

FIELD STRENGTH DETECTING APPARATUS & METHODBACKGROUND OF THE INVENTION

(Field of the Invention)

The present invention generally relates to a field strength detecting apparatus for detecting field strength (intensity) of a signal received from a mobile radio signal channel. More specifically, the present invention is directed to a field strength detecting apparatus operable only in a frequency range allocated to mobile communication systems, and capable of correcting frequency deviation contained in a field strength value detected from a mobile radio signal of a mobile radio receiver.

(Description of the Related Art)

As the frequency range of the radio waves used in the mobile communications, typically known as the automobile telephone, two frequency bands of, for instance, 800 MHz and 1.5 GHz are allocated. Approximately 300 radio channels are set within the bandwidth of about 20 MHz of the respective frequency ranges. On the other hand, the field strength (intensity) measuring apparatuses capable of measuring the field strength of the radio communication waves are commercially available. These commercially available field-strength measuring apparatuses may be operated so as to measure the field strength of the radio signals having the frequency bands used in the mobile communication field. However, since these field strength measuring apparatuses may have general purposes in use, the uniform precision can be

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achieved over the wide frequency range. As a result, these field strength measuring apparatuses are necessarily made bulky at high cost. Thus, although these measuring apparatuses may be transported by way of automobiles and the like, they are not proper for personal portability.

Generally speaking, since the field strength measuring apparatus designed for the mobile communication maintenance purpose need not measure the field strength of the radio waves in the channels other than the channels allocated to the mobile communication frequency range, if this measuring apparatus is dedicated only to measure the field strength of the signals allocated to the mobile communication frequency range, then the resultant measuring apparatus can be made from a simpler circuit arrangement, and also made compact, i.e., better portability. In Fig. 1, there is shown one conventional field strength detecting apparatus used only in the mobile communication frequency band with the above-described specific circuit arrangement. In this field strength detecting apparatus, the reception signal 1 in the channel determined based on the channel designation data 8 outputted from the channel designating unit 9 is received by the signal receiving unit 2. The output from the signal receiving unit 2 is supplied as field strength information 3 to the field strength detecting unit 4, and the detection signal derived from the field strength detecting unit 4 is outputted as the field strength detected value 5 for the reception signal 1. In this case, the level of the field strength information 3 corresponds to the field strength

detected value 5 in a 1-to-1 correspondence. For instance, assuming now that when the level of this field strength information 3 is 1 V, the detected value 5 is 10 dBμ, if the level of the field strength information 3 becomes 2 V, then the detected value 5 is 20 dBμ.

Since the field strength detected value outputted with respect to the inputted field strength information is continuously converted by the field strength detecting unit of the conventional field strength detecting apparatus with keeping the 1-to-1 correspondence, in case that either the high frequency amplifier, or the high frequency filter (both are not shown), which constitute the signal receiving unit, owns deviation caused by the frequency characteristic, when the field strength information which has been deviated by the signal receiving unit is converted as the detected voltage, this detected voltage is varied in accordance with the frequency deviation of the signal receiving unit. As a result, the field strength detected value owns such deviation. Accordingly, even when a plurality of the actually measured field strength are identical to each other, as shown in Fig. 2, the detected values outputted from the field strength detecting unit 4 own different deviation from each other depending on its frequency used for the channel. Therefore, the correct field strength could not be measured over the available frequency range in the mobile communication field.

To solve the above-described problems, one solution has been proposed in Japanese Laid-open Patent Application No. 64-32538 (opened in 1989). In this second conventional field

strength detecting apparatus, a plurality of frequency characteristic correcting elements and also a plurality of bandpass filters are employed at the signal receiving end. Then, both of the frequency characteristic correcting elements and the bandpass filters are sequentially switched in response to the frequencies of the signals transmitted from the transmission end to obtain the reception results. Based upon the reception results, a selection is made of such an optimum frequency characteristic correcting element for the transmission frequency, so that such deviation caused by the frequency characteristic of the signal receiving unit can be maintained within a preselected allowable value.

However, the above-explained second conventional field-strength detecting apparatus owns various drawbacks. For instance, since the frequency characteristic correction should be carried out by sending out the testing signal from the transmission end every time the field strength is measured, and in addition, the frequency characteristic correcting elements should be selected in accordance with the signal reception results, this field strength detecting apparatus requires the complex circuit arrangement, and also a plurality of bandpass filters in accordance with the frequency range to be measured, resulting in a bulky apparatus. This may impede portability of the detecting apparatus. Moreover, the characteristic correction cannot be performed unless the signal receiving unit is combined with the signal transmitting unit.

SUMMARY OF THE INVENTION

The preferred embodiments of the present invention have been made in an attempt to solve the above-explained problems, and therefore, have as an object to provide a portable field strength detecting apparatus capable of correcting frequency characteristics independently of the signal transmitting unit.

In one aspect the invention provides a method of measuring field strength in one of a plurality of radio signal frequency channels of a communication system comprising assigning a correction value to each frequency channel to compensate for variations in respective receiving characteristics for said channels in a signal receiving unit, receiving the radio signal in the signal receiving unit, producing a detected field strength value for the received signal and correcting the detected value by applying thereto the correction value appropriate to the frequency channel.

In another aspect the invention provides a field strength detecting apparatus for a multi-channel radio communication system comprising a signal receiving unit for receiving signals in any of a plurality of frequency channels, means for producing a detected field strength value for a received signal in a said channel, and means for correcting the detected field strength value by applying thereto a correction value selected from a number thereof according to the channel in which the signal was received .

More specifically, a field strength detecting apparatus of the present invention is directed to a field strength detecting apparatus for measuring field strength of a frequency band allocated to mobile communication. That is, this field strength detecting apparatus is characterised by comprising:

a channel designating unit for outputting two sets of same channel information used to designate a channel number corresponding to a frequency of a radio signal to be received, said two sets of same channel information being first channel information and second channel information;

a signal receiving unit for inputting therein the first channel information derived from said channel designating unit to receive a radio signal having a

frequency corresponding to the channel number designated by said first channel information, thereby outputting a field strength level of said received radio signal;

a field strength detecting unit for inputting therein the field strength level of said received radio signal derived from said signal receiving unit to output said field strength level as a field strength detected value; and

a correction circuit containing a correction value used to correct frequency characteristic owned by said signal

receiving unit within the frequency band allocated to said mobile communication, for entering therein the second channel information outputted from said channel designating unit to select the correction value corresponding to said second channel information, whereby said field strength detected value derived from said field strength detecting unit is corrected based on said selected correction value.

The above-described correction circuit is further comprised of:

- a correction memory for storing the channel number corresponding to the frequency of the radio signal within the frequency band allocated to said mobile communication and said correction value corresponding to said channel number;

- an address designating unit for designating a read address of said correction memory based upon said second channel information supplied from said channel designating unit; and

- an adding circuit for adding the correction value read from said correction memory to the field strength detected value outputted from said field strength detecting unit.

In accordance with the field strength detecting apparatus with the above-described circuit arrangement, even when the signal receiving unit owns the frequency characteristic, this frequency characteristic is previously measured and then the correction values corresponding to the respective frequencies are stored in the correction memory in connection with these frequencies. As a result, the frequency characteristic of the field strength detected value which has been received by the

signal receiving unit and detected by the field strength detecting unit can be corrected in such a manner that the same frequency as the reception frequency is designated and the correction value corresponding to this designated frequency is read out from the correction memory, so that the correct field-strength detected value can be obtained.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be described in further detail with reference to the accompanying drawings, in which:

Fig. 1 is a schematic block diagram for representing an arrangement of the conventional field strength detecting apparatus;

Fig. 2 graphically represents a variation in the field strength value detected by the conventional field strength detecting apparatus of Fig. 1, caused by the frequency characteristic;

Fig. 3 is a schematic block diagram for showing an arrangement of a field strength detecting apparatus according to an embodiment of the present invention;

Fig. 4 represents a relationship between a correction value and a signal channel based on a prepared frequency characteristic;

Fig. 5 is a schematic block diagram for indicating an internal arrangement of the correction circuit employed in the field strength detecting apparatus shown in Fig. 3; and

Fig. 6 graphically shows a variation in the corrected field strength value detected from the field strength detecting apparatus of Fig. 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Fig. 3 is a schematic block diagram for indicating an arrangement of a field strength (intensity) detecting apparatus according to an embodiment of the present invention.

It should be noted that the same reference numerals shown in Fig. 1 will be employed as those for indicating the same or similar circuit units of Fig. 3, and therefore no explanations thereof are made in the specification. The field strength detecting apparatus owns such a similar circuit arrangement that the channel designating unit 9 supplies the channel designating data 8 to the signal receiving unit 2, as compared with that of Fig. 1. A different circuit arrangement of this detecting apparatus is such that channel information 10 indicating which channel is designated is furnished from this channel designating unit 9 to a correction circuit 6 (will be discussed later). Furthermore, a detected value 5 outputted from the field strength detecting unit 4 is supplied to this correction circuit 6 which corrects the detected value 5 based on the channel information 10 to produce a corrected detection value 7. Then, the frequency characteristic is corrected and this corrected detection value 7 is outputted.

In the field strength detecting apparatus with the above-described arrangement, a reception signal 1 having such a frequency determined by the channel designating data 8 derived from the channel designating unit 9 is received by the signal receiving unit 2. Then, the field strength information 3 outputted from this signal receiving unit 2 is supplied to the field strength detecting unit 4 so as to obtain the field

strength detected value 5. It should be understood that this detected value 5 owns such a frequency characteristic as shown in Fig. 2 referred in the prior art, and therefore cannot constitute a desirable correct field-strength detected value. Therefore, this detected value 5 is supplied to the correction circuit 6. The correction circuit 6 corrects this detected value 5 with respect to each of preselected channel ranges based upon the channel information 10 supplied from the channel designating unit 9 by using correction values as represented in Fig. 4.

It should be understood that this correction value can be determined by that the frequency characteristic owned by the signal receiving unit 2 is previously measured, and based on this measured frequency characteristic, this correction value is defined in connection with the signal channels used in the mobile communication where the field strength should be measured by the field strength detecting apparatus according to the present invention.

On the other hand, as shown in Fig. 5, the correction circuit 6 is arranged by a correction unit 13 and an adder 11. This correction unit 13 is constructed of an address designating unit 130 and a correction memory 131 for previously storing correction values in correspondence with the channel numbers "0" to "300", and the address as illustrated in Fig. 4. The correction by this correction circuit 6 is performed as follows: That is, the channel information 10 supplied from the channel designating unit 9 is supplied to the address designating unit 130 of the correction

unit 6, so that a correcting value 12 corresponding to the channel number is read out and then is supplied to the adder 11. The adder 11 adds this correcting value 12 to the detected value 5 supplied from the field strength detecting unit 4, thereby performing the desired correction.

In accordance with the field strength detecting apparatus with the above-described circuit arrangement, since the above-described correction circuit 6 is employed, such a corrected detection value as shown in Fig. 6 may be produced even when the detected value 5 from the field strength detecting unit 4 contains the frequency deviation, as previously explained in the prior art detecting apparatus with reference to the frequency characteristic curve of Fig. 2. In other words, this corrected detection value reflects a very correct field strength value. In this embodiment, in order to reduce this deviation within ± 1 [dB], the entire frequency range is subdivided into six channel regions, and then the correcting values 12 are properly allocated to these six channel regions (see Fig. 4). As apparent from Fig. 4, a large number of channels are set into one channel region whose frequency characteristic is substantially flat, whereas a small number of channels are set into another channel region whose frequency characteristic deviation is large. As a consequence, a total number of channels which are handled as one channel region may be reduced in order to obtain more precise measurement values, as compared with those of Fig. 4. It should be noted that since the graphic representation of Fig. 6 is more or less exaggerated, the deviation is expressed

in large sizes.

As previously explained, since the field strength detecting apparatus according to the present invention is comprised with the memory for previously storing the correcting values used to correct the detected field strengths and the correcting circuit for adding the data (correcting value) read from this memory to the measurement value so as to perform the deviation correction, the deviation depending on the frequency characteristic is corrected based on the correcting value, so that such a field strength detected value with deviation reduced within a predetermined value can be obtained. Furthermore, since the field strength detecting apparatus is designed to measure the field strength only in the radio signals used in the mobile communication range, this field strength detecting apparatus need not have a flat frequency characteristic over a wide range. As a consequence, this detecting apparatus can be made compact, i.e., can own better portability. In addition, as the correcting values read from the memory are derived based on the reception channel information designated to the signal receiving unit, the deviation corrections can be immediately performed in synchronism with the received signal channel.

Although the present invention has been fully described by way of the preferred embodiments thereof with reference to the accompanying drawings, various changes and modifications will be apparent to those having skill in this field. Therefore, unless these changes and modifications otherwise depart from the scope of the present invention, they should be

construed as included therein.

Each feature disclosed in this specification (which term includes the claims) and/or shown in the drawings may be incorporated in the invention independently of other disclosed and/or illustrated features.

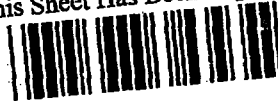
The appended abstract as filed herewith is included in the specification by reference.



CLAIMS:

1. A method of measuring field strength in one of a plurality of radio signal frequency channels of a communication system comprising assigning a correction value to each frequency channel to compensate for variations in respective receiving characteristics for said channels in a signal receiving unit, receiving the radio signal in the signal receiving unit, producing a detected field strength value for the received signal and correcting the detected value by applying thereto the correction value appropriate to the frequency channel.
2. A field strength detecting apparatus for a multi-channel radio communication system comprising a signal receiving unit for receiving signals in any of a plurality of frequency channels, means for producing a detected field strength value for a received signal in a said channel, and means for correcting the detected field strength value by applying thereto a correction value selected from a number thereof according to the channel in which the signal was received .

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1 3. A field strength detecting apparatus for measuring
2 field strength of a frequency band allocated to a mobile
3 communication, comprising:
4 a channel designating unit for outputting two sets of
5 same channel information used to designate a channel number
6 corresponding to a frequency of a radio signal to be received,
7 said two sets of same channel information being first channel
8 information and second channel information;
9 a signal receiving unit for inputting therein the first
10 channel information derived from said channel designating unit
11 to receive a radio signal having a frequency corresponding to
12 the channel number designated by said first channel
13 information, thereby outputting a field strength level of said
14 received radio signal;
15 a field strength detecting unit for inputting therein the
16 field strength level of said received radio signal derived
17 from said signal receiving unit to output said field strength
18 level as a field strength detected value; and
19 a correction circuit containing a correction value used
20 to correct a frequency characteristic owned by said signal
21 receiving unit within the frequency band allocated to said
22 mobile communication, for entering therein the second channel
23 information outputted from said channel designating unit to
24 select the correction value corresponding to said second
25 channel information, whereby said field strength detected
26 value derived from said field strength detecting unit is
27 corrected based on said selected correction value.

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1 4. A field strength detecting apparatus as claimed in
2 claim 1 wherein:
3 said correction circuit is further comprised of:
4 a correction memory for storing the channel number
5 corresponding to the frequency of the radio signal within the
6 frequency band allocated to said mobile communication and said
7 correction value corresponding to said channel number;
8 an address designating unit for designating a read
9 address of said correction memory based upon said second
10 channel information supplied from said channel designating
11 unit; and
12 an adding circuit for adding the correction value read
13 from said correction memory to the field strength detected
14 value outputted from said field strength detecting unit.

5. A field strength detecting method or apparatus substantially
as herein described with reference to Figures 3 to 6 of the accompanying
drawings.

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