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[54] **METHOD AND MEANS FOR ALLOCATING THE VOLUME OF TRAFFIC OVER DIFFERENT CONTROL CHANNELS OF A CELLULAR RADIO SYSTEM**

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[30] **Foreign Application Priority Data**

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[51] **Int. Cl.**[4] **H04B 7/00**; H04Q 7/02

[52] **U.S. Cl.** **455/33**; 455/34; 455/56

[58] **Field of Search** ..... 455/31.33, 34, 54, 56, 455/38; 179/2 EB

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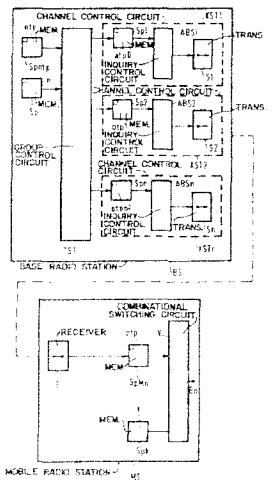
[57] **ABSTRACT**

A cellular radio system in which the mobile radio stations in the zone of any base radio station assign themselves to the control channels allocated to that base station so as to evenly spread the volume of traffic over such control channels. The base station transmits on each control channel a channel group code signifying the range of group code numbers allocated to that particular control channel. Each mobile station stores its identifying group code number, scans the group code numbers of all control channels, and assigns itself to the control channel having a channel group code which includes its group code number. The spread of traffic over the various control channels can be changed by the base radio station simply by changing the channel group codes of the various control channels, without addressing specific commands to the mobile radio station.

11 Claims, 2 Drawing Figures



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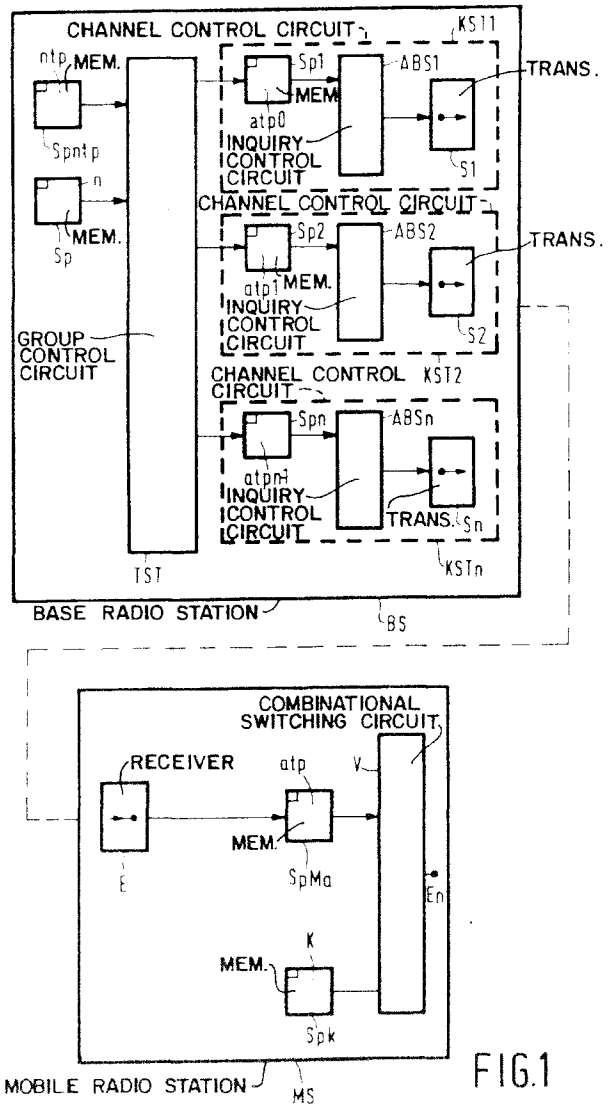

FIG.1

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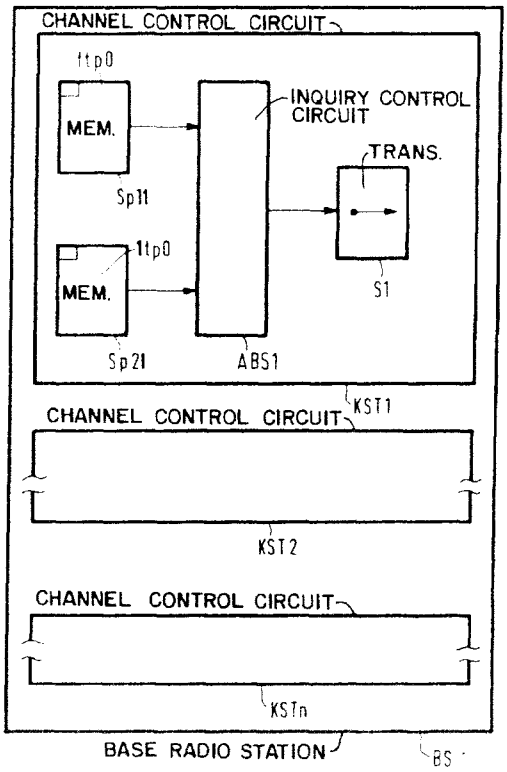

FIG. 2

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METHOD AND MEANS FOR ALLOCATING THE VOLUME OF TRAFFIC OVER DIFFERENT CONTROL CHANNELS OF A CELLULAR RADIO SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention concerns a process for spreading the volume of traffic over different control channels of a radio transmission system, and apparatus for practicing such a process.

2. Description of the Prior Art

In a radio communications system (radio transmission system) known from DE-AS 27 33 503 the service area (the entire primary coverage area) is divided up into a large number of zones (radio zones) (cellular system) and each radio zone is allocated at least one control channel (organisation channel) and several traffic channels. In a radio zone with a large number of mobile telephone subscribers (mobile radio stations) the transmitter/receiver in the radio station (base) has to be provided with several control channels. To simplify the transmission and reception separation filter the transmission and reception frequency band is split up into an upper and a lower band. The mobile radio stations are divided up into at least two groups each of which uses one of the transmission and reception frequency bands. The division of the transmission and reception frequency band into two bands is chosen so that both groups of mobile radio stations share a common band. At least some of the control channels are located in this common band.

A mobile radio station of a first group selects a control channel, e.g. for the establishment of connections. To this end the mobile radio station scans the control channels allocated to the first group for one with a good signal-to-noise ratio. If the signal-to-noise ratio of the selected control channel deteriorates because of interference to the radio field propagation or for some other reason, then the mobile radio station, on receipt of a certain control channel code, can also use a control channel allocated to another group, e.g. the second group. This allocation of control channels of another group is only undertaken in a radio zone if it has a small number of mobile radio stations.

If there are several control channels available in a radio zone, then the volume of traffic corresponding to the mobile radio stations located and registered as being in this radio zone is spread over the control channels of this radio zone. In the known radio transmission system (DE-AS 27 33 503) the mobile radio stations are split up into groups to reduce the cost of the transmitter and receiver separation filter. Regard for the traffic situation, in particular a system of control by spreading the volume of traffic over different control channels, is neither anticipated nor mentioned. If four control channels are allocated to a radio zone, for example, and if there are in that radio zone only two out of a total of four groups of mobile radio stations, then the volume of traffic in the zone is spread over two control channels allocated to only the two groups of mobile radio stations.

If the number of control channels in a radio zone belonging to that radio zone or the frequency and consequently the channel number of a control channel changes, then the mobile radio stations should automatically and independently assign themselves to the thus formed new set of control channels. If, for example, a new control channel is allocated to the radio zone, then everything possible should be done to prevent the already existing control channels and the new control channel from becoming temporarily overloaded in the short term by a large number of individual transfers of mobile radio stations.

The problem underlying the invention was to devise a process for spreading the volume of traffic over different control channels of a radio zone. In the event of a change in configuration, i.e. in the event of a control channel failure, the mobile radio stations should require no individual change commands to a new control channel.

SUMMARY OF THE INVENTION

The process in accordance with the invention provides the means for an approximately uniform spread of the volume of traffic over different control channels of a radio zone of a radio transmission system.

Some of the many mobile radio stations are in radio contact with the base radio station.

If the case of the known radio transmission system (DE-AS 27 33 503) when it comes to an establishment of connections from the base radio station to the mobile radio station the latter has to be called on all the control channels in the radio zone. This unnecessary overloading of all the control channels can be avoided by the process according to the invention. At the same time the number of transfers of mobile radio stations on an overloaded control channel can be kept low. The volume of traffic on the different control channels at any one time can be determined in the base radio station by traffic metering. The variable number of groups in the radio transmission system known to both the base radio station and the mobile radio station is chosen so that in each radio zone the various groups are spread as evenly as possible. The number of groups (ntp) shows into how many groups the total number of mobile radio stations located in the radio coverage area of the base radio station have been divided. The mobile radio station can assign itself to a control channel in a clear-cut fashion by combining the group code number with the number of groups and group code transmitted via the control channel. The group code (atp) in a control channel shows which groups of mobile radio stations are allowed to use that channel. By changing it the base radio station has a simple means of controlling the spread of the volume of traffic over its different control channels.

Advantageous versions of the invention are described in the subclaims.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is a circuit block diagram of a radio transmission system comprising a base radio station and a mobile radio station in accordance with the invention; and

FIG. 2 is a circuit block diagram of an alternative form of base radio station in the circuit of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The invention will now be described in greater detail and explained for different cases.

The radio transmission system is made up of several levels that are built up on top of one another. The lowest level consists of what are known as radio zones.

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Depending on the height of the aerial masts of the base radio stations BS and with a transmitter power of a maximum of 50 watts the radius of these radio zones can lie between 5 and 15 km. Each radio zone is covered by a base radio station BS, which can relay conversations from and to the public telephone network via radio relay equipment. Several adjoining radio zones can be combined into what is known as a paging area. The locations of all the mobile radio stations MS are subject to constant monitoring by the base station where they are stored in an address book. If a mobile radio station MS changes its paging area, then a change is made in the address book.

If a telephone subscriber of a public telephone network wishes to contact a mobile radio station MS a selective call is transmitted in all the radio zones of the paging area in which the mobile radio station MS is registered at that moment.

The transmission and reception frequency bands lie, for example, between the 860 and 960 MHz. The duplex distance between transmission and reception frequency bands can be 45 MHz and each transmission and reception frequency band can be subdivided into channel widths of 25 kHz. The channels are used in duplex operation. Depending on the volume of traffic each radio zone of the radio transmission system is allocated a number of traffic channels and at least one control channel CCH. This means that in geographically adjoining radio zones different frequencies (control channels) are used. To distinguish between a control channel CCH and a traffic channel each of them is given a special code. If a control channel CCH fails or is subject to interference any traffic channel can take over the functions of the control channel CCH by a change in code. In this way it is possible to dispense with the duplication of control channels CCH that would otherwise be necessary for reasons of reliability.

In the radio transmission system known from DE-AS 27 33 503 a mobile radio station, once switched on, runs an orientational search for the control channel with the best signal-to-noise ratio. The channel number of this control channel is stored and the mobile radio station goes into a state of rest. The mobile radio station monitors the signal-to-noise ratio of this control channel. If the signal-to-noise ratio of the control channel stored at that moment falls below a given value, then the mobile radio station scans other control channels in a search mode and compares the signal-to-noise ratios. A change in radio zone can be identified by this comparison and the mobile radio station stores the channel number of the corresponding control channel. Accordingly there are mobile radio stations in a radio zone which are ready to transmit and receive or which at a given moment establish connections with the public telephone network or with a mobile radio station of the radio transmission system via the control channel CCH, base radio stations and radio relay equipment. In the known radio transmission system (DE-AS 27 33 503) the mobile radio station stores the control channel that has the highest signal-to-noise ratio. In this way, according to the traffic situation, the volume of traffic on different control channels of a radio zone may vary.

In the radio transmission system all the mobile radio stations MS located in its area are divided up into a constant number ntp of groups TP. Each mobile radio station is permanently and unequivocally allocated to one of these groups TP. To simplify the description it is assumed in the following that the mobile radio stations MS are divided into 100 groups TP. Each mobile radio station is identified by a group code number K which is part of a stored identification code mid of such mobile radio station MS. A mobile radio station MS may be allocated to one of the groups TP on the basis, for example, of the last two figures y z of its identification code mid. The allocation criterion mtp is then the same as the two final figures y z. A mobile radio station MS with an identification code 59988 accordingly belongs to the group TP=88. The base radio station BS transmits a group code atp to the mobile radio stations MS on each control channel CCH. By comprising the received group code atp and its stored group code number K the mobile radio station MS can derive an unequivocal allocation to a control channel CCH. The group code atp transmitted by the base radio station BS to the mobile radio stations MS can, for example, consist of two parts, a largest and a smallest identification code number ltp and ftp. A mobile radio station MS assigns itself to that control channel CCH for which the condition

$$ftp \leqq mtp \leqq ltp$$

is satisfied. In the examples below mtp will be taken as being equal to K.

Case 1

At a given moment three control channels CCH 1, 2 and 3 are allocated to a radio zone, with the channel numbers 589, 614 and 765. The volume of traffic in the radio coverage area of the base radio station BS is evenly spread if each such control channel carries a third of the volume of traffic. In the group code atp transmitted on control channel CCH1 (with the channel number cnr=589) the base radio station BS makes it known that the smallest identification code number ftp=00 and the largest identification code number ltp=32. On control channel CCH2 (with the channel number cnr=614) the base radio station BS transmits to the mobile radio station MS a smallest number ftp=33 and a largest number ltp=65. Correspondingly on control channel CCH3 (with the channel number cnr=765) a smallest number ftp=66 and a largest number ltp=99. The mobile radio station MS with the group code number K=88 (identification code 59988) assigns itself to control channel CCH3 because the condition

$$66 \leqq 88 \leqq 99$$

is satisfied for this channel. The channel number cnr=765 of control channel CCH3 can be stored in the mobile radio station MS. Because of this unequivocal allocation the mobile radio stations MS can be paged by the base radio station BS on control channel CCH3.

Having been switched on each mobile radio station MS so assigns itself to a control channel CCH of a radio zone. In the subsequent course of events the mobile radio station MS continually checks that the condition for this control channel CCH is satisfied. If this condition ceases to be satisfied then a search begins in the mobile radio station MS for a new control channel CCH which satisfies the condition at that moment. If several control channels CCH satisfy this condition, then the mobile radio station MS will, as a matter of preference, assign itself to the one with the highest signal-to-noise ratio or to the one received with the greatest field strength. If the base radio station BS transmits a code for the paging area in addition to the group code atp, then a change of paging area can be identified in the

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