

The invention relates to a process according to the preamble of Claim 1.

A process of the type described in the introduction has been disclosed in the document DE-C-34 32 848, wherein it has been proposed that a sequence of lists of alternative frequencies be emitted from all the transmitters of a group of transmitters, where each of these lists is provided at its start with the operating frequency of the transmitter assigned to the respective list, to enable the appropriate list, optimized in respect of the received transmitter, to be selected from the sequence of lists.

However, a prerequisite for the reliable reception of such a sequence of lists is the correct reception of the start of each list, which in the following will be referred to as "header", with the operating frequency of the transmitter assigned to the respective list. If this is not the case - for example due to disturbances caused by multipath reception - the alternative frequencies which follow the header of each list cannot be utilized at the receiving end, not even if they are correctly received, as a correct correlation with the respective operating frequency cannot be obtained.

Therefore it has also already been proposed (Blaupunkt-Werke GmbH, Hildesheim) that all the alternative frequencies of a chain of transmitters - which can comprise a plurality of groups of transmitters (e.g. north Germany and South Germany) - be transmitted in the form of a matrix, where for each transmitter the associated alternative frequencies are grouped as matrix neighbours within the matrix. This so-called "matrix process" has the disadvantage, however, that due to the grouping rule neighbours which in reality do not constitute alternative frequencies in the above defined sense can be unavoidable, with the result that at the

receiving end corresponding mistuning to such neighbours can arise. Additionally, the creation and modification of a matrix are extremely complicated and in some cases the reallocation of a transmitting frequency which has become free could be impossible solely because an existing matrix does not permit such a modification.

In the radio data system (RDS) specified in the technical document Doc. Techn. No. 3244 of the European Broadcasting Union, which will be referred to in the following as "EBU Document", the transmission of additional information items, e.g. the transmission of alternative frequencies (AF code), in particular in the form of alternative frequencies assembled in a list, as the contents of a data stream modulated onto a 57 kHz auxiliary carrier, is provided. This information is of interest both in the case of mobile reception (e.g. in the case of car radios) - for example on leaving the broadcasting range of a transmitter - and also in the case of stationary reception - for example in the event of the breakdown or malfunctioning of a transmitter. When suitably designed receivers with memories are provided, such lists can be stored and thus the time required to set the receiver at the respective optimal frequency of this list (e.g. in accordance with optimal receiving conditions) can be reduced.

The RDS data signal also includes a so-called item of programme-identification information (PI code); directly with the aid of the AF code and indirectly with the aid of the PI code it is possible to determine those alternative transmitting frequencies on which the programme signal of the instantaneous receiving frequency can likewise be received.

The receiving-end analysis of the alternative transmitting frequencies can be carried out in such manner that the

receiver is temporarily set consecutively at the alternative frequencies for each alternative frequency. Then the received field strengths of the alternative frequencies and of the instantaneous receiving frequency are compared with one another, where that frequency which supplies the highest measured received field strength (this can naturally also be the previously set receiving frequency) is selected and set as new receiving frequency.

Here the problem arises, however, that there are situations in which the measurement of the received field strength - in particular in the case of multipath reception - does not offer a reliable quality statement concerning the reception. In the case of multipath reception, the reception disturbances caused by signal breaks are a function of alternative routing, the instantaneous signal modulation (which is determined by the type of programme - for example classical music or pop music) and in the case of mobile reception upon the vehicle speed. A received signal which is disturbed by multipath reception can, despite a relatively high received field strength between the signal breaks, nevertheless be subjectively experienced as subject to extreme interference, whereas a received signal which is disturbed only by noise can be experienced as substantially better.

As a result, the described selection of the best possible reception of a selected programme signal can lead to continuous impairment of the reception by multipath reception disturbances. It is not possible to substantially change this undesired result by - possibly with the assistance of a second tuner in the receiver - tuning to the alternative frequencies over a relatively longer measurement period and integrating the measured received field strengths, as even in the case of such integration the received signals disturbed by multipath reception generally

also possess a higher average receiving field strength than those received signals which are disturbed only by noise.

However, such disturbances can impair not only the programme signal. The additional information items, transmitted for example in the RDS data stream, can also be affected so that at the receiving end in some cases either excessively long waiting times can occur until correctly received items of RDS information are available again or misinterpretations can arise. In general this has a particularly negative effect in the case of data whose repetition cycle in the data stream is relatively long.

A further problem relating to the programme signal quality has its origins in the transmitter network structure in some lands, in particular in those lands with mutually overlapping transmitter networks. As the digital information centrally transmitted from a main transmitter, for example a list of alternative frequencies, is inappropriate in some cases for the subsidiary transmitter (e.g. converter) fed by ball reception from the main transmitter, following the ball receiver it would have to be filtered out and replaced by the list appropriate for the respective subsidiary transmitter. This filtering out and refeeding-in is associated with an increased outlay. To this must be added the fact that the filtering out also impairs the quality of the programme signal.

By way of contrast, the aim of the invention is to improve upon the reception quality in the processes of the type described in the introduction.

This aim is fulfilled, in accordance with the invention, by the features described in Claim 1.

The invention is based on the recognition that the reception quality can be improved on the one hand in that the alternative frequencies are transmitted in such manner that at the receiving end they can be assigned more reliably to the respective transmitter operating frequencies. This has the advantage that the receiver can then when necessary be tuned more rapidly to an alternative frequency offering improved reception. This even applies when the receiver is to possess only a small storage capacity.

In accordance with a further development of the invention, the reception quality can be improved in that not or at any rate not exclusively the received field strength, but acoustic and/or programme signal distortions are used to assess the reception quality. This has the advantage that those alternative frequencies which only "apparently" - namely because of a higher received field strength - offer improved reception but in reality are experienced by the user as worse, can be rejected at the receiving end.

If the additional data items transmitted within the broadcast signal occur, as in the case of the RDS data signal, in the form of digital information items, the bit errors in the RDS data signal can be used as a gauge of the programme signal distortions. Thus it has proved that the bit errors in the RDS data signal correlate relatively accurately with the programme signal distortions, although the programme signal is transmitted in the base band from 0 to 53 kHz and the RDS data signal is transmitted on a 57 kHz carrier with a tolerance of a minimum of ± 1.2 kHz.

Because of this correlation, in a further development of the invention it is possible to utilize the fact that disturbances caused by multipath reception or interference give rise to bit errors in the RDS data signal occurring in the form of bursts, whereas disturbances caused by noise

result in uniformly distributed bit errors. The degree of all the disturbances can be derived from the block error rate, which latter can be determined entirely independently of the data contents.

On this basis, for an optimal selection of the frequency which facilitates the best instantaneous reception, a tuner of the receiver is tuned consecutively to the alternative frequencies and to the set receiving frequency at intervals of time. In a somewhat better appointed receiver design, for an optimal selection of the frequency which facilitates the best instantaneous reception, a second tuner of the receiver is provided which is tuned consecutively to the alternative frequencies and to the set receiving frequency of the first tuner at intervals of for example at least 2 seconds.

During these tuning intervals - which in the case of the receiver design comprising two tuners are relatively long - the bit errors are determined for the entire received RDS data signal (which in addition to the alternative frequencies contains a large number of further items of information). Then the bit error distributions and block error rates determined for each alternative frequency and for the instantaneous receiving frequency are analyzed as follows:

If all the checked frequencies comprise bit errors distributed only in the form of bursts or only uniformly, which is synonymous with the fact that received signal disturbances due to multipath reception, interference or noise occur at all frequencies, the associated block error rates are compared with one another, and the frequency with the lowest block error rate is selected as optimal receiving frequency. The tuner of the receiver - or in the case of the receiver comprising two tuners the first tuner - is then

tuned to this selected frequency, unless the already set receiving frequency is identical to the selected frequency.

In the event that the checked frequencies exhibit different disturbances, thus bit errors caused by noise and bit errors caused by multipath reception, firstly those frequencies which are disturbed substantially by noise and not by multipath reception, i.e. those which exhibit substantially uniformly distributed errors, are preselected. To eliminate signals severely disturbed by noise, it is possible to preselect only those frequencies for whose RDS data signal a maximum permissible block error rate is not exceeded. Then the preselected frequencies are compared with one another in respect of their set block error rate, and again the frequency with the lowest block error rate is selected as optimal receiving frequency.

The above described selection of the optimal frequency can be effected with a sufficiently long measurement interval in respect of each alternative transmitting frequency without taking into consideration the respective received field strength. Especially in the case of shorter measurement intervals, it is additionally possible to use the received field strength for the selection, in which case the weighting between received field strength on the one hand and signal distortions on the other hand can be empirically determined.

The alternative frequencies can be determined with the aid of the PI code or the AF code or using and possibly supplementing - in the case of ambiguities or incomplete transmission - both codes. The PI code identifies frequencies at which the same programme signal can be received. By comparing the PI code during the transmitter search run, a clearly defined correlation between the instantaneous receiving frequency and its alternative

frequencies can be obtained. This correlation can be directly discovered from the AF code. If the AF code is not transmitted in the RDS data signal or if the AF code is defective, the alternative frequencies can therefore also be derived from or supplemented from the PI code.

With the aid of the process according to the invention it is possible to realise, for the first time, the advantages which were the object of the introduction of the RDS system and the alternative frequencies comprised therein, and which consist in continuously optimal reception by broadcast receivers (both mobile and stationary broadcast receivers) by virtue of an entirely novel concept of determining the optimal reception quality. With the assistance of the RDS data signal, the problems of the multipath reception of the useful signal can be substantially reduced in a surprising fashion.

In the process according to the invention it is provided that in the sequence of individual lists which are contained in the digital information items of the RDS data stream and which themselves contain alternative frequencies assigned to the respective transmitters of a chain of transmitters or optimized in respect of these transmitters, the operating frequency of the associated transmitter provided in or for each list be transmitted not only at the start of the list, but additionally prior to each individual alternative frequency of the respective list, so that each alternative frequency is "addressed" with the operating frequency. Thus each list consists of a sequence of digital information blocks, each block consisting of two items of information. One of these items of information of each block is (apart from very special exceptions) the operating frequency of the transmitter assigned to the respective list. If, therefore, a part of the list is incorrectly transmitted or received, because of their pairing with the operating frequency the

correctly received alternative frequencies can be clearly assigned to the associated transmitter and filed in its list at the receiving end. As, in a considered list, it is improbable that the same information block is always disturbed, from two or three consecutively received, disturbed lists of the same transmitter it is possible to store the complete list at the receiving end.

Compared to the process according to DE-C-34 32 848, the above explained pairing of each alternative frequency with the operating frequency of the transmitter assigned to the list doubles the number of items of frequency information to be transmitted in respect of each list, with the result that the cycle time for each sequence of lists is increased accordingly. Therefore it could be assumed that the reception probability and reliability in the case of such an extended cycle time is impaired rather than improved. In fact it is maintained that an advantage of the matrix process mentioned in the introduction compared to the list process according to DE-C-34 32 848 resides in the shorter cycle time of a matrix compared to a sequence of individual lists, and improved reliability of reception is deduced therefrom.

It must therefore be surprising to the technical world that despite the substantial increase in the cycle time of the sequence of lists transmitted in accordance with the invention, the reliability of reception is decisively better than in the case of the matrix process and the list process of the type defined. The reason for this surprising advantage, which could not be predicted, consists in that due to the described addressing of each alternative frequency with the operating frequency, even in the case of extremely poor reception conditions a reliable assignment of the correctly received alternative frequencies is still possible, which is not the case with the two other

processes, so that their shorter cycle time is of no advantage in such reception situations.

Further features, advantages and particulars of the invention will be explained in detail in the following in the form of three exemplary embodiments making reference to the drawings. In the drawings:

Figure 1 is a schematic illustration of the sequence of lists of alternative frequencies emitted by each transmitter of a chain of transmitters in accordance with a first exemplary embodiment of the invention;

Figure 2 is a block circuit diagram of a receiver for a process according to a second exemplary embodiment of the invention;

Figure 3 is a block circuit diagram of a receiver for a process according to a third exemplary embodiment of the invention.

Figure 1 schematically illustrates a system of alternative lists which is transmitted as additional information of a broadcasting transmitter. The example considered here is based on a broadcast signal into which an auxiliary carrier of 57 kHz is inserted. The auxiliary carrier can comprise an amplitude modulation containing a traffic radio code. By way of modulation or further modulation, a data signal coded in a specified manner (not of interest here) is impressed upon the auxiliary carrier. This data signal is transmitted in an identical form by all the transmitters of a chain of transmitters with the same programme, for example by all the transmitters of the "Bavaria 3" chain of transmitters in the service area of the Bavarian Broadcasting Corporation (abbreviated to BR). The data signal transmitted in an identical fashion contains i.a. a sequence of lists of alternative frequencies for all the transmitters of the

chain of transmitters, in the illustrated example the list of Transmitter No. 1, the list of Transmitter No. 2, the list of Transmitter No. 3, up to the list of Transmitter No. 29 in the case of a chain of transmitters comprising 29 transmitters. Each list is especially adapted to the respective transmitter and contains the alternative frequencies provided for this transmitter, thus the frequencies of those transmitters which can be alternatively received on the same programme in the reception area of the respective transmitter. For example, in the Munich area the programme "Bavaria 3" can be received alternatively from the "Wendelstein" transmitter or the "Ismaning" transmitter. If the receiver is tuned to the Wendelstein transmitter, in the event of an impairment of reception, for example due to multipath reception, by virtue of its knowledge of the alternative, Ismaning, the receiver can be temporarily tuned to the Ismaning receiver and check the latter's received field strength; if the latter is better, a switch-over is made to the Ismaning transmitter, this checking procedure being virtually inaudible to the listener.

Each list consists of a sequence of digital information blocks which are indicated in Figure 1 as horizontal lines within the list. Each information block consists of a pair of information items, as indicated by the vertical division of the list into a left-hand and a right-hand half. The first block of each list, referred to as "header", contains, in the left-hand half of the block, the number of alternative frequencies within the respective list. In the case of the list of Transmitter No. 1 with four alternative frequencies, the header contains the number #4, whereas in the case of the list of Transmitter No. 29 with seven alternative frequencies the header contains the number #7. In the right-hand half of the block the header of each list contains the operating frequency of the transmitter assigned to the list. In the case of the list of Transmitter No. 1

with the operating frequency 98.5 MHz, the frequency information 98.5 MHz is contained in the right-hand half of the header. In the case of the list of Transmitter No. 29 with the operating frequency 97.9 MHz, the frequency information "97.9 MHz" is transmitted in the header.

As regards the positioning of the operating frequency of a transmitter at the start of an assigned list of alternative frequencies, this is identical to the process according to DE-C-34 32 848. If, additionally, a block allocation as provided in the EBU document for the transmission format of alternative frequencies (group of type OA) were used, two alternative frequencies would be transmitted in the blocks of each list following the header, so that in the case of List No. 1 with four alternative frequencies the header would be followed by two blocks with $2 \times 2 = 4$ alternative frequencies.

By way of comparison, in the present exemplary embodiment according to the invention the operating frequency assigned to the list, together with an alternative frequency, is transmitted in each block following the header. These pairs thus contain the operating frequency as address for the respective alternative frequency, which has the aforementioned advantage that the reliability of reception is drastically increased although the number of blocks which are required in respect of each list and which follow the header is doubled.

In the case of the list of Transmitter No. 1, following the header instead of two blocks, as in the case of the above-mentioned combination of the EBU document and DE-C-34 32 848, it is now necessary to transmit four blocks, leading to a corresponding increase in the transmission time for the sequence of 29 considered lists. As this transmission time is equal to the cycle time of each sequence of lists, it

could be believed that due to this increase in the cycle time the reception reliability is impaired in the event of transmission disturbances. As already stated, this supposition is, however, incorrect and the surprising effect should be noted that in the case of the process according to the invention, in accordance with this exemplary embodiment in spite of an increase in the cycle time the reliability of reception is distinctly improved compared to the list process and the matrix process.

In the case of transmitters whose operating frequency does not fall in the 100 kHz frequency allocation scheme, but falls inbetween (so-called offset frequencies), for example at 92.85 MHz, not the operating frequency, but a special item of information, a so-called "filler code" corresponding to the European Broadcasting Union document mentioned in the introduction is transmitted in the header of the respective list. In the following block firstly the offset frequency, e.g. "92.85 MHz" and then the "quasi-operating frequency", for example "92.8 MHz" is transmitted. This quasi-operating frequency is transmitted in first position in the following blocks as address for the alternative frequencies.

A further deviation from the transmission rule for the individual lists illustrated in the drawing occurs if one of the alternative frequencies is an offset frequency. In this case, in place of the operating frequency the offset frequency of the alternative frequency, together with the "quasi-alternative frequency" which corresponds to the 100 kHz frequency allocation scheme, is transmitted in the corresponding block.

To identify alternative frequencies of those transmitters which in the case of regional programmes are excluded from the assigned chain of transmitters for a certain period of a transmission day or a transmission week, for example

transmitters which from 6.00 to 12.00 hours transmit the programme "Bavaria 3", from 12.00 to 13.30 hours transmit the regional programme "News from Schwaben" and from 13.30 to 24.00 hours again transmit the programme "Bavaria 3", it can be favourable to interchange the sequence of operating frequency and alternative frequency in the assigned block, thus firstly to transmit the alternative frequency and then the address "operating frequency" in the block.

Each list is specially adapted to the respective transmitter and, in accordance with the agreement within the European Broadcasting Union, contains a maximum of 25 frequencies, although usually substantially fewer. The operating frequency of the associated transmitter occurs at the beginning of each list, i.e. in the case of the list of transmitter No. 1 the operating frequency of Transmitter No. 1, e.g. 98.5 MHz, occurs at the start. As mentioned, the represented sequence of 29 lists is transmitted as data signal from each transmitter of the transmitter chains data signal.

The receiver receives and decodes the transmitted data signal, i.e. the sequence of lists of alternative frequencies. In order to select from the received sequence of lists that list which is valid for the instantaneously tuned transmitter, the receiver merely needs to compare the first frequency of each list with the instantaneous tuning frequency, which can be carried out in an extremely short length of time even in the case of 29 lists. This selection can either take place in on-line operation or in off-line operation, i.e. without or with intermediate storage of the received sequence of lists. In a preferred exemplary embodiment the selected list is always stored.

In the processing of the received and optionally intermediately stored sequence of lists, the receiver

selects that list whose first frequency (equivalent to the operating frequency of the assigned transmitter) is identical to the instantaneous tuning frequency. If the first frequency of a plurality of lists is identical to the set operating frequency, all these lists must be selected. Only the selected list(s) is(are) used for the following optimization of the tuning.

This tuning procedure is carried out either by means of an appropriate command from the listener or automatically, if for example the instantaneously received transmitter is no longer worth receiving. In the tuning procedure the receiver is automatically tuned to the alternative frequencies listed in the selected list(s) and selects that alternative frequency which offers the best possible reception. With the aid of the transmitted data signal RDS, even in the case of transmitter chains comprising more than the specified maximum number of alternative frequencies, a rapid optimization of the tuning of mobile receivers can be effected without the need for the filtering out and refeeding-in of frequency lists at the location of subsidiary transmitters.

Figure 2 is a block circuit diagram of a receiver for a process according to a second exemplary embodiment of the invention. Here reference will be made to the system described in association with Figure 1.

The broadcast signals containing additional data items and received with an antenna 1 are fed on the one hand to a tuner 2 and on the other hand to a tuner 3. The tuner 2 is part of a broadcast receiving device with an intermediate frequency amplifier 4 for the intermediate frequency supplied by the tuner, and with a demodulator 5 for the recovery of the low-frequency signals, and with an amplifier 6 for the low-frequency signals, and with a

loudspeaker 7 for the acoustic reproduction. The signal path, e.g. the output of the tuner 2, is connected to a circuit 10 for the selection of the 57 kHz carrier which is connected to a circuit 11 for the recovery of the data items. The data items are fed to a store 12. The alternative frequencies (AF) of the operating frequency transmitter received by the tuner 2 are continuously fed into this store 12.

The tuner 3 serves to continuously scan the frequency ranges which can be received by the tuner 2. Its high- or intermediate-frequency outputs signals are likewise supplied to the store 12. The frequencies scanned by the tuner 3 are continuously compared with the corresponding stored frequencies in order to provide a gauge of the transmitter which instantaneously can be best received. The frequency in each case to be set by the tuner 3 is determined by the store 12 by means of a microprocessor 13 via a line 14 and the tuner 3 is tuned accordingly.

A circuit 15 serves to measure the field strength of the respective received transmitter. As soon as the field strength measurement indicates that the signals of another transmitter possess a greater field strength than the operating frequency transmitter set by the tuner 2, the tuner 2 is switched over via a line 16 to the transmitter with the instantaneously greater field strength.

In the case of the circuit thus far described it is possible that due to interferences, e.g. those caused by reflections, distortions may occur in the acoustically reproduced audio signal. Such interferences generally arise in the vicinity of very powerful transmitters. Furthermore, due to a strong field strength at the instantaneous reception location, overloading of the receiver can occur, leading to distortion of the acoustic reproduction.

In known processes, for example according to DE-C 34 48 043, following the selection of a transmitter, fully automatic tuning is facilitated, without the assistance of the user, to that transmitter transmitting the same programme which can be better received, i.e. supplies the greatest field strength, at the instantaneous reception location.

For this purpose each transmitter will transmit not only its own list, but sequentially also the lists of all the other transmitters of the same chain of transmitters, where the operating frequencies of the individual transmitters in each case occur at the start of the individual lists. Thus, following the reception of all the lists, on the basis of its instantaneous tuning frequency the receiver can select the list associated with the instantaneously set transmitter by comparing the tuning frequency with the first frequency of each list within the sequence of lists. The receiver also recognises the alternative frequencies on which it can continue to receive the same programme on leaving the service area of the instantaneously set transmitter, without the need to check the alternative frequencies of the other lists. In this way switch-over to a different transmitter of the same chain of transmitters can generally be effected very rapidly.

However, precisely in the case of the reception of transmitters with a strong occurring field strength, the acoustic reproduction can be distorted. This can be due, for example, to overloading as a result of too strong a received field strength or interference phenomena caused by reflection.

In the present exemplary embodiment according to the invention it is therefore provided that a transmitter setting be facilitated with retention of the automatic switch-over to other transmitters transmitting the same

programme, where acoustic distortions in the reproduction are substantially avoided or reduced.

In the microprocessor 13 a switch 17 produces a switching state wherein not the strongest transmitter, but a weaker transmitter, in particular the second strongest transmitter, is used for the comparison with the respective set operating frequency transmitter.

By virtue of an additional design feature of the switch 17 as resetting key it is provided that the setting of the device to transmitters less powerful than the instantaneously greatest field strength can be cancelled if the local zone or interference zone of the transmitter is left. A multiple switching procedure is thus easily possible. The effect of the switch 17 upon the microprocessor 13 can also be contrived to be such that by briefly touching the switch 17 several times all the transmitters can be set consecutively with reducing field strength in accordance with the stored alternative list. By longer operation of the switch 17, for example for several seconds, the resetting process can be triggered.

In accordance with Figure 2 the tuner 3 can possess a different design to the tuner 2, as its actual function is merely to scan the frequency band to check for possibly stronger transmitters. Thus signal quality is not to be achieved.

In the case of the use of only one tuner it is also possible to switch over the field strength in the described manner, where however transmitters with lower field strengths can be received by the user during the interrogation process.

In a third exemplary embodiment of the invention, Figure 3 illustrates a modification of the circuit shown in Figure 2,

wherein two equivalent tuners 2 and 3 are connected into two separate groups of receivers A, B, each of which supply a LF output signal NF_A , NF_B to a LF switch 18 which in each case passes on one of the two signals to the LF amplifier 6 and loudspeaker 7. From the tuner 2 the data signals (e.g. from the RDS data stream) are selected by means of the selection circuit 10, 11 and supplied to the store 12 with the microprocessor 13. From the tuner 3 the data signals are likewise selected and supplied to the store 12 with the microprocessor 13. The tuner 2 is tunable by manual and arbitrary input. The tuner 3 is interrogated by the store 12 and microprocessor 13 via the line 14 in accordance with the stored alternative list.

The recognition of the respective transmitter with the greatest field strength takes place in the circuit 15 by comparing the received signals of the tuner 2 and the tuner 3. In the event that the transmitter with the field strength to be received in optimal fashion is not set with the tuner 2, the tuner 3 takes over this transmitter with the greatest field strength, and its LF output signal NF_B is applied via the switch 18 to the LF amplifier 6 and loudspeaker 7.

In this switching state the tuner 2 is interrogated via the line 20 by the microprocessor 12/13 in accordance with the frequencies stored in the alternative lists.

The LF signals NF_A and NF_B are fed to a circuit 19 for comparison of the modulation of the two signals. In this modulation comparison circuit the modulation content of the transmitter set with the greatest field strength is compared with the modulation content of the transmitters selected from the alternative list. Expediently this comparison takes place with the respective second strongest transmitter from the list.

The comparison can take place by direct comparison of the time behaviour of the low-frequency voltage or by comparing the envelope curves of the two LF signals. If, due to the effect of reflections, the transmitter with the greater field strength exhibits modulation breaks or modulation drops and clipping of the LF due to overmodulation, the switch 18 is automatically switched over by the microprocessor 12/13 to the second strongest transmitter so that the distortions are not noticeable to the user. If the two signals are identical, the transmitter with the respective greater field strength remains connected. As a consequence the switch 18 can be continuously switched over from the currently operative receiver A, B to the respective other receiver B, A in dependence upon the control of the microprocessor. Only in the case of manual or other input by the user, is the tuner 2 again firstly entitled to continue to be subjected to the automatic, RDS-controlled mode of operation.

Claims

1. A process for the transmission of items of digital information within a broadcast signal as tuning aid in the broadcast reception, wherein the items of digital information contain a sequence of individual lists of alternative frequencies assigned to the respective transmitters of a chain of transmitters or optimized in respect of these respective transmitters, characterised in that in the transmission of each list as a sequence of digital blocks with in each case two items of digital information per block, generally

- a) in the first block of each individual list an item of information relating to the number of the alternative frequencies of the respective list and the operating frequency of the transmitter assigned to the respective list and
 - b) in the remaining blocks of each individual list the respective operating frequency of the transmitter assigned to the respective list and the alternative frequency
- are transmitted.

2. A process as claimed in Claim 1, characterised in that at the receiving end the operating frequency transmitted in the first block and/or in the remaining blocks of each list is used to assign the alternative frequencies to the respective chain of transmitters in terms of clearly defined, disturbance-free addressing.

3. A process as claimed in Claim 1 or 2, characterised in that of the received alternative frequencies of all the lists of frequencies, only those alternative frequencies whose respective assigned operating frequency is identical to the instantaneously set receiving frequency of the broadcast receiver are stored and/or used for the tuning.

4. A process as claimed in one of Claims 1 to 3, characterised in that in the remaining blocks the operating



frequency precedes or follows the respective alternative frequency.

5. A process as claimed in one of Claims 1 to 4, characterised in that the received items of digital information are subjected to error correction and that an addressing of the alternative frequencies, carried out in accordance with the error-corrected items of digital information, is performed on the basis of the transmitter operating frequency transmitted - optionally several times - in or with each list.

6. A process as claimed in Claim 5, characterised in that bit errors detected in the received items of digital information are used for quality evaluation alone or in addition to the receiving field strength.

7. A process as claimed in Claim 6, characterised in that the bit errors are used to evaluate programme signal distortions inasmuch as

- a) disturbances due to multipath reception or interference are present in the case of bit errors occurring in the form of bursts;
- b) disturbances due to noise are present in the case of uniformly distributed errors;
- c) the degree of all the disturbances is deduced from the block error rate of the RDS (radio-data-system) data signal structured in blocks,

and wherein the following selection decisions are deduced from the bit errors determined for each alternative transmitting frequency and for the instantaneous receiving frequency:

- d) if all the checked frequencies exhibit bit errors which substantially are distributed only in the form of bursts or only uniformly, they are compared with one another in respect of their block error rate, where the frequency with the lowest block error rate is selected for the receiver tuning;



- e) if the checked frequencies exhibit different bit error distributions, initially those frequencies which exhibit substantially only uniformly distributed bit errors are preselected - optionally in dependence upon the fact that at these frequencies a specified, maximum permissible block error rate is not exceeded - whereupon the preselected frequencies are compared with one another in respect of their block error rate, where the preselected frequency with the lowest block error rate is selected for the receiver tuning.
8. A process as claimed in one of Claims 1 to 7, characterised in that at the receiving end the alternative frequency which offers the instantaneously best possible reception is checked to determine whether it permits an acoustically acceptable reproduction, and that in the event that the checked alternative frequency only permits an acoustically distorted reproduction, a different alternative frequency is selected.
9. A process as claimed in Claim 8, characterised in that manually adjustable means are used to select a different alternative frequency.
10. A process as claimed in Claim 8 or 9, characterised in that means adjustable by a signal are used to select a different alternative frequency, where the said signal - optionally also differently weighted - is derived both from the comparison of received field strengths and also from the comparison of low-frequency distortions assigned to the field strengths.
11. A process as claimed in one of Claims 1 to 10, characterised in that at the receiving end the alternative frequencies are determined by analyzing a code for the programme identification (PI code) contained in the digital RDS data signal, where the receiving end executes a transmitter search run and the PI codes of the RDS data signals received on the individual transmitter frequencies are compared with the effect that identical PI codes



identify those frequencies on which the same programme
signal can be received.

