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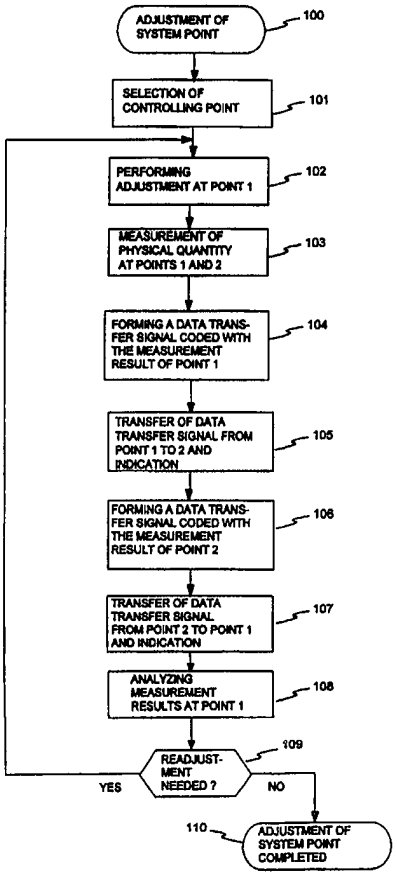
(57) Abstract

The invention relates to a method and arrangement for transferring measurement data. The solution according to the invention can preferably be applied to the transfer of measurement data of an air–conditioning system in connection with the adjustment of air volumes of the system. An idea of the invention is that when a quantity that is essential with regard to the adjustment of the system is measured at two points of the system, the measurement values received are coded into the data transfer signal (104, 106), which is transferred wirelessly between said two points (105, 107). This enables, for example, receiving the measurement values of the second point to the first point for performing the system adjustment at the first point. By means of the solution according to the invention, the adjustment can be performed by one person, and he does not need to go to the second point between the adjustments to read the measurement result.



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A method and arrangement for transferring measurement data and a measuring device

The invention relates to a method and arrangement for transferring measurement data. The solution according to the invention can be applied for transferring the measurement data of an air-conditioning system in connection with the adjustment of air volumes in the system.

The adjustment of the air-conditioning system is carried out in the usual manner so that air flow and pressure are measured from the valves of the air-conditioning system, and the system is adjusted so that the predetermined measurement values are achieved. The measurement must normally be carried out in connection with the valve adjustment at the point where the adjustment is carried out at the time, and in addition at another point of the air-conditioning duct so that the effect of the adjustment on the flow in the duct is known.

In the prior art, the adjustment is carried out so that after each adjustment, measurements are taken at the two points mentioned above. In order that the adjustment would take place quickly, two persons are needed to take the measurements at the two points mentioned, whereby the person performing the adjustment at the first point tells the person carrying out the measurement at the second point when the measurement has to be taken, and the person at the second point takes the measurement and tells the measurement result to the person at the first point. This exchange of information is usually done by speaking, if the distances between the points are short, or by mobile phones if the distances are long. If there is only one person carrying out the adjustment, after each adjustment measure he must go to the second point to take the measurement. In this case, the adjustment is a slow process. In both of the above solutions, the adjustment process causes considerable labour costs.

In addition, a solution is known in which the alarm data of the air-conditioning system are transferred wirelessly from the central unit of the air-conditioning system to a pager. By means of this solution, information about faults in the air-conditioning system can be quickly communicated to the person responsible for the maintenance, for example. However, the solution has the drawback that the central unit does not contain information about the flows at individual adjustment points, and so the solution cannot be used for adjusting the air volumes at individual points

of the system. In addition, the device according to the invention must be installed as fixed in the central unit of the air-conditioning system, whereby the device causes extra costs to the owner of the system.

The purpose of the invention is to create a solution for transferring the measurement data so that the above mentioned drawbacks of the prior art can be avoided.

The invention includes the idea that when a quantity essential for the adjustment of the system is measured at two points, the measurement values received are coded into a data transfer signal, which is transferred wirelessly between the two points. Then, for example, the measurement values of the second point are received to the first point for carrying out the system adjustment at the first point. By means of the solution according to the invention, the adjustment can be carried out by one person, and it is not necessary for him to go to the other point between the measurements to read the measurement result.

In the solution according to the invention, the device used for the wireless transfer of the data transfer signal is preferably a hand-held phone attached to the measuring device, such as a VHF, UHF or LA phone, whereby in addition to the transfer of the measurement values, the device can be used for speech transfer, when required.

The method according to the invention for transferring measurement data from a system which has a first point and a second point, in which method
- a physical quantity related to the operation of the system is measured at the second point of the system for receiving a measurement result and
- information about the measurement result is transferred from the second point of the system to the first point,

is characterized in that
- a data transfer signal is formed for transferring the data,
- the data are coded into the data transfer signal,
- the data transfer signal is transferred wirelessly from the second point of the system to the first point, and
- information about the transferred data transfer signal is indicated at the first point of the system.

The arrangement according to the invention for transferring the measurement data of the system between the first and second point of the system, whereby the arrangement comprises
- a first measuring device for measuring the first measurement quantity at the first point of the system,
- a second measuring device for measuring the second measurement quantity at the second measurement point
is characterized in that the arrangement comprises
- means for coding the measurement data into the data transfer signal, and
- means for transferring the data transfer signal wirelessly between the first and second point of the system.

A measuring device according to the invention, which comprises a sensor for measuring the physical quantity, is characterized in that it comprises
- means for forming the first data transfer signal,
- means for coding the first measurement information into the data transfer signal
- means for transmitting the first data transfer signal,
- means for receiving the second data transfer signal,
- means for indicating the second measurement information from the second data transfer signal.

In the following, the invention will be described in more detail with reference to the accompanying drawings, in which

Figure 1 shows a flow chart of a method according to the invention for transferring measurement data,
Figure 2 shows a block diagram of a measuring device according to the invention,
Figure 3 shows a block diagram of a system according to the invention for transferring measurement data,
Figure 4 shows a timing diagram of a procedure according to the invention for using a data transfer channel,
Figure 5 shows a timing diagram of a message according to the invention, which is sent from the first point of the system, and
Figure 6 shows a timing diagram of a message according to the invention, which is sent to the first point of the system.

Figure 1 shows a method according to the invention for transferring the measurement data, 100. At first, in block 101, the so-called controlling point of the measurement arrangement is determined. In the following, this controlling point of the system is called the first point of the system, and the other points are called the second, third, etc. points of the system. In the method according to Figure 1, there are two of the measurement points related to the system adjustment procedure.

The next step in the method according to Figure 1 is to carry out an adjustment measure related to the operation of the system at the first point of the system, block 102. After this, measurements of a physical quantity related to the operation of the system are carried out at the first and second point of the system, block 103. The measurement results received are saved and shown at the point of the system at which the measurement has been taken. If the system is an air-conditioning system, for example, the physical quantity is preferably the air pressure or air flow.

In the next step, a data transfer signal is formed at the first point of the system, and the result of the measurement taken at the first point is coded into the signal, block 104. After this, the data transfer signal is transferred to the second point of the system, block 105. The measurement information coded into the signal is indicated at the second point, this information is saved and presented.

When the above mentioned measurement information has been transferred to the second point of the system, the transfer of the measurement information from the second point to the first point is automatically activated. The first step in this process is to form a data transfer signal, into which the result of the measurement carried out at the second point is coded, block 106. After this, the data transfer signal is transferred to the first point of the system, block 107. The measurement information coded into the transferred data transfer signal is indicated at the first point, this information is saved and presented. In accordance with the above, the message transferred from the first point to the second point activates data transfer from the second point to the first point.

After this, the measurement results received at the first point are analyzed, block 109. If the measurement results show that the system operates as desired, the adjustment measures can be stopped at the point in question and the measurement sensors detached from the first and second point of the system. On the other hand, if the measurement results show that the system needs to be adjusted at the first point, the procedure returns to block 102 and the required adjustment is performed.

Figure 2 shows a block diagram of a measuring device according to the invention. It comprises a measurement unit 230, a transceiver unit 220 and a control unit 200. The measurement unit 230 comprises a sensor 231 for measuring the quantity needed in the adjustment, and an amplifier 232. The analog measurement signal formed by the sensor is amplified in the amplifier 232 and fed to the analog-to-digital converter 202 of the control unit, in which the measurement signal is converted into digital. The processor 201 reads the value of the measurement signal from the analog-to-digital converter 202 and saves the value in the memory 203. The processor 201 also transfers the measurement value to the first display driver 205, which forms the control signal for the first display 206 for showing the measurement value on the display screen of the device.

In accordance with the invention, the measurement value received from the measurement unit and saved in the memory is transferred to the second measuring device in the following way, for example. The processor 201 reads the measurement value from the memory 203 and transfers it to the modem 209, which forms, for example, an analog audio frequency signal, into which the information has been coded. The analog signal formed by the modem is fed to the transceiver unit 220, which converts the audio frequency analog signal into a radio frequency signal in the transceiver 221, which further feeds the RF signal to the antenna 222 for transmission.

The RF signal sent from the second measuring device is received by the antenna 222 of the transceiver unit, after which it is amplified and demodulated into an audio frequency analog signal in the transceiver 221. The audio frequency analog signal is fed to the modem 209 of the control unit, and the modem decodes the signal for indicating the transmitted data from the analog signal. The processor 201 reads the received data from the modem 209 and saves the data in the memory 203. In addition, the processor feeds the received data to the second display driver 207, which controls the second display 208 for displaying the data on the screen.

The measuring device also has a keypad, by which the functions of the measuring device can be controlled. For example, the keypad can include a key for starting the transmission of a message to another measuring device. Specifying a measurement device as the controlling measuring device can also be carried out by activating a key. In this case, the measuring devices can be alike, because specifying the measuring device as the controlling or responsible measuring device can be done in

connection with the use of the device. The keypad is connected to the control unit processor, which indicates the activation of the key.

The transceiver unit 220 also comprises a microphone 223 for converting speech into an audio signal. Thus the signal to be transmitted can be modulated by the audio signal received from the microphone at moments when the modem is not transferring a signal to the transceiver. Thus, by demodulating the received signal, the transmitted speech signal can be repeated by the loudspeaker 224, which is integrated into the receiving measuring device. Thus it is also possible to to transfer speech with the device.

In the device shown in Figure 2, the control unit processor also comprises an external connection 210 for connecting external devices, such as a computer or a printer. The external connection can be parallel or serial, such as an RS or 232 connection.

A hand-held phone, such as a VHF, UHF or LA phone, can be advantageously used as the transceiver unit, because such phones are manufactured in large series, and their radio connections have been designed to comply with data transfer standards and regulations. In addition, a hand-held phone can easily be used for speech transfer in addition to the transfer of measurement data, because it contains the audio components required for this.

The measuring device can preferably be implemented as portable, whereby it consists of components such as a VHF phone, a small control unit attached to it, and a measurement unit connected to the control unit by a cable.

Figure 3 shows an arrangement, which comprises two measuring devices according to Figure 2. The first measuring device comprises a control unit 200, a measurement unit 230 and a transceiver unit 220. The transceiver unit comprises a transceiver 221, a microphone 223, a loudspeaker 224 and an antenna 222. Data transfer between the first and second measuring device takes place by radio between the antenna of the first measuring device 222 and the antenna of the second measuring device 322. Similarly, the second measuring device comprises a transceiver 321, which together with the microphone 323, the loudspeaker 324 and the antenna 322 forms the transceiver unit 320. In addition, the second measuring device has a control unit 300 and a measurement unit 330.

In the arrangement according to Figure 3, one of the measuring devices is set as the controlling or first measuring device, such as a measuring device consisting of the units 200, 220 and 230. Thus the controlling measuring device sends the data transfer signal first to the second measuring device consisting of the blocks 300, 320 and 330, and thereafter the second measuring device sends the data transfer signal to the first measuring device.

In a preferred embodiment the first and second measuring devices are substantially similar. They are preferably portable and are arranged to be repeatedly attached/ detached to/from measuring points of a system.

The above description related to a solution according to the invention, in which measurement data are transferred both from the first point of the system to the second point, and from the second point of the system to the first point. However, according to the invention it is also possible to transfer measurement data in one direction only, for instance from the second point of the system to the first point. An application like this, based on uni-directional data transfer is sufficient when the measurement and adjustment of the system is performed by one person only.

The solution according to the invention can also be used to transfer information between more than two measurement points. Then each measurement point has preferably a unique address, by which the device of the controlling measurement point can control the data transfer of other measuring devices. If the measurement device has two displays, the operation of the displays can be preferably arranged so that the first display continuously shows the measurement value measured by the measuring device in question, and the second display shows the measurement values of other measuring devices by turns. The the second display can preferably show, besides the measurement value, also the address of the measuring device from which the measurement value to be displayed has been received.

Figure 4 shows the use of a data transfer channel in a system which comprises two measuring devices and in which the same data transfer channel, such as a VHF, UHF or LA channel, is used for both directions of data transfer. In the diagram, the horizontal direction depicts time, running from left to right. In the vertical direction, each diagram has two states, the upper one depicts the active state and the lower one the passive state. Diagram 400 therein shows the reservation of a data transfer channel for transferring measurement data. The time periods 401 and 402 used for transferring measurement data have a length of 100-200 ms, for

example. The interval between the periods used for transferring the measurement results can be considerably longer, such as 3 seconds. In Figure 4, the interval is shown relatively shorter than the real value for clarity.

Diagram 410 shows the use of a data transfer channel for transferring the measurement results from the controlling point, i.e. the first point of the system to the second point. This data transfer takes place between the periods 411 and 412.

Diagram 420 shows the use of a data transfer channel for transferring the measurement results from the second point of the system to the first point. This data transfer takes place between the periods 421 and 422.

Diagram 430 shows the use of a data transfer channel for speech transfer. Periods when the data transfer channel is not used for transferring the measurement data, that is, the periods 431, 432 and 433, can be used for speech transfer. Because the relative portion of these periods of the total time is relatively high, such as 90%, the use of a data transfer channel for the transfer of measurement data does not not materially disturb the transfer of speech. If desired, the signal transmitting measurement data and the speech signal can also be transferred simultaneously as a sum signal, whereby the signal transferring measurement data from the sum signal is indicated in the receiver on the basis of the signal frequency, for example. Thus there is no interruption in the transfer of the speech signal.

Figure 5 shows the use of a data transfer channel for transferring a message from the first point of the system to the second point of the system and the structure of the message to be transferred. In diagram 510, the messages to be transferred in the periods 511 and 512 consist of the address portion 513, the data portion 514 and the checksum 515. The address portion 513 contains the address of the measuring device, to which the result measured at the first point is transferred and/or from which the measurement data are next transferred to the first point. The data portion 514 contains information about the measurement result. The part 515 comprises the checksum, which has been calculated on the basis of the information contained by the address and data portions transmitted.

The checksum is used to check in the receiving measuring device that no error has occurred during the data transfer. This is carried out so that a checksum is also calculated in the receiving measuring device on the basis of the received

information and compared with the received checksum. If these checksums are the same, it is very unlikely that the transferred information would contain an error.

Figure 6 shows the use of a data transfer channel for transferring a return message from the second point of the system to the first point of the system and the structure of the message to be transferred. There in diagram 620, the return messages to be transferred in the periods 621 and 622 comprise the data portion 624 and the checksum portion 625. The data portion 624 includes information about the result of the measurement carried out at the second point of the system, and the checksum portion 625 contains the checksum calculated on the basis of the information contained by the data portion. The return message does not necessarily require an address portion, because after a message sent from the first point of the system, a return message is expected from the address which has been coded into the message sent from the first point.

On the basis of the above, a person skilled in the art can implement an arrangement according to the invention by means of components known per se and a processor program which executes the functions according to the invention. Thus the selection or sizing of the components of the device according to the invention is not described in more detail here.

Some embodiments of the solution according to the invention have been presented above. The principle according to the invention can naturally be modified within the scope defined by the claims, with respect to the details of the implementation and the applications. Particularly it has to be noted that although the invention can preferably be applied to the adjustment of water distribution, heating and air conditioning systems, the invention can also be used in connection with various other systems, when measurement data are transferred between points of measurement at a long distance from one another. In addition, it is to be noted that although a method for coding measurement data into an audio frequency analog signal has been presented above, digital coding methods can naturally also be used.

Claims

1. A method for transferring measurement data from a system which has a first and a second point, in which method
- a physical quantity related to the operation of the system is measured at the second point of the system for obtaining a measurement result (103) and
- information about said measurement result is transferred from the second point of the system to the first point
characterized in that
- a data transfer signal (104) is formed for transferring said information,
- said information is coded into said data transfer signal (104),
- said data transfer signal is transferred wirelessly from the second point of the system to the first point of the system (107) and
- said information about the transferred data transfer signal is indicated at the first point (107) of the system.

2. A method according to Claim 1, **characterized** in that said physical quantity is air pressure.

3. A method according to Claim 1, **characterized** in that said physical quantity is air flow.

4. A method according to any one of the preceding claims, **characterized** in that on the basis of the measurement information transferred from the second point of the system to the first point of the system, the system adjustment is performed at said first point of the system (102).

5. A method according to Claim 4, **characterized** in that
- a physical quantity related to the operation of the system is also measured at the first point of the system
- the adjustment at said first point of the system is also performed on the basis of the result of the measurement carried out at the first point of the system.

6. A method according to any one of the preceding claims, **characterized** in that
- the physical quantity related to the operation of the system is also measured at the first point of the system, and
- information about the measurement result obtained at the first point of the system is transferred to the second point of the system.

7. A method according to Claim 6, **characterized** in that data transfer from the first point of the system to the second point and data transfer from the second point of the system to the first point is carried out at different times in the same data transfer channel.

8. A method according to Claim 6 or 7, **characterized** in that data transfer from the second point of the system to the first point is activated by means of a message transferred from the first point of the system to the second point.

9. A method according to any one of the preceding claims, **characterized** in that the measurement data are coded into an audio signal for data transfer.

10. A method according to any one of the preceding claims, **characterized** in that said data transfer takes place by radio.

11. A method according to any one of the preceding claims, **characterized** in that the measurement of said physical quantity is carried out by a sensor, which is placed at a point of the system for measurement during the adjustment of the system, whereafter the sensor is detached from said point of the system.

12. An arrangement for transferring the measurement data of the system between the first and second point of the system, whereby the arrangement comprises
- a first measuring device (200, 220, 230) for measuring the first measurement quantity at the first point of the system,
- a second measuring device (300, 320, 330) for measuring the second measurement quantity at the second measuring point
characterized in that the arrangement comprises
- means (200) for coding the measurement data into the data transfer signal and
- means (220, 221, 222, 320, 321, 322) for transferring the data transfer signal wirelessly between the first and second point of said system.

13. An arrangement according to Claim 12, **characterized** in that it comprises means (200) for activating data transfer from a measuring device at the first point of the system.

14. An arrangement according to any one of the Claims 12 to 13, **characterized** in that said means (220, 320) for transferring measurement data wirelessly

comprise a radio transceiver using the VHF, UHF or LA frequency band for data transfer.

15. An arrangement according to any one of the claims 12 to 14, **characterized** in that it comprises means (200, 220, 300, 320) for transferring the measurement data as pulses, and means (200, 220, 300, 320) for transferring the speech signal during the period between the transfer of consecutive pulses.

16. An arrangement according to any one of the Claims 12 to 15, **characterized** in that said two measuring devices are substantially similar.

17. An arrangement according to any one of the Claims 12 to 16, **characterized** in that said two measuring devices are portable and are arranged to be repeatedly attached/detached to/from measuring points.

18. An arrangement according to any one of the Claims 12 to 16, **characterized** in that said two measuring devices both comprise
- means (201, 209, 220) for forming a first data transfer signal,
- means (230, 201, 209) for coding the first measurement information into said data transfer signal,
- means (220) for transmitting said first data transfer signal,
- means (220) for receiving a second data transfer signal,
- means (209, 201) for indicating a second measurement information from said second data transfer signal.

19. A measuring device, which comprises a sensor (231) for measuring a physical quantity, **characterized** in that it comprises
- means (201, 209, 220) for forming the first data transfer signal,
- means (230, 201, 209) for coding the first measurement information into said data transfer signal,
- means (220) for transmitting said first data transfer signal,
- means (220) for receiving the second data transfer signal,
- means (209, 201) for indicating the second measurement information from said second data transfer signal.

20. A measuring device according to Claim 19, **characterized** in that it comprises storage media (203) for saving the measurement information.

21. A measuring device according to any one of the Claims 19 to 20, **characterized** in that it comprises display means (205 - 208) for displaying the first and/or second measurement data.

22. A measuring device according to any one of the Claims 19 to 21, **characterized** in that it comprises means (209) for forming an audio signal, into which the information of the measurement value has been coded, and means (209) for indicating the measurement value from the received audio signal.

23. A measuring device according to any one of the Claims 19 to 22, **characterized** in that it comprises means (201, 209, 221) for coding the address data into the data transfer signal to be transmitted and means (201, 209) for indicating the address data from the received data transfer signal.

24. A measuring device according to Claim 23, **characterized** in that it comprises means (201, 209, 220) for transmitting a data transfer signal as dependent on the address data indicated from the received data transfer signal.

25. A measuring device according to any one of the Claims 19 to 24, **characterized** in that it comprises
- means (221, 223) for coding the speech signal into the data transfer signal to be transmitted during a period when measurement data are not being transferred, and
- means (221, 224) for indicating the speech signal from the received data transfer signal.

26. A measuring device according to any one of the Claims 19 to 25, **characterized** in that it comprises means (201, 204) for setting the measuring device in the controlling or replying state of operation.

27. A measuring device according to any one of the Claims 19 to 26, **characterized** in that it comprises, as connected to one another, a VHF, UHF or LA radio phone (220), a control unit (200) and a measurement unit (230).

28. A measuring device according to any one of the Claims 19 to 27, **characterized** in that it is portable.

29. The **use** of a method according to any one of the Claims 1 to 11 or an arrangement according to any one of the Claims 12 to 18 or a measuring device

according to any one of the Claims 19 to 28 in connection with the adjustment of a heating, water distribution or air-conditioning system.

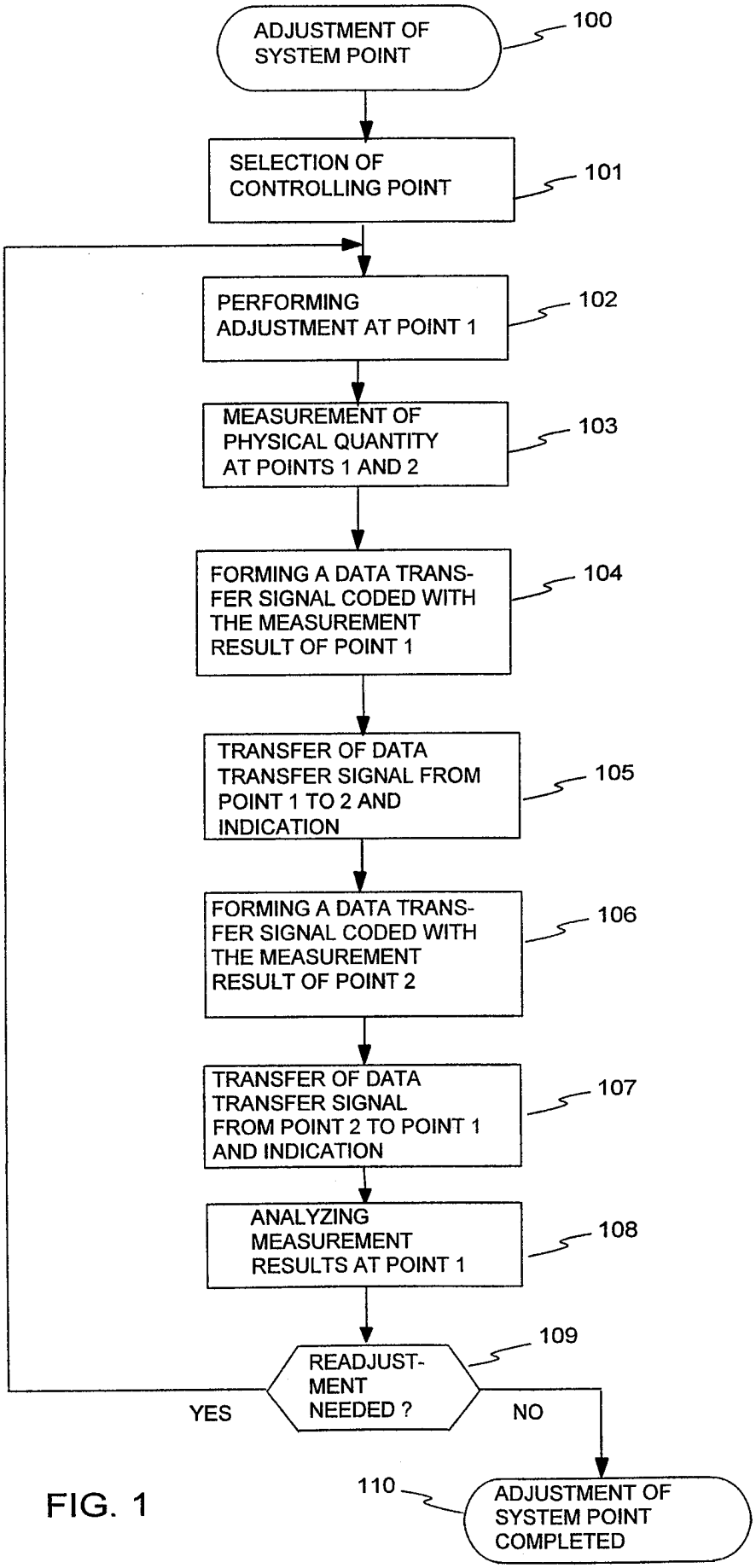
ADJUSTMENT OF SYSTEM POINT
100
SELECTION OF CONTROLLING POINT
101
PERFORMING ADJUSTMENT AT POINT 1
102
MEASUREMENT OF PHYSICAL QUANTITY AT POINTS 1 AND 2
103
FORMING A DATA TRANS-FER SIGNAL CODED WITH THE MEASUREMENT RESULT OF POINT 1
104
TRANSFER OF DATA TRANSFER SIGNAL FROM POINT 1 TO 2 AND INDICATION
105
FORMING A DATA TRANS-FER SIGNAL CODED WITH THE MEASUREMENT RESULT OF POINT 2
106
TRANSFER OF DATA TRANSFER SIGNAL FROM POINT 2 TO POINT 1 AND INDICATION
107
ANALYZING MEASUREMENT RESULTS AT POINT 1
108
READJUST-MENT NEEDED ?
109
YES
NO
ADJUSTMENT OF SYSTEM POINT COMPLETED
110

FIG. 1

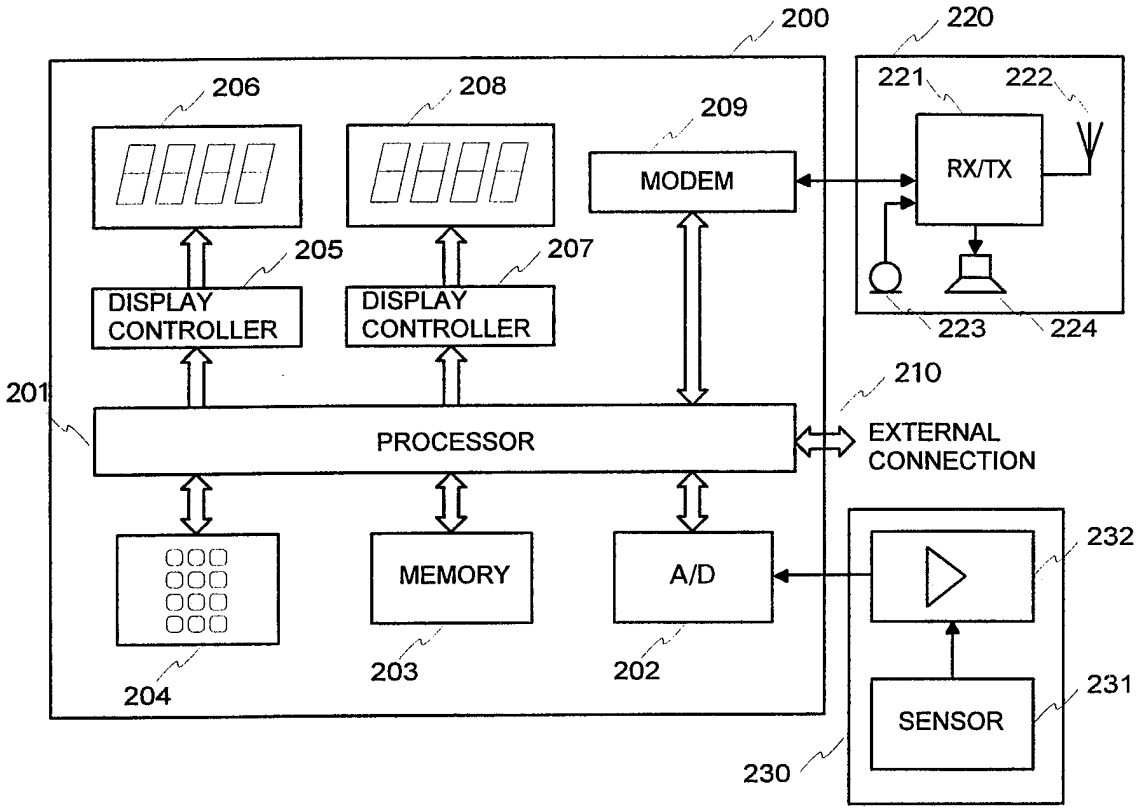
200
220
206
208
209
221
222
MODEM
RX/TX
205
207
DISPLAY CONTROLLER
DISPLAY CONTROLLER
223
224
201
210
PROCESSOR
EXTERNAL CONNECTION
232
MEMORY
A/D
231
SENSOR
204
203
202
230

FIG. 2

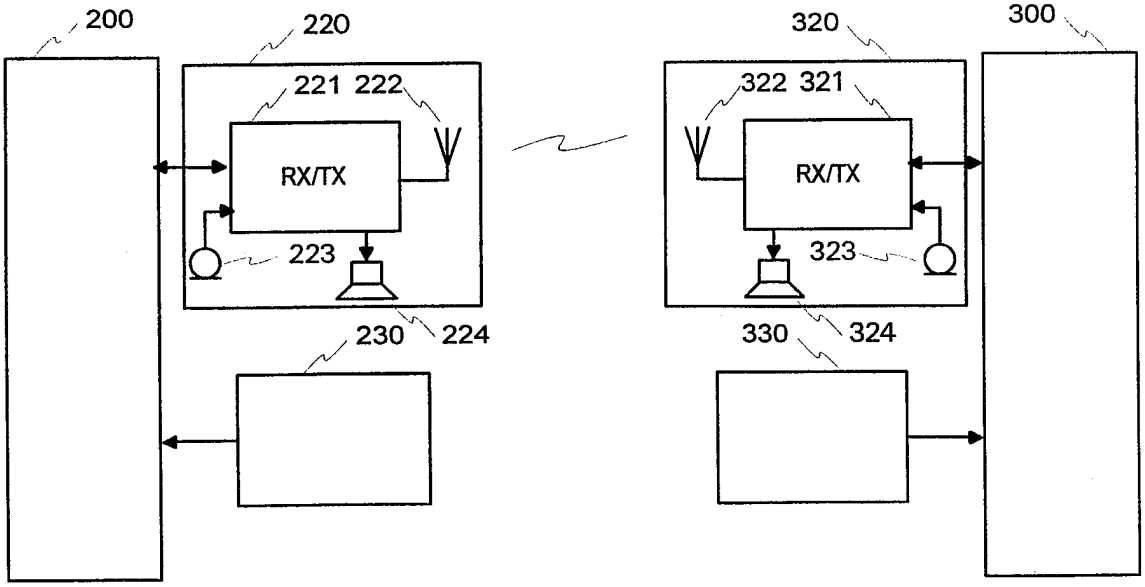
200
220
320
300
221 222
322 321
RX/TX
RX/TX
223
323
230
224
330
324

FIG. 3

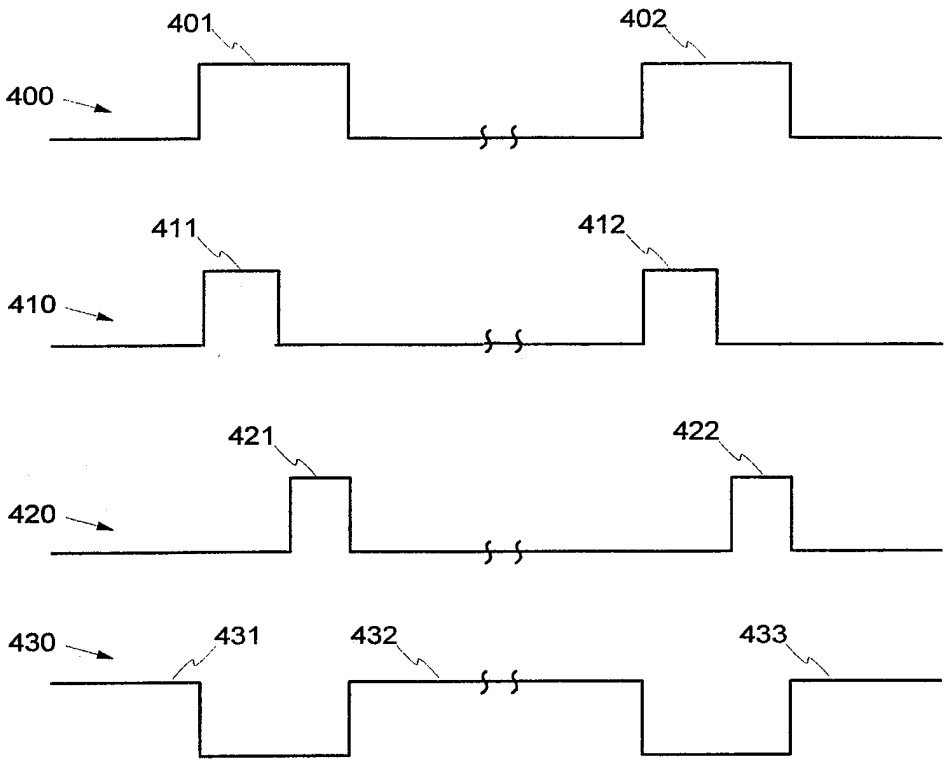

FIG. 4

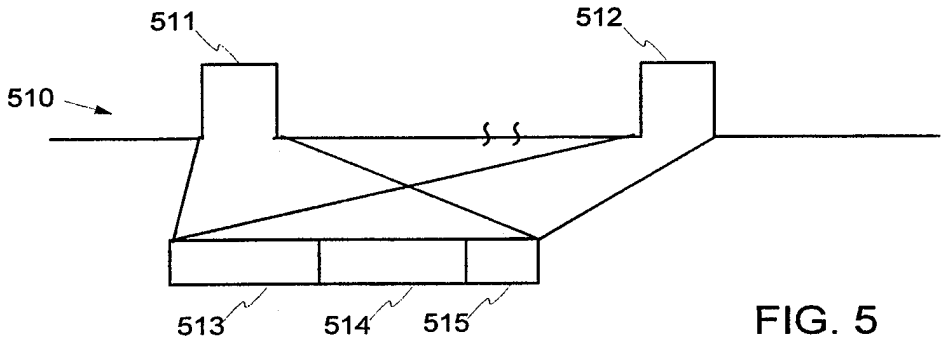

FIG. 5

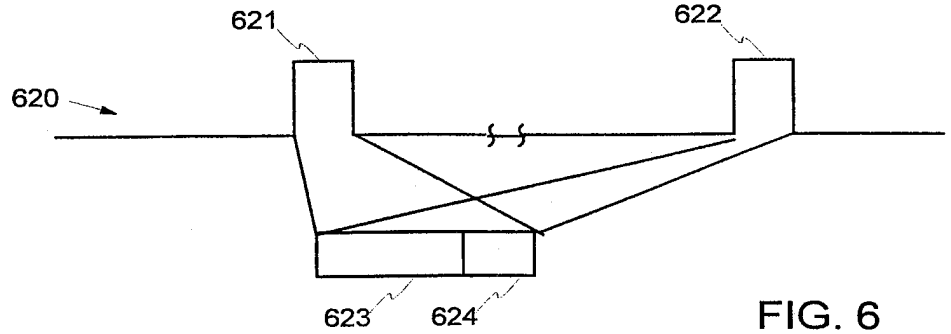

FIG. 6