet constituting the stream, and is transmitted from the digital broadcast transmitting apparatus.

[33b] According to another aspect of the present invention, there is provided a stream processing method for a digital broadcast receiving apparatus, the method comprising: receiving and demodulating a stream transmitted from a digital broadcast transmitting apparatus; equalizing the demodulated stream; and processing data by decoding the equalized stream, wherein the stream is interleaved in a state that supplementary data which are processed to be robust against errors are inserted into the entire payload region of at least one packet constituting the stream, and is transmitted from the digital broadcast transmitting apparatus.

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Advantageous Effects

- [34] According to the present invention, supplementary data is stuffed by utilizing a payload area of a packet, in generating a stream. Therefore, depending on packets, even the supplementary data is transmitted, without having to use an adaptation field, and as a result, data transmission efficiency, which would be degraded if an adaptation field header is used, is improved.
- [35] [Brief Description of the Drawings]
- [36] FIG. 1 is a block diagram of a transmission stream (TS) generating device according to an exemplary embodiment of the present invention;
- [37] FIG. 2 is a block diagram of a digital broadcast transmitting apparatus according to an exemplary embodiment of the present invention;
- [38] FIGS. 3 and 4 are provided to explain a variety of examples of structures of streams being generated at the present TS generating device;
- [39] FIG. 5 is a flowchart provided to explain a method of generating a transmission stream (TS) according to an exemplary embodiment of the present invention;
- [40] FIG. 6 is a block diagram of a digital broadcast receiving apparatus according to an exemplary embodiment of the present invention;
- [41] FIGS. 7 and 8 are block diagrams provided to explain a variety of examples of structure of a digital broadcast receiving apparatus according to the present invention; and
- [42] FIG. 9 is a flowchart provided to explain a method of digital broadcast reception according to an exemplary embodiment of the present invention.

Best Mode for Carrying Out the Invention

- [43] FIG. 1 is a block diagram of a transmission stream (TS) generating device according to an exemplary embodiment of the present invention. Referring to FIG. 1, a TS generating device 100 includes an adapter unit 110, and a stuffing unit 120.
- [44] The adapter unit 110 receives normal data and generates a stream having a plurality

of packets. In this process, the adapter unit 110 generates an adaptation field in some of a plurality of packets. The adapter unit 110 may generate a stream which contains a predefined packet having a new PID so that supplementary data can be stuffed in some of the packets.

- [45] An adaptation field is provided at one part of a packet, to be used adaptively. An adaptation field includes an adaptation field header (AF header), optional field, and stuffing region. The AF field records therein information about location and size of adaptation field, etc. The optional field is to selectively use program clock reference (PCR) flag, original program clock reference (OPCR) flag, splicing point flag, private data flag, or adaptation field extension flag. The stuffing region is where supplementary data can be added.
- [46] The stuffing unit 120 stuffs supplementary data into the entire payload region of some packets of the generated stream, which do not have adaptation fields. The supplementary data may include turbo coding data. The turbo coding data may be generated by compressing data in a compression standard which is different from the one applied to normal data, and by robust-processing the data. The stuffing unit 120 receives supplementary data from an external module such as a broadcast recording apparatus, or a variety of internal modules such as compression module such as MPEG-2 module, video encoder, or audio encoder, and stuffs the received data in the stream generated at the adapter unit 110.
- [47] The adapter unit 110 does not generate an adaptation field for a packet, if supplementary data is going to be stuffed in the entire payload region of the packet. Because additional region such as adaptation field header is not used in the packets where supplementary data is stuffed into the entire payload region, data transmission rate is improved.
- [48] Although not shown in FIG. 1, the TS generating device 100 may further include components such as reed-solomon (RS) encoder (not shown), interleaver (not shown), and duplicator. The RS encoder may receive supplementary data externally, and perform RS encoding. That is, the RS encoder may receive supplementary data stream which contains sync signal region. The supplementary data stream may include total 188 bytes of packets, and these may include 1 byte of sync signal, 3 bytes of header, and 184 bytes of supplementary data. The RS encoder removes sync signal from the supplementary data stream, computes parities regarding supplementary data region, and adds 20-byte-long parities. As a result, a packet of the final result of encoding the supplementary data stream includes total 207 bytes. Among these, 3 bytes are allocated to the header, 184 bytes to the supplementary data, and 20 bytes to the parities. An interleaver (not shown) interleaves RS-encoded supplementary data stream, and provides the duplicator (not shown) with the result. The duplicator generates a parity stuffing

region in the supplementary data stream, and provides the stuffing unit with the supplementary data stream. Accordingly, by stuffing parities of the supplementary data stream during the processing for transmitting the generated stream, supplementary data can be processed more robustly.

[49] FIG. 2 is a block diagram of a digital broadcast transmitting apparatus according to an exemplary embodiment of the present invention. Referring to FIG. 2, a digital broadcast transmitting apparatus includes a TS generating device 100, a randomizer 210, an supplementary reference signal stuffer 220, and a TS processor 230.

[50] The TS generating device 100 may have the same structure as illustrated in FIG. 1. Accordingly, the TS generating device 100 outputs a stream which contains packets having supplementary data stuffed in the payload region, and packets having normal data stuffed in the payload region.

[51] The randomizer 210 randomizes the stream being output from the TS generating device 100.

[52] The supplementary reference signal (SRS) stuffer 220 may stuff supplementary reference signal with respect to the packets provided in the randomized stream. The SRS refers to a sequence which is already known to both of a digital broadcast transmitting apparatus and a digital broadcast receiving apparatus. The SRS may be inserted in the stream as the supplementary data, and transmitted so that the receiving device can perform synchronization and channel equalization.

[53] The SRS stuffer 220 may stuff SRS in an adaptation field, if a packet has an adaptation field therein. Regarding a packet which does not have an adaptation field, that is, if a packet has supplementary data stuffed in a payload region, SRS may be stuffed in the payload region together with the supplementary data.

[54] The TS processor 230 modulates the stream output from the SRS stuffer 220, and sends out through a radio frequency(RF) channel.

[55] Specifically, the TS processor 230 may be configured to include a RS encoder (not shown), an interleaver (not shown), a trellis encoder (not shown), a MUX (not shown), a pilot inserter (not shown), a VSB modulator (not shown), and a RF up-converter (not shown). To explain briefly about functions of the constituting elements, the RS encoder performs RS encoding to add parity bytes to the TS so that error by channel characteristic during the transmission can be corrected. The interleaver interleaves the RS-encoded data according to interleaving rule, and the trellis encoder trellis encodes the data. Next, the MUX inserts field sync and segment sync into the trellis-encoded TS. the pilot inserter inserts pilot tone by adding a DC value to a signal output from the MUX. Next, the VSB modulator performs VSB modulation, and the RF up-converter up-converts the signal into RF channel band signal, and outputs the signal over an antenna. As explained above, the TS processor 230 converts a signal generated at the

TS generating apparatus 100 into a single carrier signal in time domain, and outputs the result.

- [56] Meanwhile, the TS processor 230 may further include a turbo processor (not shown) to decode the supplementary data more robustly. The turbo processor may encode the supplementary data, by detecting supplementary data stream from the stream, computing a parity regarding the supplementary data stream, and stuffing the parity into the parity stuffing region. The turbo processor may then interleave the encoded supplementary data stream, and stuffs it back into the stream so that the stream can be restructured.
- [57] FIGS. 3 and 4 are provided to explain various configurations of a stream being generated at the TS generating device of FIG. 1 or FIG. 2. Referring to FIG. 3, one stream includes a plurality of packets (1~n), and each packet is divided into a header and a payload region.
- [58] Referring first to FIG. 3, the first packet 1 is divided into a header region containing sync and packet identifier (PID), and a payload region containing SRS and turbo stream (TS1), TS2, TS3. That is, it is apparent that the first packet 1 does not have an adaptation field. supplementary data such as SRS, TS1, TS2, TS3 are stuffed in the entire payload region of the first packet 1. As explained above, the stuffing unit 120 may distribute and stuff a plurality of supplementary data packets TS1 to TS2 into the payload region of the packet where no adaptation field is provided. Additionally, the SRS stuffer 220 may insert the SRS into the payload region of the packet as the supplementary data.
- [59] In the second packet 2, SRS and TS3 are stuffed in the entire payload region. As explained above, the stuffing unit 120 may stuff one supplementary data packet TS3 in the payload region of the packet where no adaptation field is provided.
- [60] The third and fourth packets 3, 4 are provided for the transmission of normal data. These packets 3, 4 provided with adaptation fields by the adapter unit 110. The SRS stuffer 220 stuffs SRS in the payload region of the adaptation field. Accordingly, it is apparent that the AF header is defined together.
- [61] The fifth packet 5 is generated in the same pattern as the first packet 1. That is, patterns of the respective packets repeat in the cycle of 4 packets. As explained above, the stuffing unit 120 may stuff supplementary data in the packet at a predetermined location, so that a plurality of packets can be arranged in a pattern where packets in predetermined locations are in the same pattern. More specifically, a group of four packets (G1, ..., G-m) is repeatedly generated.
- [62] The number of packets in one cycle may be set according to the number of trellis encoder blocks (not shown). For example, if there are 12 trellis encoder blocks (not shown) provided to perform stream encoding, the stuffing unit 120 stuffs sup-

plementary data in a manner such that the packets in every first, second, third, fourth, sixth, or twelfth locations, which are the divisors of number 12, are in the same pattern. By doing so, the size of supplementary data region processible within the trellis encoder block can be extended as large as possible.

- [63] FIG. 4 illustrates a packet configured in different pattern from the one illustrated in FIG. 4. Referring to FIG. 4, AF is not provided in the first and second packets where only the supplementary data stream (SRS, TS1, TS2, TS3) are stuffed, while AF is provided in the third and fourth packets where supplementary data (SRS, TS4) and normal stream (NS) are stuffed. More particularly, SRS is stuffed in the payload region of the first and second packets, and stuffed in the AF in the third and fourth packets. By utilizing AF header, which takes 2 bytes for each packet, data transmission rate can be enhanced.
- [64] The adapter unit 110 and the stuffing unit 120 may generate a stream in various patterns other than that shown in FIG. 3 or FIG. 4. For example, the adapter unit 110 may generate packets having AFs and packets without AFs alternately, and the stuffing unit 120 may insert supplementary data in the payload regions of the packets without AFs. As explained above, stream configuration may be varied in many ways.
- [65] FIG. 5 is a flowchart illustrating a method of generating a TS according to an exemplary embodiment of the present invention. According to the method of generating a TS, first, normal data is received (S510), and accordingly, a stream having a plurality of packets is constructed (S520). In particular, a new PID may be defined and a packet may be added. In this case, adaptation field is created exclusively in some of the packets. The packets having adaptation fields and the packets without adaptation fields may be arranged according to a predetermined pattern. For example, the packets may be arranged in 2:2 ratio as illustrated in FIGS. 3 and 4, or in various ratio such as 1:1, 1:3, 3:3, and so on.
- [66] Next, supplementary data is stuffed in the entire payload region of the packets without adaptation field (S530). In this case, the supplementary data may be turbo coding data. The supplementary data may also include SRS. As supplementary data is stuffed in the normal payload region of the packets, it is unnecessary to provide regions such as adaptation field header, and accordingly, these regions are omitted. Meanwhile, if the packets have adaptation fields, supplementary data is stuffed in the adaptation fields. Accordingly, the adaptation field header enables to distinguish supplementary data stuffed in the adaptation field from the normal data stuffed in the normal payload region.
- [67] FIG. 6 is a block diagram of a digital broadcast receiving apparatus according to an exemplary embodiment of the present invention. Referring to FIG. 6, the digital broadcast receiving apparatus includes a demodulator 610, an equalizer 620, and a data

processor 700.

- [68] The demodulator 610 receives stream transmitted from the digital broadcast transmitting device over an antenna, and demodulates the received stream. The stream received and demodulated at the demodulator 610 may be the stream being generated at the TS generating device illustrated in FIG. 1. Accordingly, the received stream may have the configuration as illustrated in FIG. 3 or FIG. 4. That is, a stream includes a plurality of packets, and supplementary data is stuffed in the entire payload of some packets. The packets having supplementary data stuffed therein are the ones that do not have adaptation field, including adaptation field header and adaptation field payload.
- [69] The equalizer 620 equalizes the demodulated TS. If SRS exists in the supplementary data, the equalizer 620 may perform channel equalization using SRS.
- [70] The data processor 700 detects normal data stream and supplementary data stream from the payload regions of packets of the equalized TS, and decodes the detected streams to recover normal data and supplementary data. The data processor 700 may be configured in various ways.
- [71] FIGS. 7 and 8 are block diagrams provided to explain an exemplary configuration of a digital broadcast receiving device having data processors 700 of various structures.
- [72] Referring first to FIG. 7, the data processor 700 includes a MUX 710, a decoder 720, a supplementary data decoder 730, a stream stuffer 740, a deinterleaver 750, a RS decoder 760, and a de-randomizer 770.
- [73] The MUX 710 detects and detects normal data stream and supplementary data stream from the equalized TS. In this case, the MUX 710 detects supplementary data stream from a predetermined location according to the pattern of the packets applied in the stream generating process, and detects normal data stream from the other locations. If packets of a predetermined cycle based on one of the divisors of number 12 are in same pattern, it is possible to check the locations of stuffing in the supplementary data streams periodically, and to detect the supplementary data streams. The detected normal data stream is provided to the decoder 720, and the supplementary data stream is provided to the supplementary data decoder 730.
- [74] The decoder 720 decodes the provided normal data stream, and provides the stream stuffer 740 with the result.
- [75] The supplementary data decoder 730 decodes the provided supplementary data stream. That is, the supplementary data decoder 730 may decode the turbo coding data. Specifically, the supplementary data decoder 730 may include a trellis decoder (not shown), an outer de-interleaver (not shown), an outer interleaver (not shown), and outer map decoder (not shown), a frame formatter (not shown), and a symbol de-interleaver (not shown).

- [76] The trellis decoder trellis-decodes the provided supplementary data stream, and the outer de-interleaver de-interleaves the trellis-decoded stream. The outer map decoder may convolution-decode the de-interleaved stream. The outer map decoder outputs a soft decision output or a hard decision output according to the result of convolution decoding. The hard decision output of the outer map decoder, that is, the hard decision stream is provided to the frame formatter, and the frame formatter formats the convolution-decoded hard decision stream in accordance with a dual TS frame. The symbol de-interleaver may de-interleave the frame-formatted stream from symbol unit to byte unit. Meanwhile, if a soft decision is output from the outer map decoder, the outer interleaver interleaves the supplementary data stream and provides the trellis decoder with the result. The trellis decoder re-performs trellis decoding of the interleaved stream, and provides the outer de-interleaver with the result. The outer de-interleaver performs de-interleaving again, and provides the outer map decoder with the result. The operations of the trellis decoder, the outer de-interleaver, and the outer interleaver may be reiterated until a hard decision is output. Accordingly, a reliable decoding value can be obtained.
- [77] As explained above, the supplementary data stream processed at the supplementary data decoder 730 can also be provided to the stream stuffer 740 with the normal data stream processed at the decoder 720.
- [78] The stream stuffer 740 stuffs the supplementary data stream being decoded at the supplementary data decoder 730 into the normal data stream being output from the decoder 720, to re-construct one TS.
- [79] The de-interleaver 750 de-interleaves the TS being processed at the stream stuffer 740, and the RS decoder 760 RS-decodes the de-interleaved TS.
- [80] The de-randomizer 770 de-randomizes the RS-decoded TS. The de-MUX 780 de-multiplexes the de-randomized TS, to recover normal data and supplementary data.
- [81] Meanwhile, the digital broadcast receiving apparatus according to the present invention may be implemented in the configuration illustrated in FIG. 8. Referring to FIG. 8, the data processor 700 includes a MUX 810, a first processor 820, and a second processor 830.
- [82] The MUX 810 divides normal data stream and supplementary data stream from the equalized TS, and provides the first and second processors 820, 830 with the results, respectively.
- [83] The first processor 820 decodes the normal data stream to recover normal data. That is, the first processor 820 includes a decoder 821, a first de-interleaver 822, a RS decoder 823, and a first de-randomizer 824.
- [84] The decoder 821 decodes normal data stream, and the first de-interleaver 822 de-interleaves the decoded stream. The RS decoder 823 RS-decodes the de-interleaved

stream, and the first de-randomizer 824 de-randomizes the stream being output from the RS decoder 823 to recover normal data.

- [85] The second processor 830 decodes supplementary data stream to recover supplementary data. That is, the second processor 830 includes a supplementary data decoder 831, a second de-interleaver 832, a parity remover 833, a second de-randomizer 834, and a data recoverer 835.
- [86] The supplementary data decoder 831 decodes supplementary data stream provided by the MUX 810, and the second de-interleaver 832 de-interleaves the decoded supplementary data stream. The parity remover 833 removes parity bit added to the supplementary data stream, and the second de-randomizer 834 de-randomizes parity-removed supplementary data stream.
- [87] The data recoverer 835 recovers supplementary data by processing the de-randomized supplementary data stream. Specifically, the data recoverer 835 includes a de-interleaver (not shown) to de-interleave de-randomized stream, a condenser (not shown) to remove parity stuffing region of the de-interleaved supplementary data stream, a RS decoder (not shown) to RS-decode the stream, and a sync inserter (not shown) to recover supplementary data by inserting sync signal into the decoded stream.
- [88] FIG. 9 is a flowchart provided to explain a digital broadcast receiving method according to an exemplary embodiment of the present invention. Referring to FIG. 9, the digital broadcast receiving method receives TS in which supplementary data is stuffed in the entire payload region of some packets, and demodulates the received TS (S910). The received stream may have the same structure as those illustrated in FIGS. 3 and 4.
- [89] That is, the received stream may have the structure in which a plurality of supplementary data streams are stuffed in the entire payload regions of the packets which do not have adaptation fields.
- [90] Additionally, the received stream may have the structure in which a plurality of supplementary data packets are divided and stuffed in the entire payload regions of some (first packets) of the packets which do not have adaptation fields, and in which one supplementary data packet is stuffed in the entire payload region of some other packets (second packets) of the packets which do not have adaptation fields.
- [91] When the received stream is demodulated (S910), the processed stream is equalized (S920).
- [92] Next, normal data stream and supplementary data stream are detected from the equalized stream (S930). In this case, supplementary data stream may be detected from predetermined locations according to the packet pattern of received stream, and normal data stream may be detected from the other locations. In other words, because sup-

plementary data are stuffed in locations at intervals of a predetermined number of packets in the transmission, the predetermined number corresponding to one of divisors of number 12, the locations of the packets where the supplementary data are stuffed, can be determined and so the supplementary data stream can be detected, if packets at predetermined intervals are in the same pattern.

[93] As supplementary data stream and normal data stream are detected respectively, the streams are decoded to recover supplementary data and normal data (S940). Processing on the streams are already explained above in detail with reference to the digital broadcast receiving apparatus illustrated in FIGS. 7 and 8, and therefore, detailed explanation thereof will be omitted for the sake of brevity.

[94] Although a few embodiments of the present invention have been shown and described, it would be appreciated by those skilled in the art that changes may be made in this embodiment without departing from the principles and spirit of the invention, the scope of which is defined in the claims and their equivalents.

[95]

[96]

[97]

Industrial Applicability

[98] The invention is applicable to a broadcast system which constructs broadcast data into stream form and transmits and receives the data stream.

[99]

[100]

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CLAIMS:

1. A digital broadcast receiving apparatus, comprising:
a demodulator to receive and demodulate a stream transmitted from
a digital broadcast transmitting apparatus;
5 an equalizer to equalize the demodulated stream; and
a data processing unit to decode the equalized stream,
wherein the stream is interleaved in a state that supplementary data
which are processed to be robust against errors are inserted into the entire
payload region of at least one packet constituting the stream, and is transmitted
10 from the digital broadcast transmitting apparatus.
2. The digital broadcast receiving apparatus according to claim 1,
wherein the stream is transmitted from the digital broadcast transmitting apparatus
in which after an adapter unit constitutes the stream into which the supplementary
data can be inserted and an insertion unit inserts the supplementary data into the
15 stream, the stream is encoded, interleaved, and trellis-encoded.
3. The digital broadcast receiving apparatus according to claim 1,
wherein the data processing unit comprises:
an additional data decoder to decode the supplementary data; and
a deinterleaver to deinterleave the decoded supplementary data.
- 20 4. A stream processing method for a digital broadcast receiving
apparatus, the method comprising:
receiving and demodulating a stream transmitted from a digital
broadcast transmitting apparatus;
equalizing the demodulated stream; and
25 processing data by decoding the equalized stream,

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wherein the stream is interleaved in a state that supplementary data which are processed to be robust against errors are inserted into the entire payload region of at least one packet constituting the stream, and is transmitted from the digital broadcast transmitting apparatus.

- 5 5. The stream processing method according to claim 4, wherein the stream is transmitted from the digital broadcast transmitting apparatus in which the stream is constituted to be able to include the supplementary data, the supplementary data are inserted into the stream, and the stream is encoded, interleaved, and trellis-encoded.
- 10 6. The stream processing method according to claim 4, wherein the processing the data comprises:

decoding the supplementary data; and

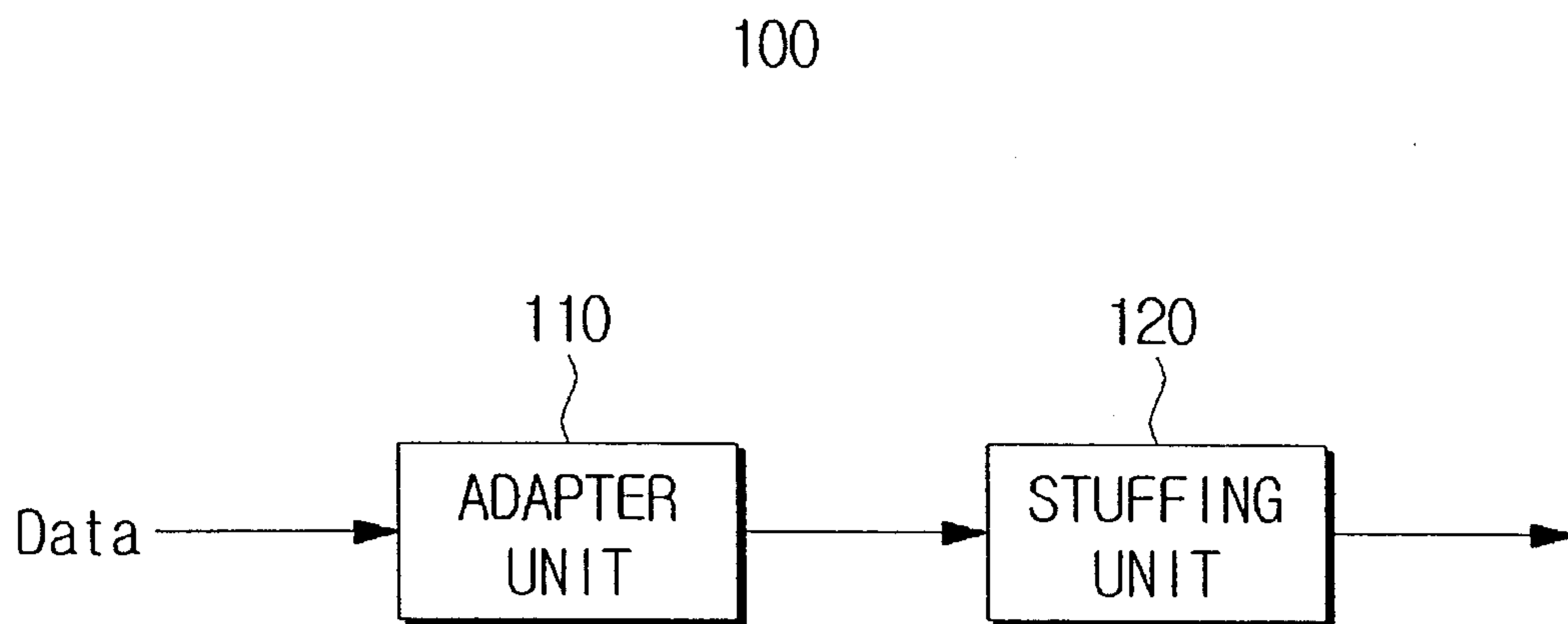
deinterleaving the decoded supplementary data.

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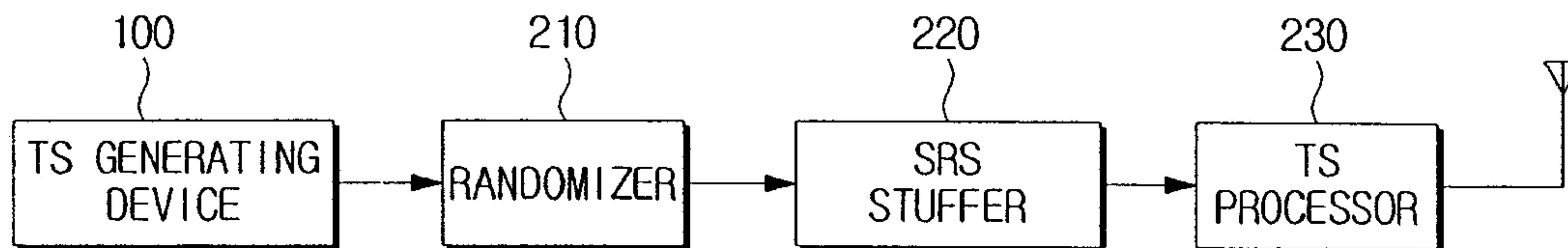
OTTAWA, CANADA

PATENT AGENTS

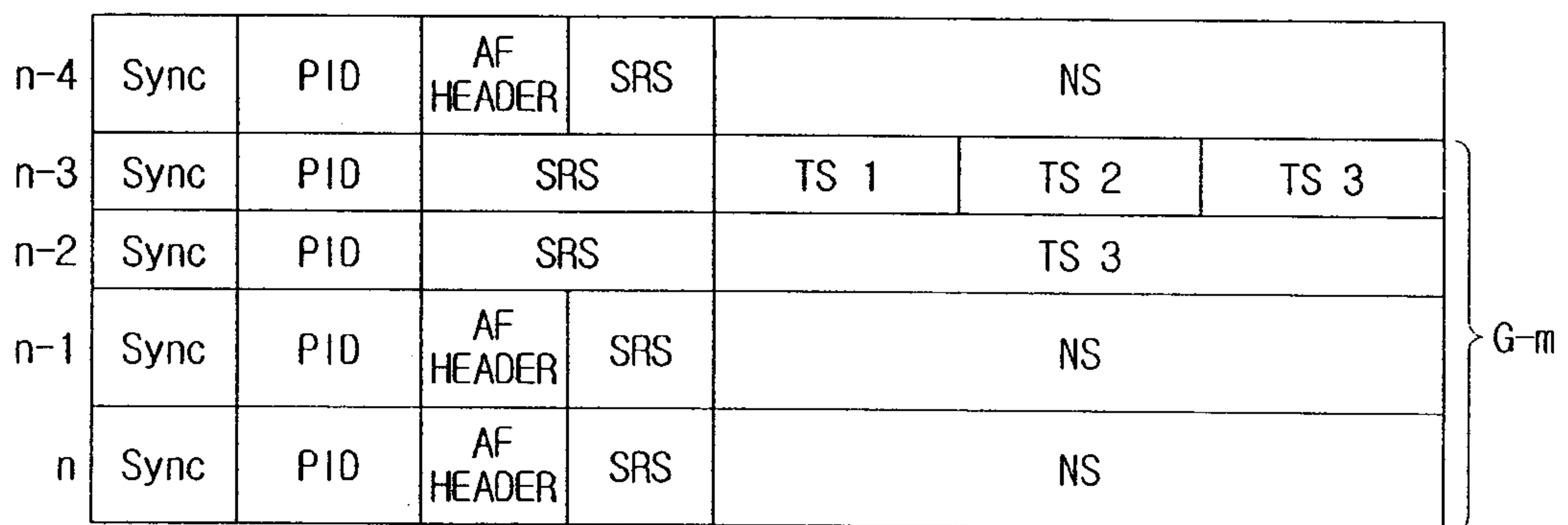
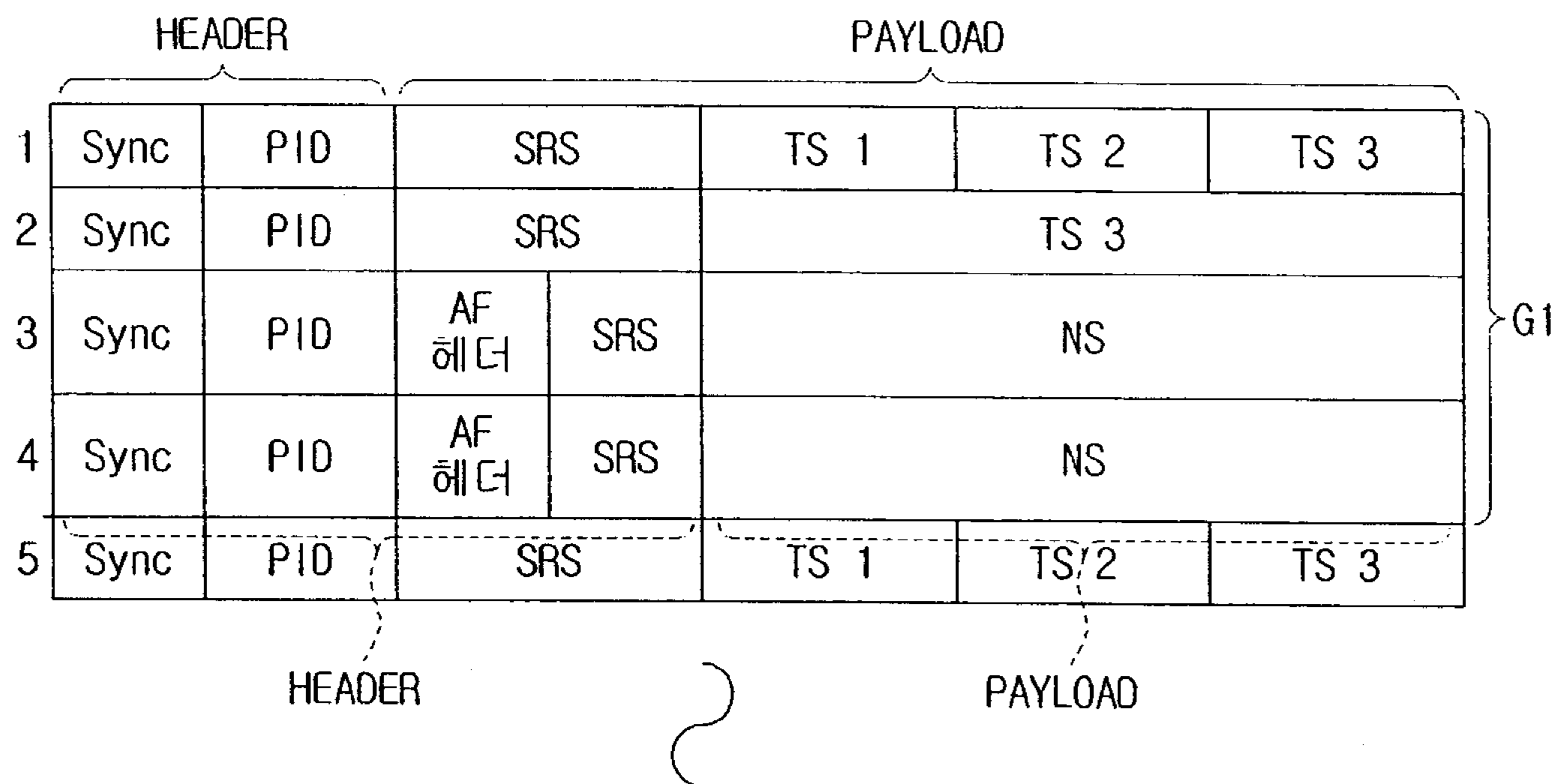
[Fig. 1]



[Fig. 2]



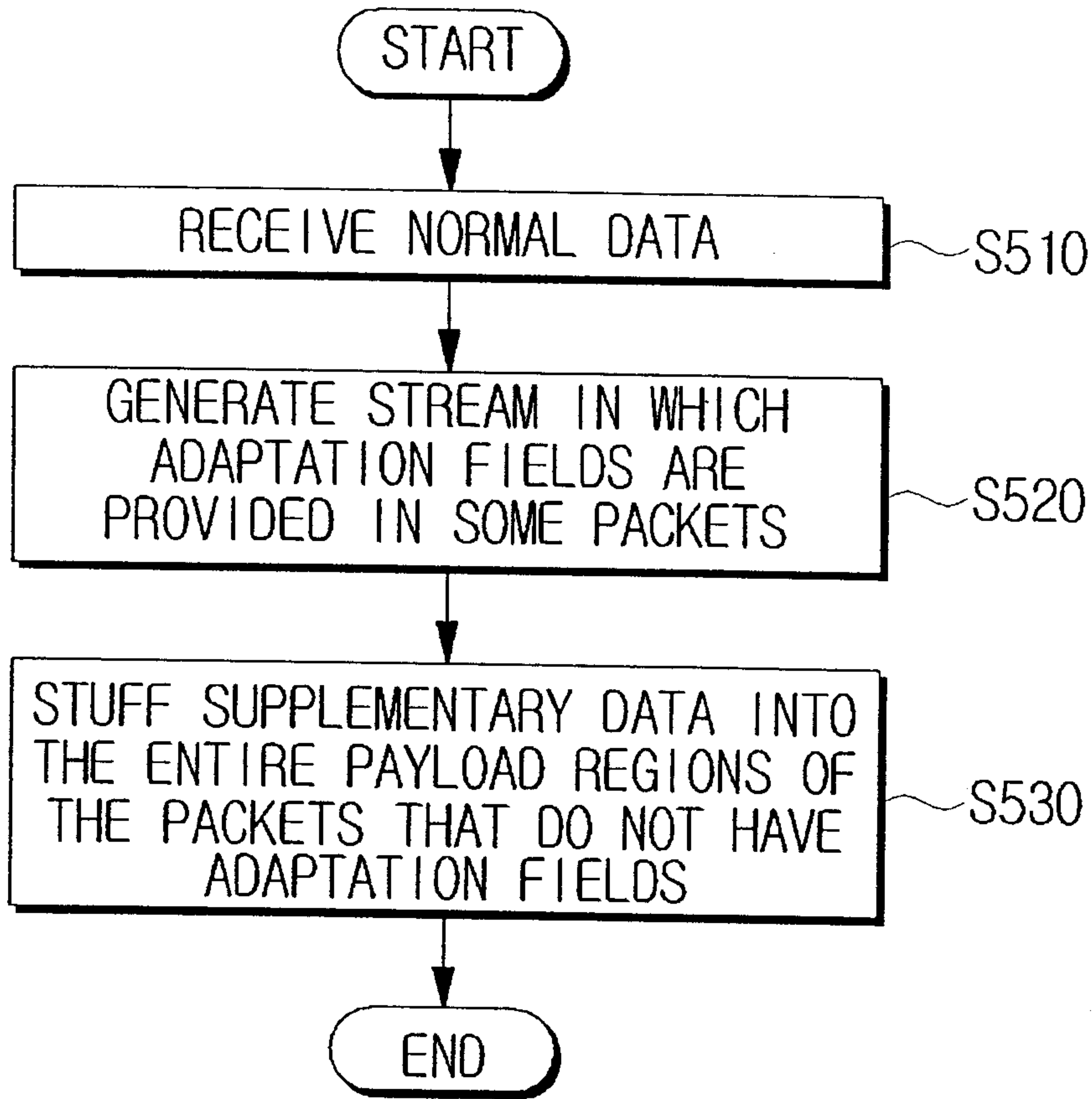
[Fig. 3]



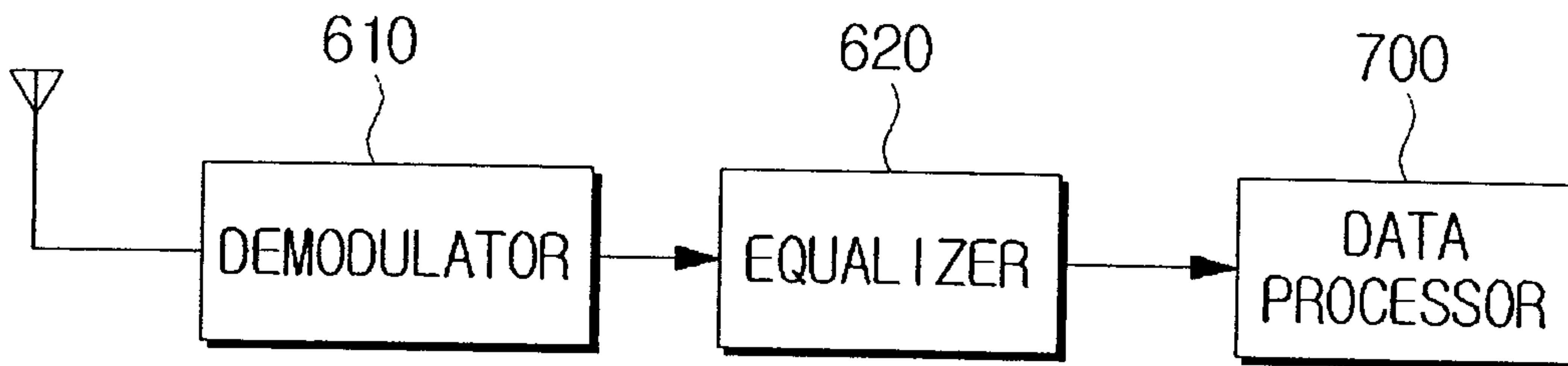
[Fig. 4]

Sync	PID	SRS		TS 1	TS 2
Sync	PID	SRS		TS 3	
Sync	PID	AF HEADER	SRS	TS 4	NS
Sync	PID	AF HEADER	SRS	NS	

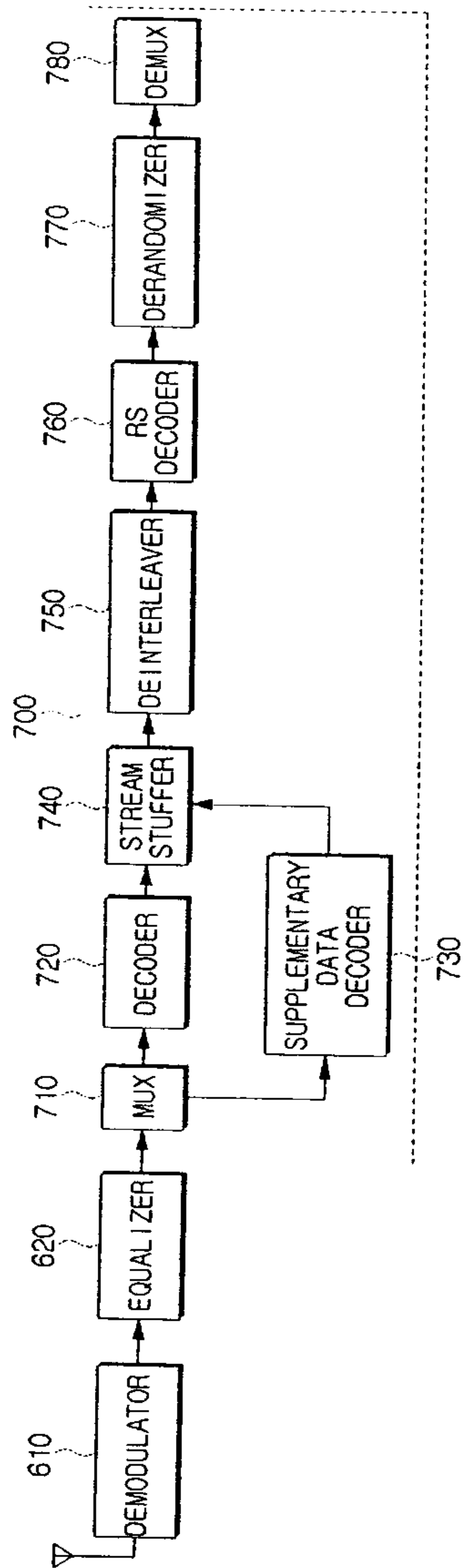
[Fig. 5]



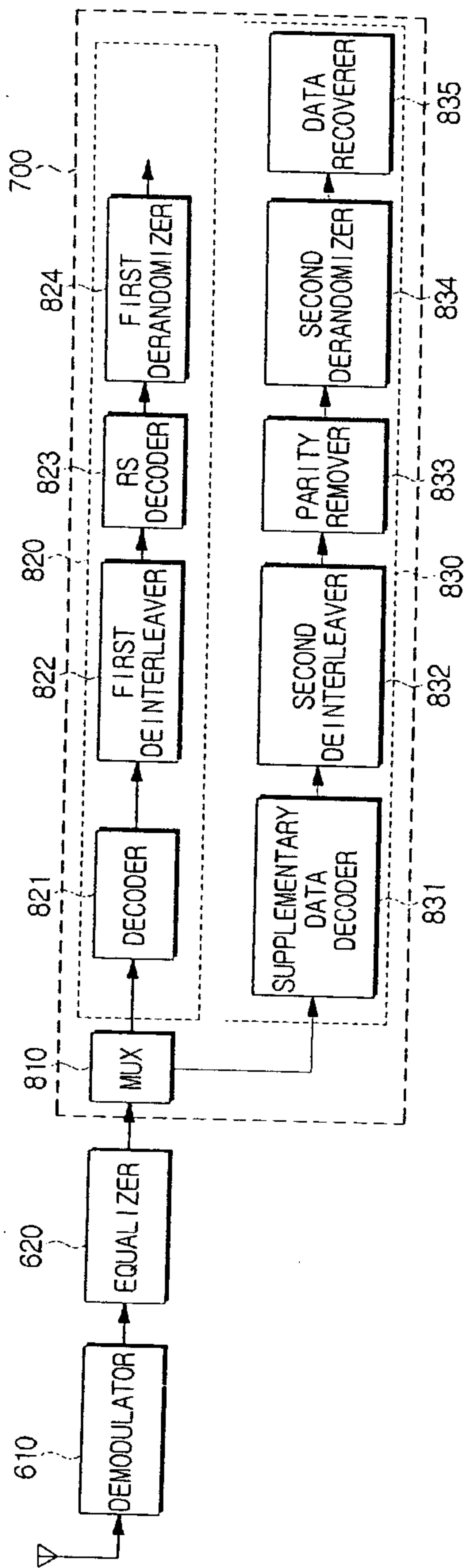
[Fig. 6]



[Fig. 7]



[Fig. 8]



[Fig. 9]

