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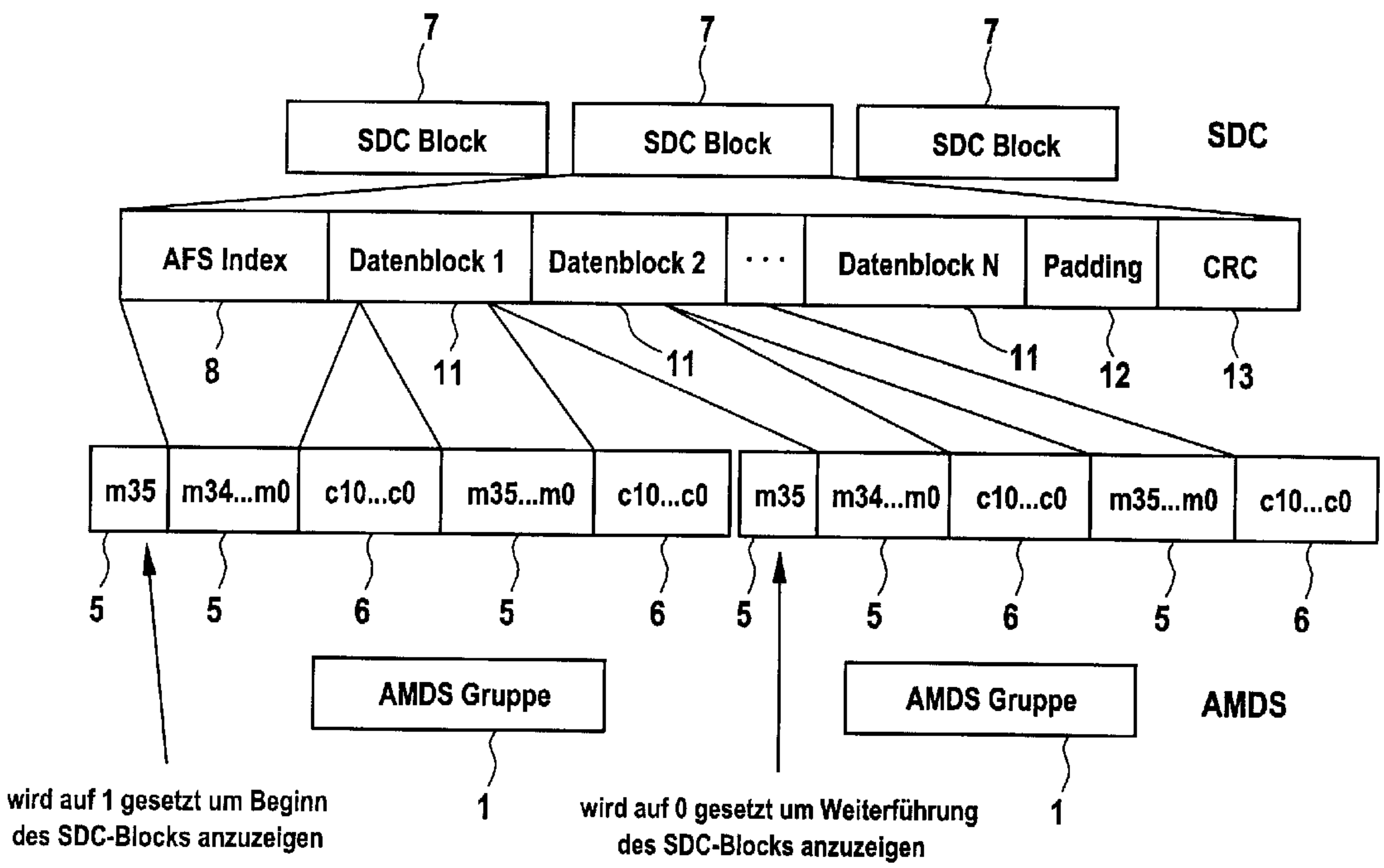
(54) Titre : PROCEDE ET DISPOSITIF POUR TRANSMETTRE DES DONNEES SUPPLEMENTAIRES RELATIVES A DES FREQUENCES D'EMISSION NUMERIQUES ALTERNATIVES, DANS UN SYSTEME DE TRANSMISSION RADIO ANALOGIQUE

(54) Title: METHOD AND DEVICE FOR BROADCASTING AUXILIARY DATA IN AN ANALOG RADIO BROADCAST SYSTEM



(57) Abrégé/Abstract:
A method and device for the transmission of additional data in an analog radio transmission system, wherein the additional data also contains information relating to alternative transmission frequencies of a respective program, and the alternative transmission frequencies relate to digital radio transmission systems. The alternative transmission frequencies for digital radio transmission systems are transmitted in an amplitude modulation data system (AMDS) format by transmitting said service description channel data (SDC) by mapping into the AMDS format.

Abstract

Method and device for broadcasting auxiliary data in an analog radio broadcast system in which the auxiliary data include information regarding alternative broadcast frequencies of the respective program and the alternative broadcast frequencies relate to digital radio broadcast systems. The alternative broadcast frequencies for digital radio broadcast systems are transmitted in the AMDS (amplitude modulation data system) format by virtue of these SDC (service description channel) data being transferred into the AMDS format by means of mapping.

(Fig. 3)

Method and Device For Broadcasting Auxiliary Data in an Analog Radio Broadcast System

The present invention relates to a method and device for broadcasting auxiliary data in an analog radio broadcast system in which the auxiliary data include information regarding alternative broadcast frequencies of the respective program and the alternative broadcast frequencies relate to digital radio broadcast systems. The alternative broadcast frequencies for digital radio broadcast systems are transmitted in the AMDS (amplitude modulation data system) format by virtue of these SDC (service description channel) data being transferred into the AMDS format by means of mapping.

Prior Art

The technical specification (ETSI TS 1201 980) entitled "Digital Radio Mondiale (DRM) [worldwide digital radio]; System Specification", published by the European Telecommunication Standards Institute in September 2001, has disclosed a digital radio broadcast system that broadcasts, for example, on conventional AM frequencies and includes, among other things, a service description channel (SDC) described in chapter 6.4 on pages 63 through 78. In the DRM system, the data are divided up into SDC blocks and transmitted. Each block contains an indicator, which is referred to as the AFS index, a data field by means of which reference data can be transmitted, and a check word that is used for error detection and error correction. The AFS index here is an unsigned binary number between 0 and 15, which indicates the transmission count of so-called super frames, which separates this SDC block from the next with the identical content, provided that the identification field of the fast access channel contains the 0 symbol. The AFS index here should be identical for all SDC blocks and can, for example, be changed in a reconfiguration. The data field is subdivided into a variable number of data blocks (data entities). The data field here can contain an end marker as well as padding bits that fill the free fields. The length of this data field depends on the broadcast mode selected here, which determines the robustness of the broadcast system. The test field, also referred to as the cyclic redundancy check (CRC), contains a 16 bit long CRC data word, which is calculated by means of the AFS index and the data field.

The ITU recommendation BS.706-2 entitled “Data Systems in Monophonic AM Sound Broadcasting (AMDS)” of February 1998 has disclosed a protocol for analog radio with which auxiliary data regarding alternative frequencies can be transmitted so that when a considerable drop in reception quality occurs, the receiver can automatically switch to another reception frequency.

Despite the above-mentioned introduction of DRM for digital radio broadcast in the long wave, medium wave, and short wave bands, for a certain period of time, the same programs will be broadcast using both analog (AM) and digital technology (DRM). Because of the limited number of channels, it is frequently the case that an analog signal and a digital signal cannot always be broadcast in every frequency range. Particularly in the short wave band, the various frequency ranges have different propagation ratios. It can therefore be necessary for a receiver, which is first set to a DRM program and loses the signal there, to be switched to another band in which the program is being broadcast, but only in analog form. In this case, in order to be able to refer to other possible alternative frequencies, particularly also those that transmit digitally, the analog broadcast uses the AMDS.

Essence and Advantages of the Invention

The essence of the present invention is to disclose a method and device with which alternative frequencies of the currently set station can be transmitted in an analog radio broadcast system; these alternative broadcast frequencies can relate to the same wave band, but on a digital radio broadcast system, in particular the Digital Radio Mondiale (DRM). According to the present invention, this object is attained by means of the defining characteristics of the independent claims. Advantageous modifications and embodiments ensue from the dependent claims.

It is advantageous for the alternative broadcast frequencies for digital radio broadcast systems to be advantageously transmitted in the amplitude modulation data system (AMDS) format.

It is also advantageous for the digital radio broadcast system to broadcast in DAB (digital audio broadcast) format, DRM (Digital Radio Mondiale) format, DVB-T (digital video broadcast – terrestrial) format, iBiquity format, IBOC (in band on channel) format, AM/FM format, or UMTS (universal mobile telecommunications system) format. It is particularly advantageous to use DRM systems because DRM programs are broadcast on the AM band on which analog radio programs that use the AMDS protocol are also broadcast.

It is also advantageous for the data broadcast in the AMDS format to be SDC data that are transferred into the AMDS format by means of mapping. In the DRM system, the so-called service description channel is provided, which can be used to transmit auxiliary data. A combination receiver, i.e. a receiver that can receive both analog AM signals and digital DRM signals, can, at no additional cost, easily evaluate these SDC data as it receives them. For this reason, according to the present invention, the SDC format is used to transmit data, but these data are transferred into the so-called AMDS format by means of mapping in order to be broadcast in analog radio broadcast systems.

It is also advantageous for the data blocks of the SDC data to be adopted into the data fields of the AMDS blocks.

It is also advantageous for the AFS index of the SDC blocks to be adopted into the data fields of the AMDS blocks as well. It is also advantageous for the bits of the test field of each AMDS group to be generated from the data fields of the adopted SDC data blocks.

It is also advantageous for a data bit of each AMDS group to indicate whether it is the first or a subsequent AMDS group of a multitude of AMDS groups transmitted in succession, which together contain the data of an SDC block. In particular, it is advantageous for the first data bit of the first block of an AMDS group, i.e. the m35 bit of the first AMDS block, to contain a 1 if it is, in this case, the first AMDS group of a multitude of AMDS groups transmitted in succession, and for these first data bits of the first blocks of the subsequent AMDS groups, i.e. the m35 bits of the first AMDS blocks, to each contain a 0.

It is also advantageous for the AMDS blocks to be continuously numbered by means of a counter. It is particularly advantageous for the continuous numbering of each AMDS group to be contained in one or more AMDS data bits reserved for this.

It is advantageous for the one or more reserved AMDS data bits, which contain the continuous numbering of each AMDS group, to be the data bits that follow the first data bit m35 of the first AMDS block of an AMDS group, i.e. the data bits m34, m33, m32, ..., depending on how many bits are required for the counter.

It is also advantageous for the same AMDS groups to be transmitted multiple times.

It is particularly advantageous for the continuous numbering of each AMDS group to be contained in an AMDS data field reserved for this, which is composed of several reserved AMDS data bits. It is also advantageous for the continuous numbering of the AMDS groups to be performed by means of synchronization in that cyclic block codes are used to calculate the content of test fields based on the content of the data fields, offset value pairs are added to the test fields, pairs of syndromes are calculated from the offset values, and the syndrome pairs obtained can be used to determine the respective content of the AMDS groups.

It is also advantageous for the device to contain a calculation unit, which, depending on the information contained in the AMDS data fields, determines test words for error detection and error correction and inserts them into the test fields of the AMDS test fields.

It is also advantageous for the device to have a counter unit that continuously numbers the AMDS blocks and for the numbering to be entered into an AMDS data field reserved for this.

A receiver is advantageously provided, which is designed for reception and playback of radio signals transmitted in analog and digital fashion; during playback of a radio signal transmitted in analog fashion, the receiver receives the auxiliary data transmitted in AMDS format regarding alternative broadcast frequencies on which the same program is being digitally broadcast, evaluates these auxiliary data, and, if there are alternative broadcast frequencies on which the same program is being broadcast in digital format, automatically switches to the digitally broadcast alternative frequency.

The receiver advantageously stores all received auxiliary data regarding alternative broadcast frequencies in a database and from this database, selects the alternative frequency with the best reception of the selected radio program.

In the selection of an alternative frequency from the database, the alternative frequencies are advantageously searched in a predetermined sequence depending on their broadcast type, particularly in the sequence DAB, DRM, FM, AM.

Drawings

Exemplary embodiments of the present invention will be explained in detail below in conjunction with the drawings.

Fig. 1 shows the structure of the AMDS (amplitude modulation data system) format,

Fig. 2 shows the structure of the SDC (service description channel) format used in DRM (Digital Radio Mondiale),

Fig. 3 shows the mapping of SDC data in AMDS groups,

Fig. 4 shows the implementation of a counter, and

Fig. 5 schematically depicts an exemplary embodiment of the device according to present invention.

Description of the Exemplary Embodiments

Fig. 1 schematically depicts the structure of the amplitude modulation data system. An AMDS group 1 is composed of 94 bits; this AMDS group is equally subdivided into an AMDS block1 2 and an AMDS block2 2, each of which is subdivided into 47 bits. Such an AMDS block2 with 47 bits is further subdivided into a data field 3 with 36 bits and a test field 4 with 11 bits; the data field transmits reference data and the test field 4 contains a test word, which is calculated from the data field 3 by means of a cyclic code and is used for error detection and error correction. The 36 bit long data field 3 is in turn subdivided into AMDS data bits 5 that are numbered starting at m35 and count down to m00, the last AMDS data bit of the reference data. This data field 3 is followed by the test field 4, which is composed of 11 AMDS parity bits 6 that are numbered starting with c10 and count down to c00. This test field 4 contains data that were calculated from the data field 3 by means of a cyclic block code.

Fig. 2 depicts the structure of a short description channel (SDC) block of the kind used in the DRM (Digital Radio Mondiale) digital radio system. The short description channel is used to transmit data that refer, for example, to alternative frequencies of the same program so that when there is a drop in the reception quality of the currently selected radio program, it is possible to indicate a different frequency on the same wave band or a different wave band that is currently broadcasting the same radio program. The digital radio program here is also in a position to refer to alternative digital frequencies or to frequencies on which the same program is being transmitted by means of analog radio broadcasting methods such as FM or AM. Particularly in the transition phase shortly after the introduction of digital radio programming, the same radio programs must be broadcast in both analog and digital form because not every listener has a digital receiver. Particularly during this transition phase, it is not possible for programs that are broadcast in analog form to transmit auxiliary data regarding alternative frequencies in which the same program is being broadcast in digital form. The SDC block 7 contains an AFS index 8, which is composed of 4 bits. After this AFS index, a data field 9 of variable length is transmitted, which is used to send the reference data. The data field 9 here can be composed of varying numbers of data blocks 11, which are numbered from 1 to N, depending on which broadcast mode and which SDC mode is currently being used to broadcast. In the SDC block 7, the data field 9 is followed by a test word 10, which is composed of 16 bits and is also referred to as the CRC (cyclic redundancy check). This test word 10 is calculated from the bits of the AFS index and the data field and is used for error detection and error correction of the transmitted data.

In Fig. 3, the SDC blocks – of the kind that are transmitted, for example, in the DRM system – are arrayed opposite the AMDS data structure in order to show the mapping for the transfer of the SDC data into the AMDS format. The SDC blocks 7 are transmitted one after another for this purpose. Each SDC block 7 here is composed of an AFS index 8, which is followed by 1 to N data blocks 11 that contain the reference data. Then the SDC block 7 contains padding bits 12 and a 16 bit long cyclic redundancy check word 13. In order to transmit the SDC data, the AFS index information in block 8 and the information in the data blocks 1 through N 11 are adopted into the AMDS data structure; the padding bits 12 and the CRC bits of 13 are disregarded. Since one AMDS group 1 contains two AMDS blocks of 47 bits each, each AMDS group has reference bits m35 through m00, followed by 11 AMDS parity bits c10 through c00, and, in the AMDS block2, an additional 36 reference bits m35 through m00 and 11 parity bits of the AMDS block2 c10 through c00. Since the first reference bit m35 of the first block of the AMDS group 1 is reserved in order to indicate the beginning of an SDC block or a continuation of the SDC block, the first AMDS reference bit m35 of block1 of an AMDS group 1 is not described with SDC data. The information of the AFS index 8 is thus entered into the AMDS data bits m34 and following of the first AMDS block of the AMDS group 1. The data blocks 1 through N 11 following the AFS index 8 are continuously entered into the AMDS data bits 5; the AMDS data bits m34 through m00 of the AMDS block1 and the AMDS data bits m35 through m00 of the AMDS block2 are available for this. These AMDS data bits are interrupted by the AMDS parity bits c10 through c00, which are respectively calculated as a function of the preceding AMDS data bits and then entered. Since it is not possible, due to the amount of data contained in an SDC block, for the reference data of an SDC block to be adopted in their entirety into one AMDS group, several AMDS groups 1 are appended one after another until all of the reference data of an SDC block have been accommodated in the AMDS groups 1. In order to transmit the information of an SDC block 7, it is therefore necessary to transmit several AMDS groups 1 in succession, for which reason it is also logical to use the first AMDS reference bit m35 of the first AMDS block to indicate whether the current AMDS group 1 contains the beginning of an SDC block or is a AMDS group 1 that follows a preceding AMDS group 1 in which an SDC block started. The first AMDS data bit m35 of the first AMDS block can be used for this in that the m35 bit of this first AMDS block of an AMDS group is set to 1 if it is the first AMDS group that contains the beginning of the reference data of an SDC block or in that the m35 bit of this first AMDS block of an AMDS group is set to 0 to indicate that this AMDS group is a continuation of a preceding AMDS group that relates to the same SDC block. The parity bits c10 through c00 6 of the AMDS groups 1 are calculated as a function of the preceding reference bits m35 through m00 and then transmitted. It is also useful to number the AMDS groups since transmission in the AM band often experiences interference, which makes it advantageous to transmit the AMDS groups multiple times, one after the other. By numbering the AMDS groups, it is possible to determine which of the AMDS groups, which have been transmitted one after the other with the same content, belong together and in which AMDS group the transmission of new information begins. The fact that the receiver can recognize the repetitions and can recognize when a new AMDS group is being transmitted makes it also advantageous to provide a continuous counter. In this case, the AMDS groups that contain the same information can also be transmitted multiple times and if need be, spaced chronologically apart from one another, which advantageously requires a 3-bit or 4-bit counter.

Fig. 4 shows a counter of this kind in which an AMDS group 1 is depicted, which is composed of two succeeding AMDS blocks, each AMDS block being composed of reference bits m35 through m00, followed by the parity bits c10 through c00. Since the first data bit of the first AMDS block of the AMDS group 1 (m35) is reserved for indicating the beginning or continuation of an SDC block, the succeeding 3 bits or 4 bits, namely bits m34 through m32 or m34 through m31, of the first AMDS block of the AMDS group are reserved for an AMDS group counter, which means that the AMDS reference bits m31 through m00 or m30 through m00 of the first AMDS block and the data bits m35 through m00 of the second AMDS block of the AMDS group are available for the actual information. The AMDS group counter, which can be implemented, for example, by means of the reference bits m34 through m32 of the first AMD block, advantageously begins with a 0 symbol in order to indicate the beginning of an SDC block. The succeeding AMDS groups, however, contain incrementally increased counter symbols in order to permit recognition of when the transmission of a new SDC block starts.

Alternatively, it is also possible to implicitly implement the counter by means of the synchronization mechanism by defining additional pairs of offset words, the number of offset word pairs corresponding to the number of groups among which the counter is to differentiate. In the receiver, the offset word pairs are binarily added to the test words of the two blocks of which an AMDS group is composed. In this case, groups with the same content use the same offset word pairs. To synchronize the receiver, the received bitstream is supplied to the decoder in blocks of 47 bits each and a syndrome is calculated. Then, the block subdivision is shifted by one bit and the syndrome is calculated again for the new code word thus produced. When the first syndrome of a syndrome pair is produced, the next 47 bit block is supplied to the decoder. When the second syndrome of the syndrome pair is produced, the synchronization is complete. In the subsequent blocks, the corresponding offset words are then added and the blocks are supplied to the decoder. If the syndrome 0 is produced, then the block is error-free and can be decoded. It should be noted here that a pair of offset words that belong together is used in succeeding blocks. If the synchronization was successful, then in the subsequent block, each of the first offset words of the offset word pairs must be added until a decoding with syndrome 0 is possible. Then the next subsequent block can be decoded with the appropriate second offset word of the offset word pair.

Fig. 5 is a schematic block circuit diagram of a device according to the present invention. The mapping device 14 here is supplied with SDC blocks, which, after being processed, are output as AMDS groups. The SDC blocks supplied to the mapping device 14 arrive in a clipping unit 15 in which the padding bits 12 and the parity bits (CRC) 13 of the SDC blocks are removed. Then the output signal of the clipping unit 15 is supplied to a parity bit insertion unit 16. The output signal of the clipping unit 15 is simultaneously supplied to a parity bit calculating unit 17 in which the AMDS data fields m35 through m00 are used to calculate the respective parity bits c10 through c00 that are then supplied to the parity bit insertion unit 16, which inserts the parity bits c10 through c00 of the test field 4 into the provided slots of the AMDS block. After the insertion of the AMDS parity bits, the output signal of the parity bit insertion unit 16 is sent to the counter insertion unit 18. The counter insertion unit 18 is supplied with the signals of a counter unit 19, which numbers the individual AMDS blocks and supplies this numbering to the counter insertion unit 18, which then inserts it into the reference bits of the first block of an AMDS group, i.e. in the case of a 3-bit counter, at the positions m34 through m32 of the first block. If a 4-bit counter is used, then the bits m34 through m31 of the first block of an AMDS group are reserved for this. Then in the start marking unit 20, the first reference bit m35 of the block 1 of an AMDS group is set to 0 if this AMDS group contains the beginning of a new SDC block or the m35 bit of the first block of the AMDS group is set to 0 if this AMDS group contains a continuation of the data of an SDC block of a preceding AMDS group.

Translation Key for Figs 1 – 5

Fig. 1:
Gruppe – group
Bit – bits
Block – block
Datenfeld – data field
Prüffeld – test field
Offsetwort – offset word

Fig. 2:
SDC-Block – SDC block
AFS-Index – AFS index
Datenfeld – data field
Prüfwort – test word
Datenblock – data block

Fig. 3:
Datenblock – data block
AMDS Gruppe – AMDS group
first remark:
will be set to 1 to indicate the beginning of the SDC block
second remark:
will be set to 0 to indicate the continuation of the SDC block

Fig. 4
AMDS Gruppe – AMDS group
first remark:
AMDS group counter, 000 symbol indicates beginning of an SDC block
second remark:
changes with each new SDC block transmitted

Fig. 5
box 15 – clipping of the SDC padding bits and the SDC parity bits
box 16 – insertion of AMDS parity bits
box 18 – counter insertion
box 20 – m35 bit of the ADMS group, possibly = 1, otherwise = 0
box 17 – calculation of AMDS parity bits
box 19 – counter

What is claimed is:

1. A method for broadcasting auxiliary data in an analog (AM, FM) radio broadcast system, in which the auxiliary data include information regarding alternative broadcast frequencies of the respective program,
wherein the alternative broadcast frequencies relate to digital radio broadcast systems.

2. The method as recited in claim 1,
wherein the alternative broadcast frequencies for digital radio broadcast systems (DRM, DAB, iBiquity, IBOC, UMTS) are transmitted in AMDS (amplitude modulation data system) format (1, 2, 3, 4, 5, 6).

3. The method as recited in claim 1 or 2,
wherein the digital radio broadcast system is broadcast in DAB (digital audio broadcast) format, DRM (Digital Radio Mondiale) format (7, 8, 9, 10, 11, 12), DVB-T (digital video broadcast – terrestrial) format, iBiquity format, IBOC (in band on channel) format, AM/FM (amplitude modulation / frequency modulation) format, or UMTS (universal mobile telecommunications system) format.

4. The method as recited in one of the preceding claims,
wherein the data broadcast in the AMDS (amplitude modulation data system) format (1, 2, 3, 4, 5, 6) are SDC (service description channel) data (7, 8, 9, 10, 11, 12) that have been transferred into the AMDS format by means of mapping.

5. The method as recited in one of the preceding claims,
wherein the data blocks (11) of the SDC data are adopted into parts of the data fields (3) of the AMDS blocks (2).

6. The method as recited in claim 4,
wherein the AFS index (8) of the SDC blocks (7) is also adopted into the data fields (3) of the AMDS blocks (2) and the bits (6) of the test field (4) of each AMDS group (1) are generated from the data fields (9) of the adopted SDC data blocks (7).

7. The method as recited in one of the preceding claims, wherein a data bit (5) of each AMDS group (1) indicates whether it is the first or a subsequent AMDS group (1) of a multitude of AMDS groups (1) transmitted in succession, which together contain the data of an SDC block (7).

8. The method as recited in claim 7, wherein the first data bit (m35 of block1) of the first AMDS block (2) of each AMDS group (1) indicates whether it is the first (m35=1) or a subsequent (m35=0) AMDS group (1) of a multitude of AMDS groups (1) transmitted in succession, which together contain the data of an SDC block (7).

9. The method as recited in one of the preceding claims, wherein the AMDS groups (1) are continuously numbered by means of a counter (m34, m33, m32 of block1).

10. The method as recited in claim 9, wherein the continuous numbering of each AMDS group (1) is contained in one or more AMDS data bits (m34, m33, m32) reserved for this.

11. The method as recited in one of claims 9 or 10, wherein the one or more reserved AMDS data bits (m34, m33, m32) that contain the continuous numbering of each AMDS group (1) are the data bits (m34, m33, m32, ...) that follow the first data bit (m35) of the first AMDS block (2) of an AMDS group (1).

12. The method as recited in one of the preceding claims, wherein the same AMDS groups (1) are transmitted multiple times.

13. The method as recited in one of the preceding claims, wherein the continuous numbering of the AMDS groups (1) is performed by means of synchronization in that

- cyclic block codes are used to calculate the content of test fields (6) based on the content of the data fields (5),
- offset value pairs are added to the test fields (6),

- syndromes are calculated in pairs from the offset values, and
- the syndrome pairs obtained can be used to determine the respective content of the AMDS groups.

14. A device for generating auxiliary data that are broadcast in an analog radio broadcast system (AM, FM), in which the auxiliary data include information regarding alternative broadcast frequencies of the respective program,
wherein it is possible to supply the device with SDC (short description channel) data (11) that the device (14) converts into AMDS (amplitude modulation data system) data fields (3).

15. The device as recited in claim 14,
wherein the device (14) includes a calculation unit (17), which, depending on the information contained in the AMDS data fields (3), determines test words (4) for error detection and error correction and inserts them into the test fields (6) of the AMDS test fields.

16. The device as recited in one of claims 14 or 15,
wherein the device has a counter unit (19) that continuously numbers the AMDS groups (1) and the numbering is entered into at least one AMDS data field (m34, m33, m32) reserved for this.

17. A receiver for reception and playback of radio signals transmitted in analog and digital fashion,
wherein during playback of a radio signal transmitted in analog fashion, the receiver receives the auxiliary data transmitted in AMDS format regarding alternative broadcast frequencies on which the same program is being digitally broadcast, evaluates these auxiliary data, and, if there are alternative broadcast frequencies on which the same program is being broadcast in digital format, automatically switches to the digitally broadcast alternative frequency.

18. The receiver as recited in claim 17,

wherein the receiver stores all received auxiliary data regarding alternative broadcast frequencies in a database and from this database, selects the alternative frequency with the best reception of the selected radio program.

19. The receiver as recited in claim 18,
wherein for the selection of an alternative frequency from the database, the alternative frequencies are searched in a predetermined sequence depending on their broadcast type, particularly in the sequence DAB, DRM, FM, AM.

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Fig. 1

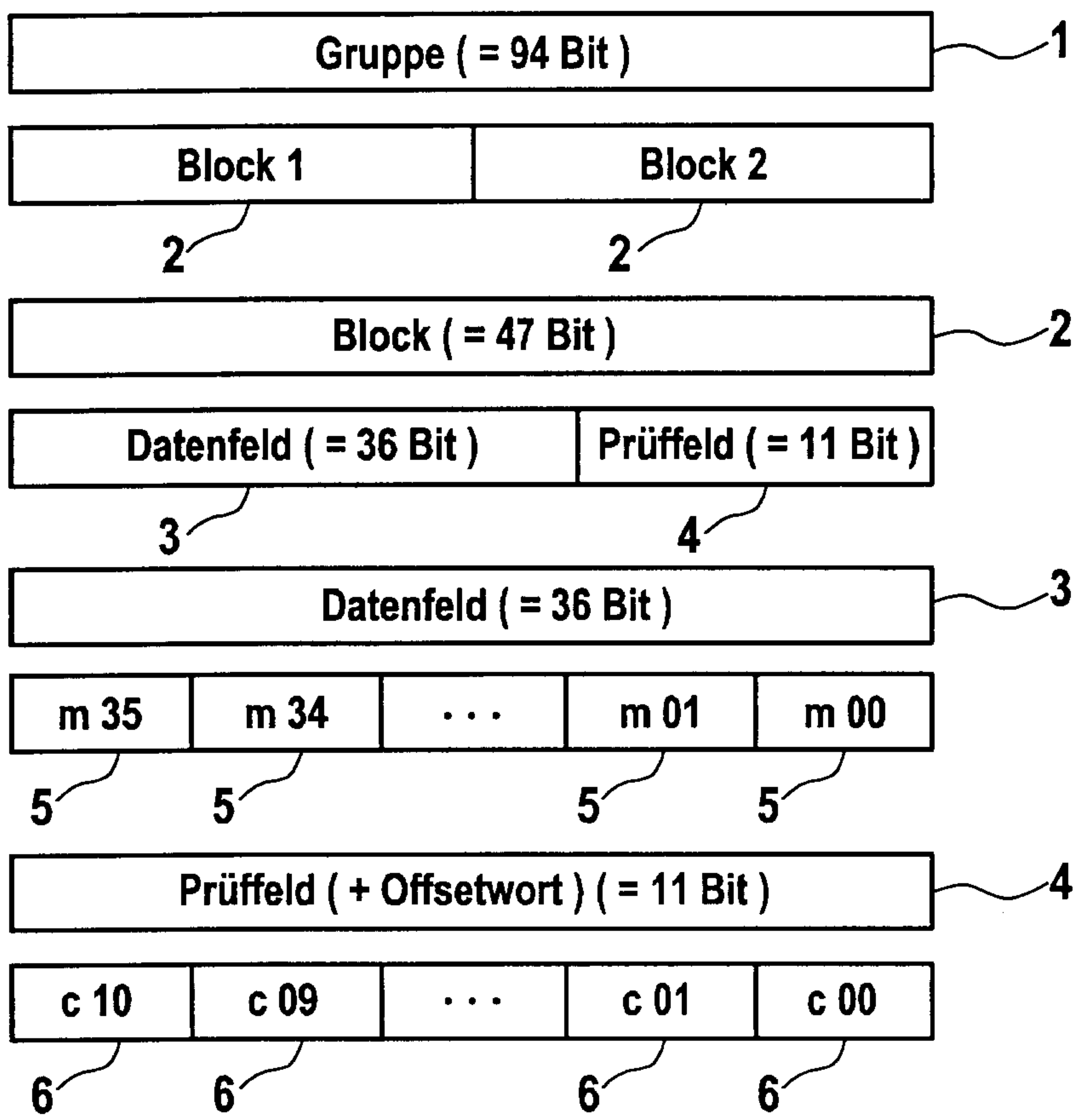
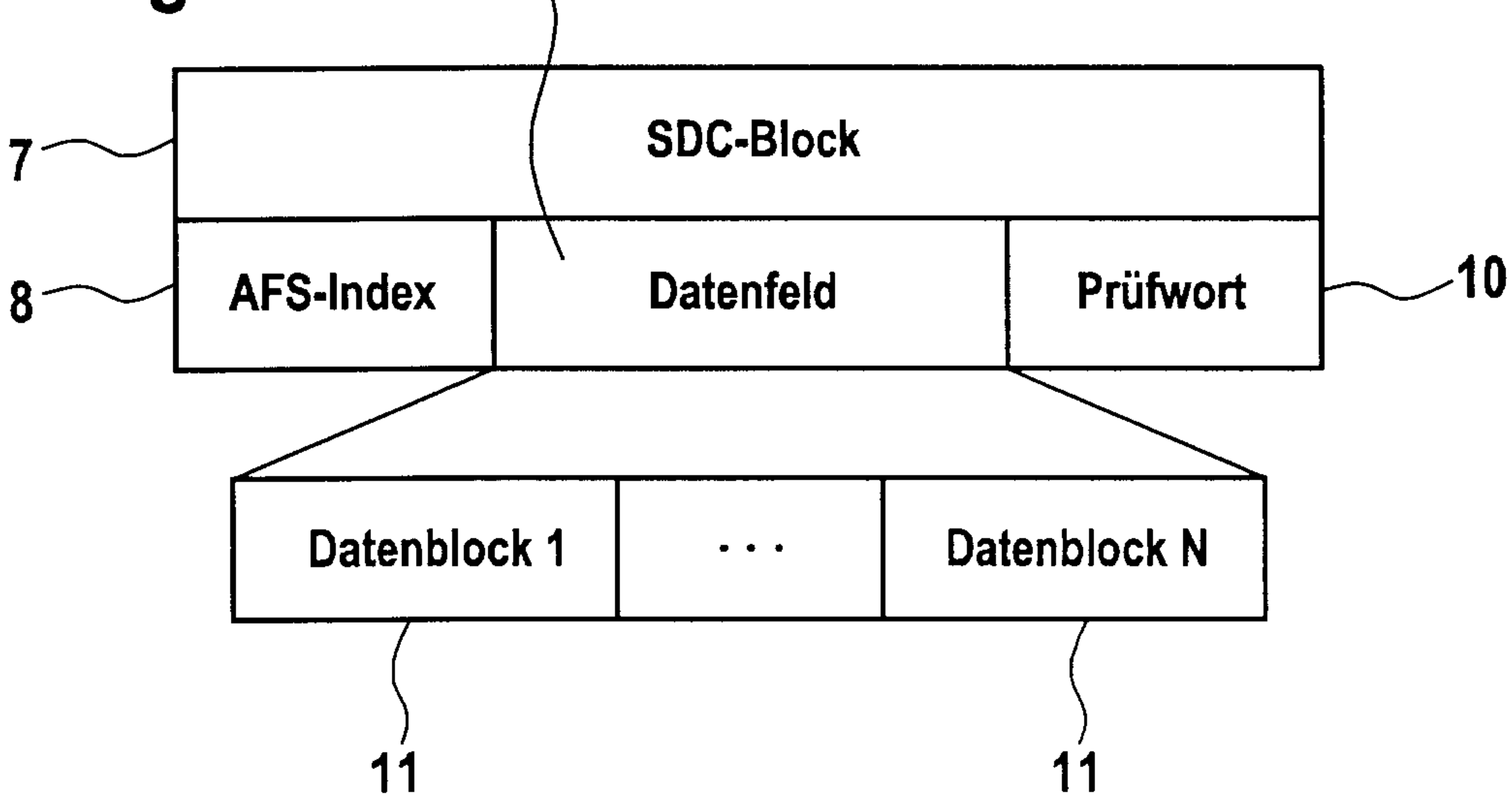


Fig. 2



R. 309324

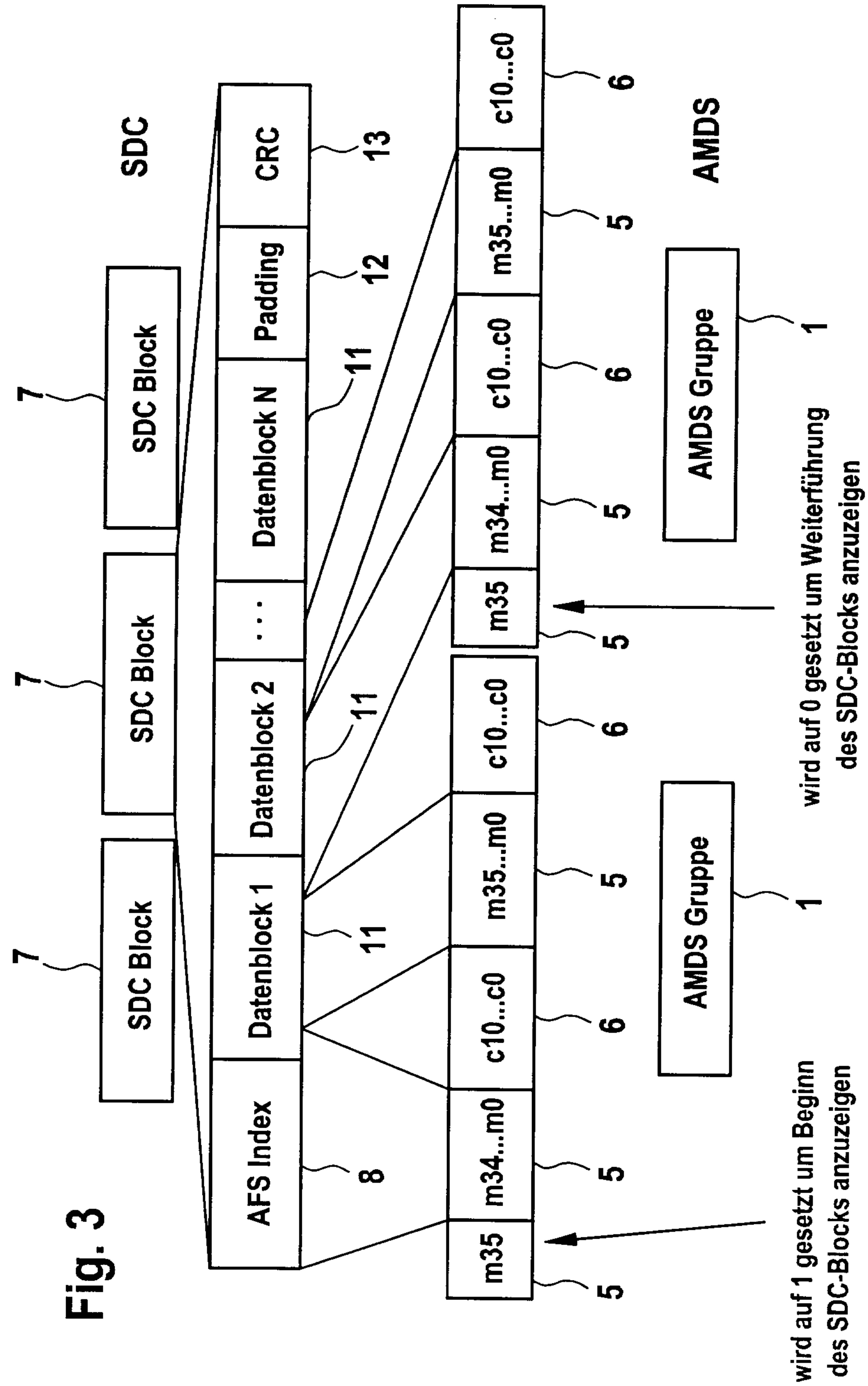


Fig. 3

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Fig. 4

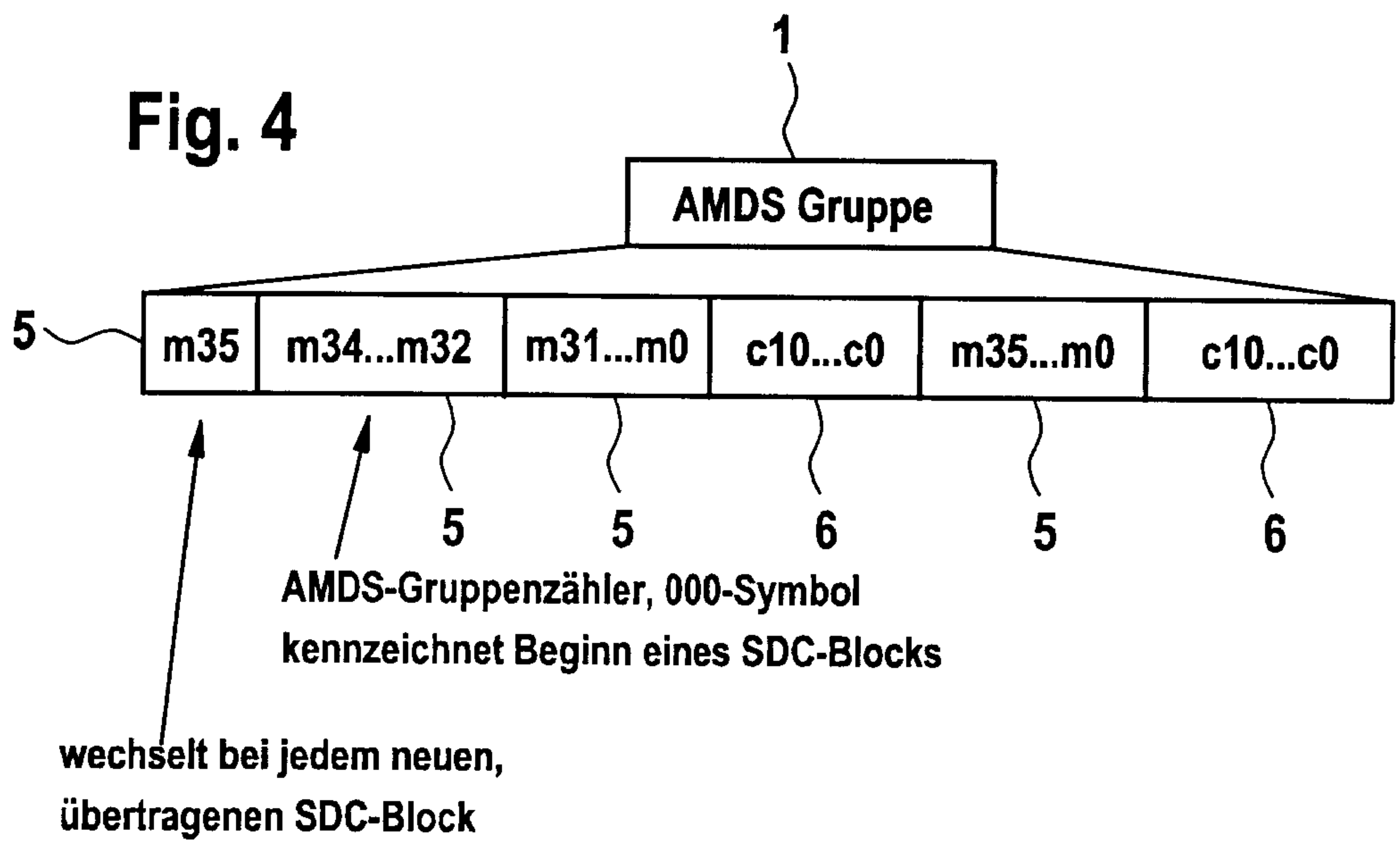

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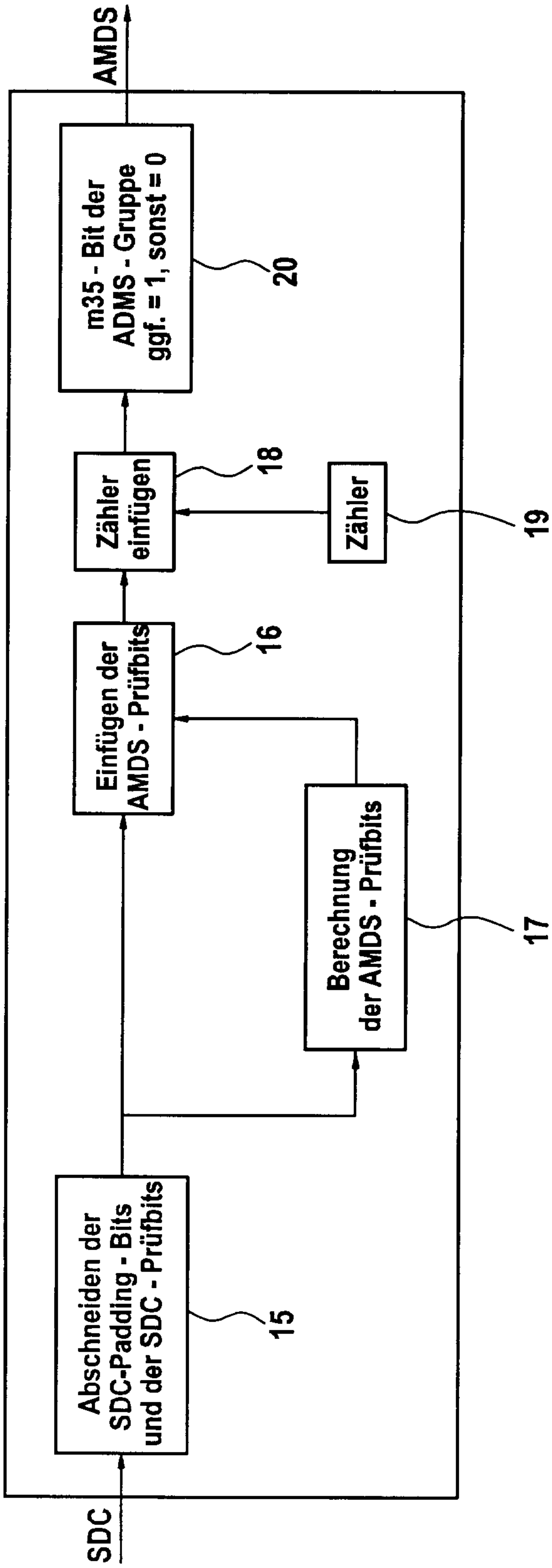
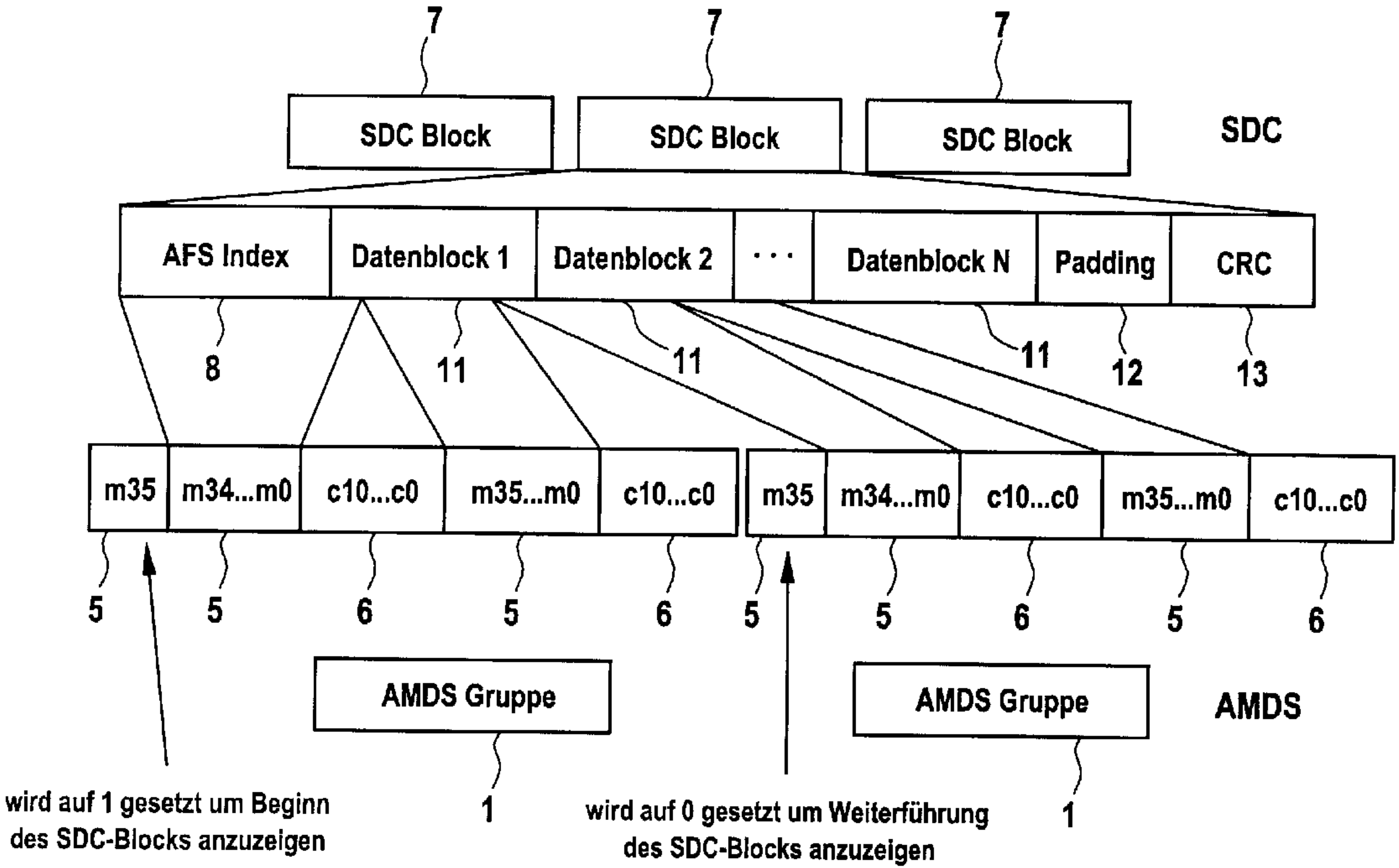
Fig. 5




7
7
7
SDC Block
SDC Block
SDC Block
SDC
AFS Index
Datenblock 1
Datenblock 2
. . .
Datenblock N
Padding
CRC
8
11
11
11
12
13
m35
m34...m0
c10...c0
m35...m0
c10...c0
m35
m34...m0
c10...c0
m35...m0
c10...c0
5
5
6
5
6
5
5
6
5
6
AMDS Gruppe
AMDS Gruppe
AMDS
1
1
wird auf 1 gesetzt um Beginn des SDC-Blocks anzuzeigen
wird auf 0 gesetzt um Weiterführung des SDC-Blocks anzuzeigen