



US 20190008283A1

(19) **United States**(12) **Patent Application Publication**
GEHRKE et al.(10) **Pub. No.: US 2019/0008283 A1**(43) **Pub. Date: Jan. 10, 2019**(54) **MATTRESS AND PIECE OF SLEEPING OR
RECLINING FURNITURE HAVING A
MATTRESS****Publication Classification**(51) **Int. Cl.***A47C 20/04* (2006.01)*A47C 31/00* (2006.01)*A61B 5/00* (2006.01)*A61B 5/113* (2006.01)(52) **U.S. Cl.**CPC *A47C 20/041* (2013.01); *A47C 31/008*
(2013.01); *A61B 5/6891* (2013.01); *A47C*
21/003 (2013.01); *A61B 5/4806* (2013.01);
A61B 5/725 (2013.01); *A61B 5/1135*
(2013.01)(71) Applicant: **DEWERTOKIN GMBH**, Kirchlengern
(DE)(72) Inventors: **KARSTEN GEHRKE**, Porta
Westfalica (DE); **ARMIN HILLE**,
Bielefeld (DE); **STEFFEN LOLEY**,
Osnabrück (DE); **ALEXANDER**
TEWS, Bielefeld (DE)(73) Assignee: **DEWERTOKIN GMBH**, Kirchlengern
(DE)(21) Appl. No.: **16/067,475**(22) PCT Filed: **Dec. 30, 2016**(86) PCT No.: **PCT/EP2016/082912**

§ 371 (c)(1),

(2) Date: **Jun. 29, 2018**(30) **Foreign Application Priority Data**

Dec. 30, 2015 (DE) 20 2015 107 148.5

May 24, 2016 (DE) 10 2016 109 524.9

Oct. 7, 2016 (DE) 20 2016 105 633.0

(57)

ABSTRACT

The invention relates to a mattress (30) for a piece of sleeping or reclining furniture, having at least one sensor (12) arranged in the mattress (30) for sensing vibrations, motion, and/or sound. The mattress (30) is characterized in that the mattress has at least one element for receiving structure-borne sound, to which the at least one sensor (12) is coupled. The invention further relates to a piece of sleeping or reclining furniture, in particular a bed (1), having such a mattress (30).

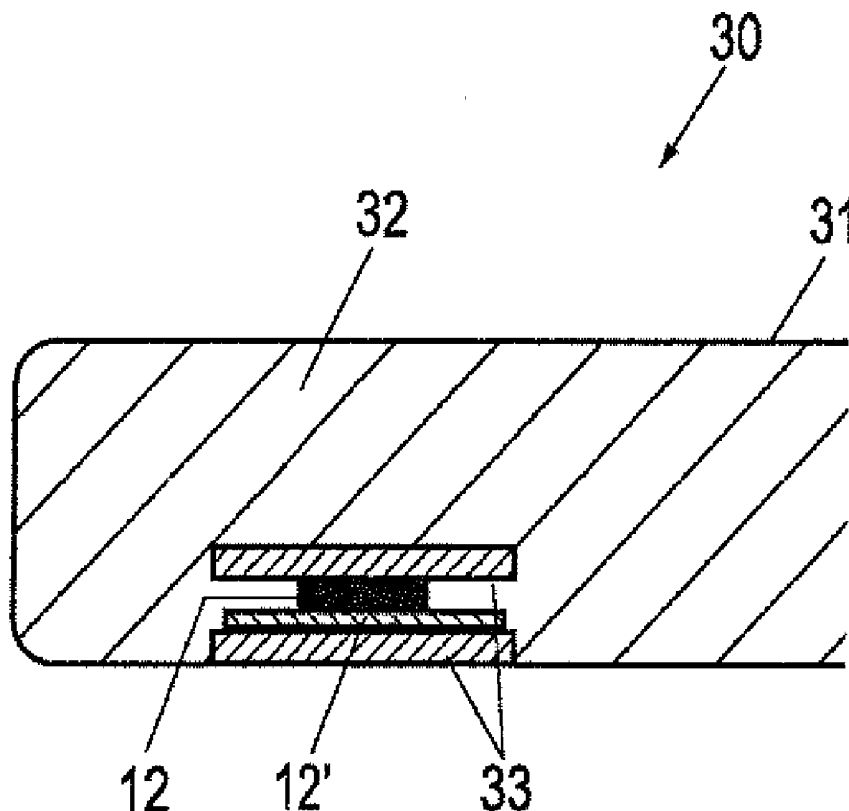


Fig. 1

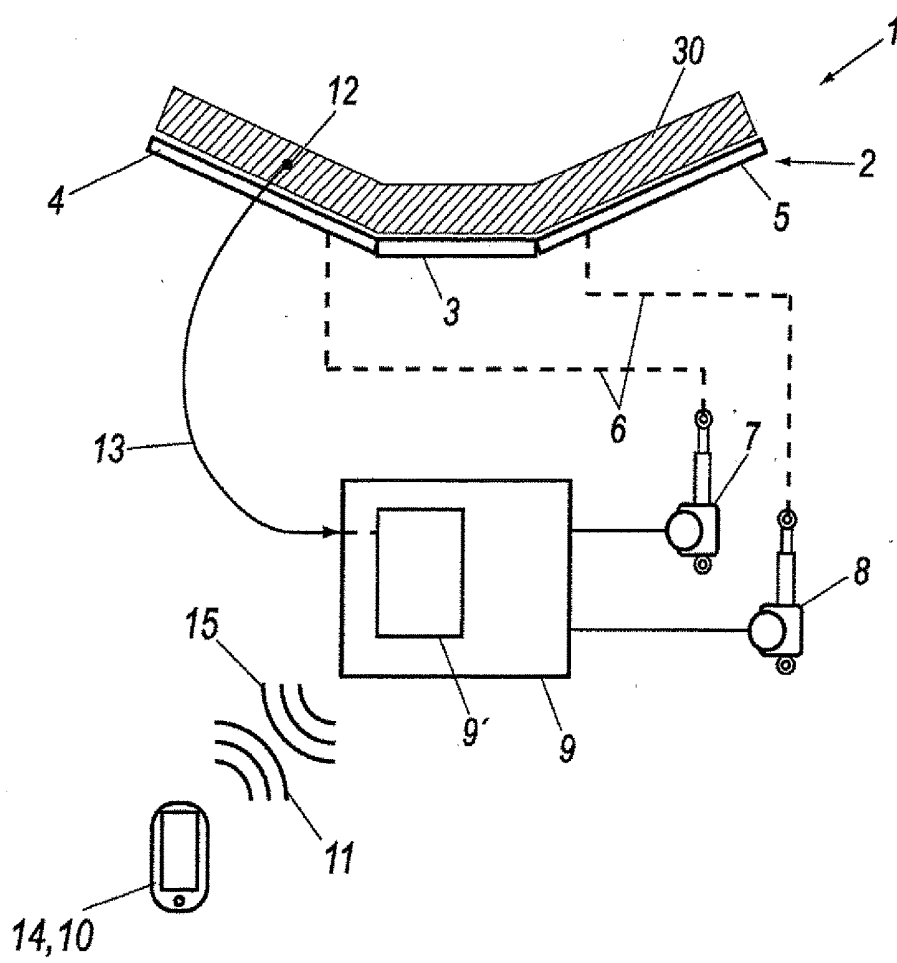


Fig. 2

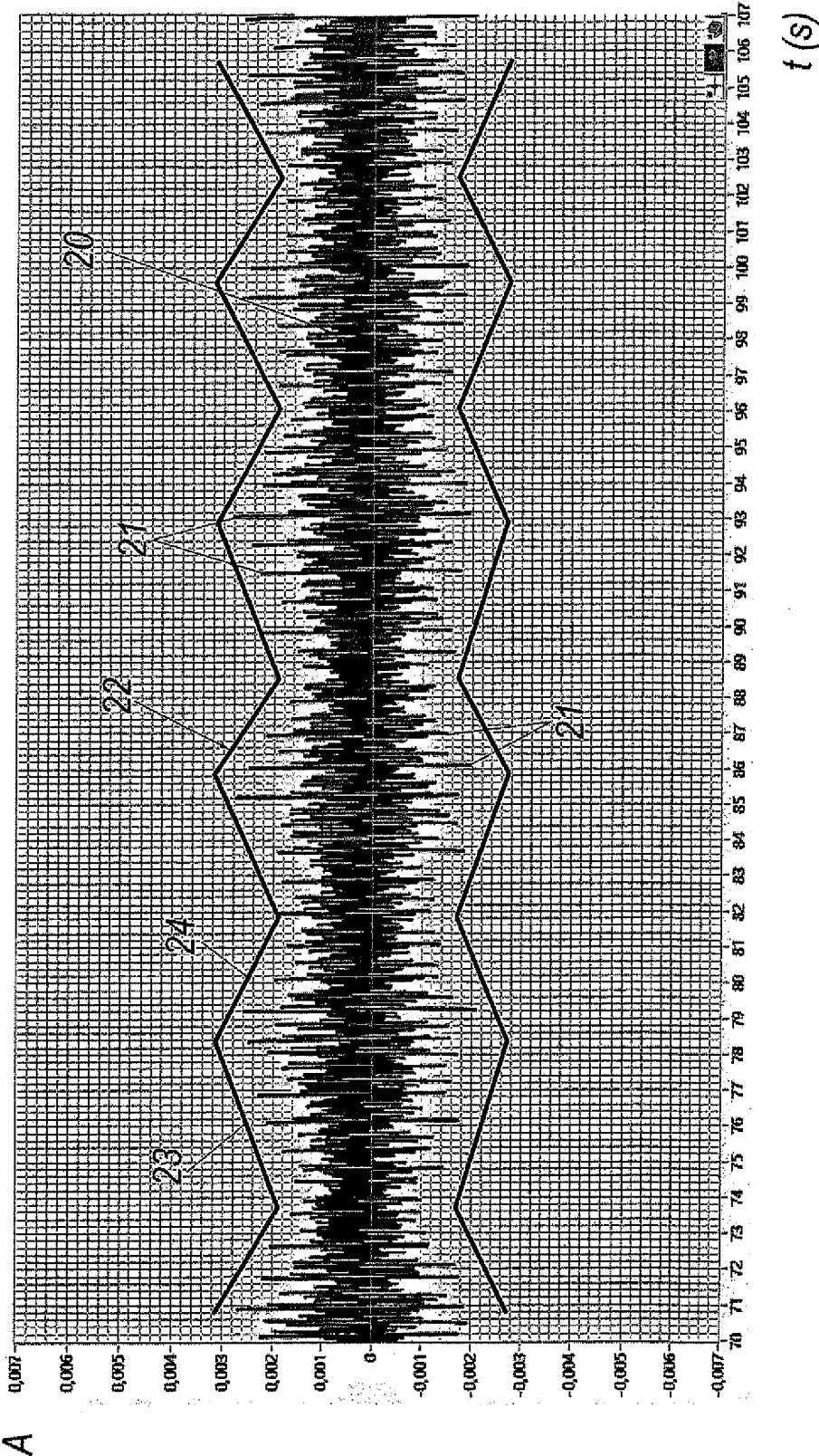


Fig. 3

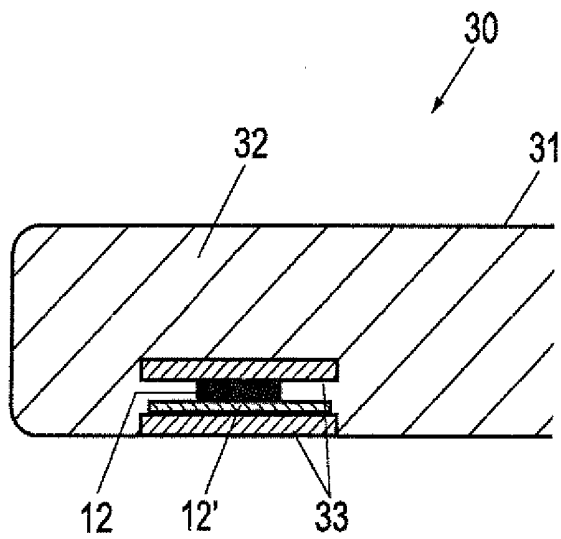


Fig. 4

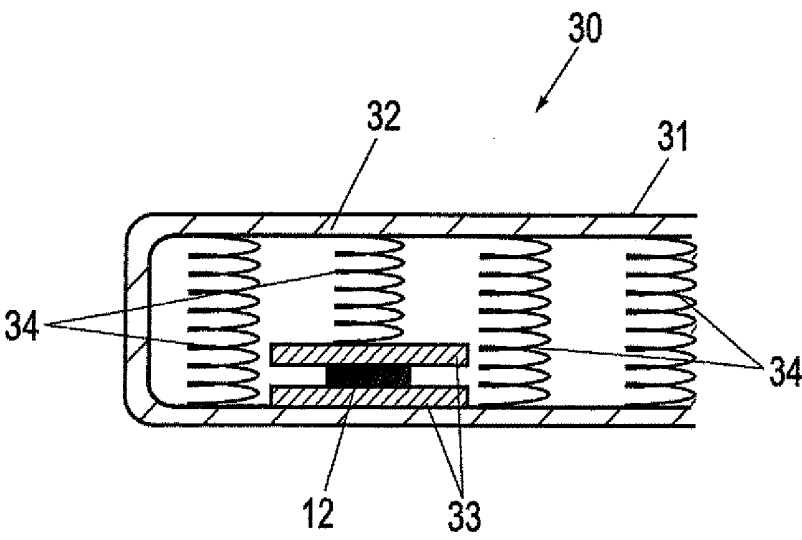


Fig. 5

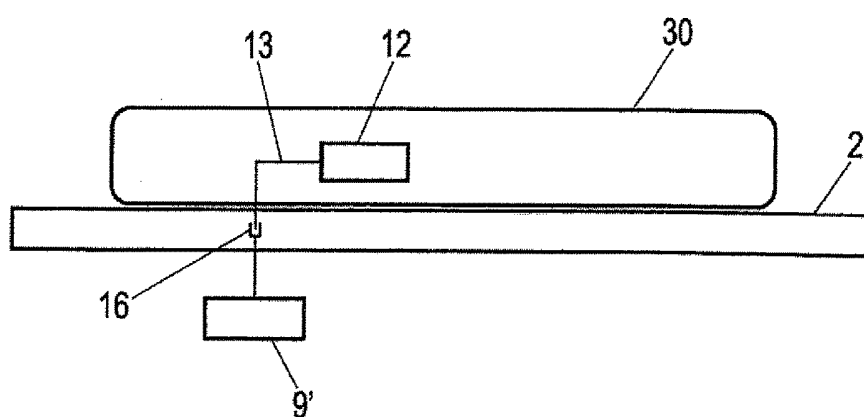


Fig. 6

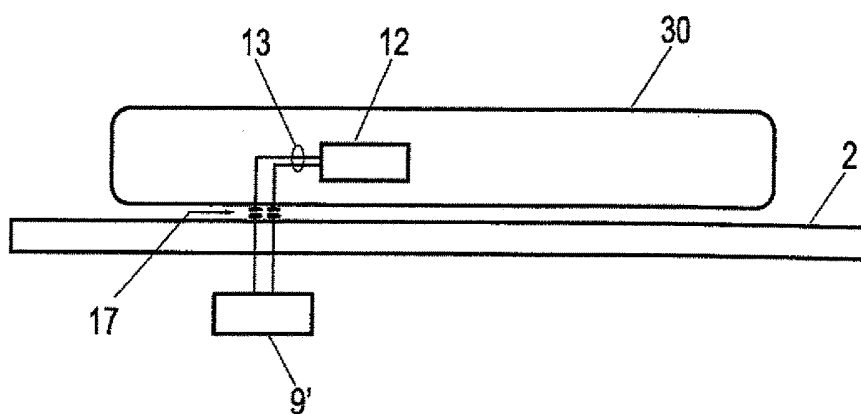


Fig. 7

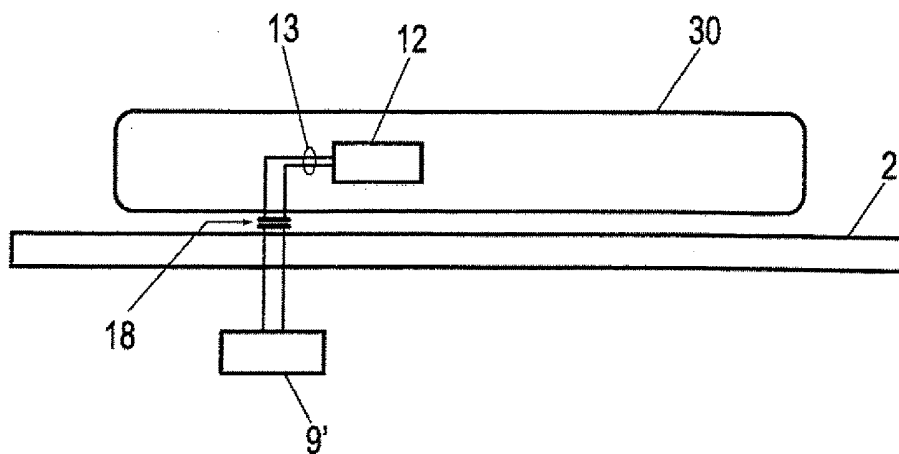
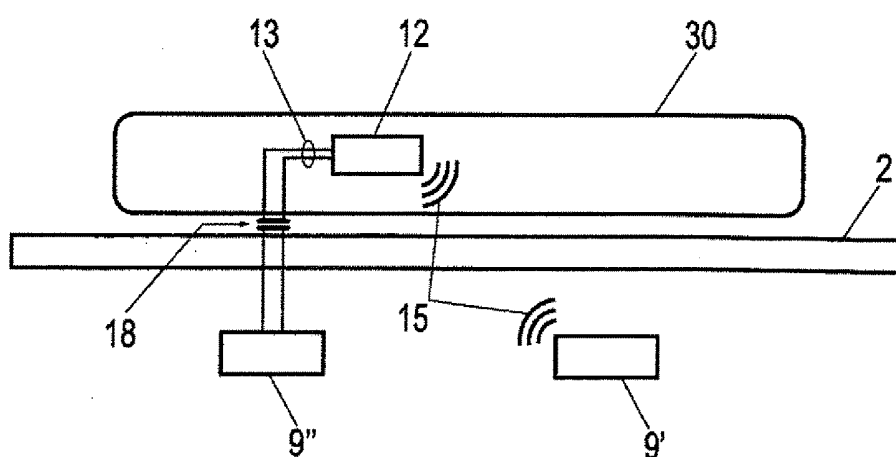


Fig. 8



**MATTRESS AND PIECE OF SLEEPING OR
RECLINING FURNITURE HAVING A
MATTRESS**

[0001] The invention relates to a mattress for a piece of sleeping or reclining furniture, having at least one integrated sensor arranged in the mattress for detecting vibrations, movement and/or sound and moreover a piece of sleeping or reclining furniture, in particular a bed, having such a mattress.

[0002] In the clinical field, monitoring devices are known to monitor the respiration and/or heart activity of a patient while sleeping in order to intervene in case of alarming cardiac function and circulatory parameters.

[0003] Meanwhile, devices for monitoring the sleep state based on physiological parameters for non-clinical purposes are available on the market. These devices, when placed on a nightstand for example, record sounds and/or states of movement during sleep by means of microphones and/or cameras. From the acquired information, a sleep state is derived whose time course is recorded. The recorded sleep history can be retrieved and evaluated later. It can shed light on how deep and restful sleep has been.

[0004] In addition to systems that use camera and/or microphone, a sensor-based system is known in which a pressure-sensitive sensor strip is placed over the mattress and in which this sensor strip is connected to a mobile phone (smartphone), which records the sensor data. Among other things, a heart rate and a respiratory rate are derived from the sensor data. A disadvantage of the mentioned non-clinical systems is that the reliability of the detection depends greatly on the correct positioning of the monitoring devices on a nightstand or on the mattress. The reliability and ease of use of these devices are thus limited.

[0005] From the document U.S. Pat. No. 6,485,441 B2, a system for monitoring the sleep state is known, in which a number of vibration sensors is arranged in the mattress, whereby mispositioning or slippage of the sensors is prevented. However, integrating the sensors leads to an undesirable reduction (attenuation) of the received signal strength.

[0006] It is an object of the present invention to provide a piece of sleeping or reclining furniture and a mattress or an electromotive furniture drive of the type mentioned, in which at least one sensor integrated into the mattress has a high sensitivity and provides signals with a high signal strength.

[0007] This object is achieved by a mattress or a piece of sleeping or reclining furniture with the respective features of the independent claims. Advantageous embodiments and further developments are given in the dependent claims.

[0008] A mattress according to the invention is characterized in that it comprises at least one element for receiving sound, e.g. structure-borne sound, airborne sound or movement, with which the at least one sensor is coupled for detecting vibrations, movement and/or sound. The sensor thus integrated into the mattress is protected by its positioning against slipping and also from damage or other disturbances, thus providing a reliable detection of vibration, movement and sound. For this purpose, the integrated element for receiving the sound can be fixedly attached to the mattress. The mattress also acts as a good transmitter for structure-borne sound due to its large-area contact with the person. The integrated element for receiving sound, in particular structure-borne sound, hereinafter also referred to

as structure-borne sound receiver, absorbs in particular the structure-borne sound and passes it on to the sensor, so that a good signal strength is given. The structure-borne sound receiver is preferably made of a material, which has a higher strength for example compared to soft materials provided in the mattress, e.g. a foam material, and thus attenuates the structure-borne sound recorded from the mattress to a low extent and passes it well to the sensor. In addition, the structure-borne sound receiver preferably has a size which clearly exceeds that of the sensor.

[0009] Particularly preferably, the sensor is disposed in areas of the mattress, which are adjacent to the sound-generating body parts of the monitored persons, thus for example in the heart/lung area and in the area of the throat or mouth opening. For example, the sensor may be arranged on a back region of the mattress, since such vibrations, movement or sound from the chest region of a person using the mattress can be detected particularly well, which allow drawing conclusions about the respiration and circulation of the person. A positioning of the sensor in a lower half and in particular in a lower third of the back region is especially suitable in this regard. Other arrangements may be configured such that the at least one sensor is arranged centrally in the mattress or in a middle region of the mattress. The middle or the middle region means the center of mass or the center of gravity of the mattress. The special advantage is that turning the mattress has no effect on the signal quality of the sensor. In this case, preferably the structure-borne sound receiver can extend up to the bearing surfaces of the mattress and thus be positioned closer to the sound sources. For the production of mattresses with special dimensions such as oversizes, this is also advantageous because the arrangement of the sensor in the mattress remains virtually the same from the manufacturing point of view.

[0010] As an alternative to an arrangement centrally in the volume, an arrangement can also be provided in the center of the area adjacent to one of the bearing surfaces. Although the mattress can no longer be used on both sides, it can be turned around its vertical axis.

[0011] The at least one sensor may, for example, be a piezoelectrically or electromagnetically operating sensor. Such a sensor operates in a robust manner and is suitable to record both vibrations (structure-borne sound) and airborne sound, wherein it is possible to constructively determine the ratio in which these different types of sound are detected. Another suitable sensor is an electromechanical sensor, e.g. a micromechanical acceleration sensor.

[0012] Furthermore, several sound or vibration pickups can be combined in a sensor or in various sensors, wherein, for example, a piezoelectrically and an electromagnetically operating sound or vibration pickup are arranged at the same position or at different positions. The different sensor types are characterized by characteristic frequency ranges for which they are particularly suitable. The combination of different sensor types makes it possible to analyze a particularly broad frequency spectrum.

[0013] The sensor is embedded, for example, directly or surrounded by protective layers in a foam material of the mattress. For example, the sensor may be positioned between two protective layers, which, for example, comprise sponge rubber or felt.

[0014] In an advantageous embodiment of the mattress, the sensor is connected to a sensor plate, which acts as an element for receiving structure-borne sound and thus as an

antenna. The element is preferably an aluminum or steel plate, which absorbs and transmits sound as far as possible without damping.

[0015] When the sensor is arranged in a spring mattress, at least one of the springs of the spring core can rest with one end on the sensor or one of the protective layers surrounding it. This spring forms in this case the structure-borne sound receiver and acts advantageously as a kind of antenna, which absorbs the sound or movement and passes it on to the sensor.

[0016] In advantageous embodiments, the mattress has an externally accessible plug contact or at least two conductive contact surfaces for contacting the sensor. In this way the sensor can be supplied with power. It can also be provided to arrange a signal unit or an evaluation unit close to the sensor in the mattress. The signal unit can, for example, comprise a (pre)amplifier for the sensor signal or other signal-processing elements such as filters. In addition, the signal unit may include a transmitter in order to provide in a wireless manner the signals detected by the sensor in an optionally digitized form. The signal unit can also be supplied with operating current via the plug contact or the at least two conductive contact surfaces. An evaluation unit which is present locally close to the sensor is used for (pre)evaluation of the measured sensor signals. The functionality of such or an external evaluation unit will be described in more detail below. Also, an inductive power and signal transmission via induction coils is possible. In that case, an induction coil is arranged in the outer area of the mattress, for example below a cover.

[0017] A piece of furniture according to the invention for sleeping or reclining (resting), in particular a bed, has such a mattress with at least one integrated sensor. The advantages mentioned in connection with the mattress are thus provided.

[0018] In an advantageous embodiment, the piece of sleeping or reclining furniture further comprises an evaluation unit which can be connected to the sensor and which is set up for processing and evaluating the signals of the at least one sensor and for detecting physiological parameters of the person using the piece of sleeping or reclining furniture. The recorded physiological parameters are, for example, a heart rate, a respiratory rate, a state of movement and/or a snoring state of the person. In order to reliably evaluate even small signals, the evaluation unit advantageously has a filter, in particular a low or band pass filter for signal processing. Alternatively or additionally, a first signal conditioning can also be effected directly on the sensor, for example by arranging a signal amplifier and/or an analogously and/or digitally operating signal filter adjacent to the sensor or integrated in a sensor housing. A transmission of the measuring signal to the evaluation unit which is less susceptible to interference is thus achieved.

[0019] Furthermore, the evaluation unit may have a memory for storing a time course of the physiological parameters. Alternatively or additionally, the evaluation unit can be connected for this purpose to an external memory. In this case, this can concern a cloud on the one hand, thus for example memory offered by an external service provider, which is provided decentrally and/or distributed by servers that are accessible via the internet. On the other hand, it can also be a so-called personal cloud, where a storage location is local, e.g. in the form of an NAS (Network Attached Storage) memory which is reachable within an intranet.

Finally, a mass storage connected directly to the evaluation unit via a wired connection would also be understood as a cloud in this sense. Other forms of a wired, or more specifically, a wire-bound cloud include USB mass memory sticks or memory cards such as SD cards. These cloud-forming storage elements may be provided at various locations and components, e.g. also in a PC (personal computer) or a smartphone as a mobile device.

[0020] The evaluation unit may also have a monitoring device for comparing the physiological parameters with predetermined limits, so that in the event that a health hazard to a person is detected, said person or a further person can be warned.

[0021] At least for this purpose, the evaluation unit preferably comprises a transmission unit for transmitting the physiological parameters to a mobile device such as a smartphone, or another external device. The transmission unit is preferably set up for the wireless transmission of the physiological parameters to the mobile device, in particular via a WLAN or Bluetooth transmission link. When the physiological parameters are transmitted to the mobile device, a comparison of the physiological parameters with predetermined limits can also be made in the mobile device. A wired connection to external units is also conceivable, for example, if the external unit is a personnel call system in a care home.

[0022] Alternatively, the monitoring device itself may be formed externally of the evaluation unit and be connected to the evaluation unit. Such an external monitoring device can, for example, be formed in a mobile device. The functionality necessary for this purpose can be provided via an appropriate program ("app"). The external monitoring device may also be part of an alarm center, for example, in a care facility.

[0023] In a further advantageous embodiment, the piece of sleeping or reclining furniture comprises an electromotive furniture drive with adjusting drives for adjusting furniture parts. Furthermore, a control device for controlling the adjusting drives is provided, wherein the evaluation unit is preferably coupled to the control device or is integrated in the control device. In this way, components of the control device, which are already present in the electric motor furniture drive, are also used for the evaluation unit or for the sensor and/or a possibly existing signal unit in the mattress, e.g. a power supply unit, communication devices and/or a housing including the connection possibilities. In addition, a wiring of the sensor is simplified when using the existing structure of the electromotive furniture drive.

[0024] In a further advantageous embodiment of the piece of sleeping or reclining furniture, the evaluation unit for the signals of the sensor is additionally set up for the detection and evaluation of vibrations and movements that occur during actuation one or more of the adjusting drives. In this way, the at least one sensor can be used as a positive secondary benefit in order to determine a malfunction and/or an overload and/or a non-load of one or more of the adjusting drives during operation. The determined statuses point to technical problems of the adjusting drives which have already occurred or may be imminent, or to incorrect use.

[0025] Since the respective adjusting drive is mechanically coupled to the furniture components, the sensor is able to detect even the smallest vibrations and/or noises of the respective adjusting drive. All signals related in this context are detected by the evaluation unit and classified by means

of suitable filters, e.g. suitable bandpass filters, as signals of the adjusting drives. The statements about the wear and/or noise condition of the respective adjusting drive are stored.

[0026] The invention will be explained in more detail below by means of exemplary embodiments with reference to the drawings, wherein:

[0027] FIG. 1 shows a first exemplary embodiment of a sleeping furniture with a mattress with integrated sensor in a schematic view;

[0028] FIG. 2 shows a representation of a time dependence of sensor data;

[0029] FIGS. 3, 4 each show a schematic sectional drawing of a mattress with an integrated sensor; and

[0030] FIGS. 5-8 each show a schematic drawing for electrical contacting a sensor arranged in a mattress.

[0031] FIG. 1 shows a bed 1 as an example of a bedroom furniture with a mattress 30 in a schematic view.

[0032] The bed 1 has at least one support element 2 for receiving the mattress 30. The bed 1 can be used as a single bed for one person or be designed as a double bed for several people. The support element 2 is formed, for example, as a slatted frame, as a flat support surface or the like and is placed or mounted on a basic element (not shown here), e.g. a frame with feet.

[0033] In the example shown, the support element 2 has a back part 4 and a leg part 5, which are arranged so as to be movable relative to a fixed middle part 3 or relative to the base element. This movable arrangement is realized, for example, by means of a so-called motion fitting (not shown here). The movement is designed to be displaceable and/or pivotable.

[0034] The bed 1 shown in this example is equipped with an electromotive furniture drive. The movably mounted back part 4 and the leg part 5 are coupled in each case via an only schematically shown connection 6 to an electromotive adjusting drive 7, 8. Thus, the back part 4 is coupled to the electromotive adjusting drive 7. The electromotive adjusting drive 8 is provided to move or adjust the leg part 5.

[0035] The electromotive adjusting drives 7, 8 are presently designed as linear drives. The linear drives have one or more electric motors, wherein each motor is provided downstream with a speed-reducing gear with at least one gear stage. Another gear, for example in the form of a threaded spindle gear, can be provided downstream of the speed reduction gear, which generates a linear movement of an output member from the rotational movement of the motor. The last gear member or a further member connected thereto forms the output member. The output member of the respective electromotive adjusting drive communicates with the respective furniture component (back part 4, leg part 5) or alternatively with a component connected to the base element, so that during an operation of the electric motor of the respective adjusting drive 7, 8 the movable furniture components 4, 5 are adjusted relative to each other or relative to the base element.

[0036] The electromotive adjusting drives 7, 8 are connected to a control device 9. This connection can be formed, for example, as a pluggable cable connection, which is not shown here. The control device 9 has an electrical supply unit, which provides the electric power, e.g. from a power supply network, for the electromotive adjusting drives 7, 8. For this purpose, the control device 9 is connectable via a power cord, not shown in this example, to a mains plug with

a mains connection. The mains plug conducts the input-side mains voltage via the power cord to the electrical supply unit of the control device 9, which supplies a low voltage on the secondary side in the form of a DC voltage.

[0037] Alternatively, the control device 9 is provided upstream with an external mains-dependent power supply with mains input and secondary-side low-voltage output, which supplies the low voltage in the form of a DC voltage via the line.

[0038] In an alternative embodiment, the control device is not arranged in a separate housing, but is integrated in one of the adjusting drives 7, 8. This adjusting drive then represents a main drive to which, if necessary, further adjusting drives can be connected.

[0039] In a further alternative embodiment of an electromotive furniture drive, the control device can be arranged distributed in the system, such that each of the adjusting drives 7, 8 itself has a motor control and comprises a bus communication interface via which the adjusting drives 7, 8 are connected to each other and to other components. In this case, it can be provided that at least one of the adjusting drives 7, 8 has its own power supply unit for its power supply or for supplying several or all existing adjusting drives and/or possibly further system components.

[0040] A handset 10 is provided with which the electromechanical adjusting drives 7, 8 are controllable via the control device 9. The handset 10 may be connected via a cable to the control device 9 in an embodiment. Alternatively, the handset 10 can be provided with a transmission device for a wireless transmission of signals to the control device 9. The wireless transmission can be realized by a radio transmission link, an optical transmission link (e.g. for infrared light) and/or an ultrasonic transmission link, wherein the control device 9 is equipped with a respectively corresponding receiving unit. Further alternatively, the handset can also form the control device for the adjusting drives, for example, in that the operating current of the adjusting drives is switched directly via switches of the handset.

[0041] In the illustrated exemplary embodiment, a mobile device 14 takes over the function of the handset 10. The mobile device 14 may be in particular a commercially available mobile phone ("smartphone") or a tablet computer. Preferably, a software ("app") for the function as a handset 10 is installed on the mobile device 14. Control instructions to the adjusting drives 7, 8 can be sent via a wireless transmission link 11 from the mobile device 14 used as a handset to the control device 9.

[0042] The wireless transmission link 11 may for example be based on a WLAN (Wireless Local Area Network) or Bluetooth transmission path.

[0043] According to the application, a sensor 12 is provided in the illustrated bed 1, which detects vibrations, movement and/or sound and is integrated into the mattress 30. In alternative embodiments of the mattress 30, a plurality of sensors 12 may be provided.

[0044] The sensor 12 is formed for example as a piezoelectric component or as an electromagnetic or electromechanical component and is sensitive to vibrations or movements of the base, to or on which it is fastened. Such vibrations include, in particular, structure-borne sound. "Movements" shall include in particular low-frequency vibrations and deflections of the sensor 12 whose frequency

is in the Hertz or sub-Hertz range. in addition, the sensor 12 may be sensitive to (airborne) sound waves and act as a microphone in this sense.

[0045] The sensor 12 is connected via a sensor cable 13 to the control device 9. If needed, a power supply for the sensor 12 is provided via the sensor cable 13 and signals outputted from the sensor 12 are forwarded to the control device 9. In an alternative embodiment, the sensor 12 can be coupled to the control device 9 via a wireless connection, for example a radio link. In this case, the sensor 12 is provided with its own power supply, for example in the form of a possibly rechargeable battery.

[0046] The control device 9 comprises an evaluation unit 9' for processing and evaluating the signals supplied by the sensor 12. The evaluation unit 9' comprises amplifiers and filter units, for example, which make it possible to draw conclusions from the signal transmitted from the sensor 12 on certain body functions of a person in bed 1. In particular, the evaluation unit is set up to determine from the signals of the sensor 12 physiological parameters of the person. Such parameters relate, for example, to heart and circulatory functions and include, for example, a heart rate and a respiratory frequency. Furthermore, it can be determined whether the person in bed is snoring. In addition, movements of the person are recorded. Details for determining the aforementioned parameters from the signals of the sensor 12 will be explained in more detail below in connection with FIG. 2.

[0047] The determined parameters are transmitted either directly or after intermediate storage in the evaluation unit 9' as wireless signals 15 to the mobile device 14, which is equipped with appropriate software ("app"), which allows an evaluation and preferably graphical representation of the time-dependence of the determined sleep parameters. WLAN (Wireless Local Area Network) or Bluetooth can be used again, for example, as a transmission path for data of the evaluation unit 9'.

[0048] In addition, a comparison of the measured physiological parameters with predetermined limit values for these parameters can additionally be provided in the evaluation unit 9' or the control device 9. If the determined parameters are transmitted directly to the mobile device 14 during the sleep phase, that is to say without longer intermediate storage in the evaluation unit 9', then such a comparison can take place there alternatively or additionally. When exceeding or falling below the limit values or when one or more of the parameters leave a predetermined range, it is provided that the evaluation unit 9' or the control device 9 or the mobile device 14 outputs an alarm signal. This alarm signal can be output visually and/or acoustically directly from the evaluation unit 9' or the control device 9 or the mobile device 14. Alternatively or additionally, it may be provided that the mobile device 14 emits an alarm message via a further wireless transmission link (e.g. WLAN, mobile network), which is not shown here. In this way, another person can be notified if unusual sleeping parameters are displayed. The illustrated bed 1 or the electromotive furniture drive with the sensor 12 can thus also be used for clinical monitoring or for personal monitoring or for monitoring infants to protect against sudden infant death. For example, an alarm message may be issued when a person has left the bed, optionally when a person has left the bed for a predetermined time, or when no physiological parameters, or only critical ones, are detected.

[0049] Advantageously, the connection between the sensor 12 and the evaluation unit 9' is arranged within the bed 1, which prevents the sensor cable 13 from having to be laid outside the bed 1. The integration of the sensor 12 in the mattress ensures correct positioning of the sensor 12 at all times and thus reliable evaluation of the data of the sensor 12. It can be provided to combine the sensor 12 with the evaluation unit 9' in a structural unit.

[0050] In the exemplary embodiments of FIG. 1, the evaluation unit 9' for the signals of the sensor 12 is integrated in the control device 9. Alternatively, it is possible to form the evaluation unit 9' separately from the control device 9 in a separate housing. For the transmission of the determined physiological parameters, the evaluation unit 9' can then be electrically coupled to the control device 9. Also, a use of such a self-sufficient evaluation unit 9' detached from the control device 9 is possible, especially if a transmission unit for wireless transmission of the determined physiological parameters and/or preprocessed signals from the sensor 12 to the mobile device 14 or another external component is already present in the housing of the evaluation unit 9'.

[0051] FIG. 2 shows a detail of a measured signal 20 of the sensor 12 in a diagram. The progression over time t is given in seconds on the horizontal axis. On the vertical axis, a signal amplitude A is shown in arbitrary units.

[0052] The illustrated portion of the signal curve of the signal 20 is without movement during a quiet sleep phase and without snoring of the observed person. A movement of the person manifests itself in amplitudes, which exceed the illustrated one by a factor of some 10-100. Movements are therefore very easy to identify. Also snoring and the resulting vibrations are clearly distinguishable from the signal curve shown, since they are reflected in a multiple greater amplitude.

[0053] In the course of the signal 20 shown in FIG. 2, regular peaks 21 which originate from the heartbeat of the person and are subsequently called heartbeat peaks 21 can be observed. From the distance of the heartbeat peaks 21, a heart rate can be determined. The time interval of adjacent heartbeat peaks 21 allows statements about the pulse uniformity, which can be a measure of the depth of sleep.

[0054] Furthermore, it can be seen in FIG. 2 that the amplitude of the heartbeat peaks 21 regularly varies at a lower frequency. This variation is represented by an envelope 22. The envelope 22 shows alternating rising flanks 23 and descending flanks 24. The course of the envelope 22 is correlated with the respiration of the person. The rising flanks 23 indicate an inhalation phase and the descending flank 24 an exhalation phase.

[0055] The example of FIG. 2 shows how conclusions can be drawn from the signals of the sensor 12 on cardiovascular parameters, in this case on pulse and respiration. In a similar way, further sleep parameters such as states of motion and snoring can be determined.

[0056] For evaluating the signals 20, a filtering is carried out of the raw signals of the sensor 12, in particular by means of a low-pass filter. The use of a bandpass filter with suitable cut-off frequencies is also possible. Low-pass or bandpass filters are used to eliminate interference frequencies. The processing of the signals preferably takes place with the aid of a digital signal processor (DSP).

[0057] The sensor 12 may additionally or alternatively also serve to monitor the correct function of the electromo-

tive drive. An actuation of the adjusting drives 7, 8 leads to a movement of the moving furniture parts, for example, of the back part 4 and/or the leg part 5. In addition, the actuation of the adjusting drives 7, 8 results in vibrations of these furniture parts and also of the entire furniture, which is also detected by the sensor 12. These vibrations occur in a typical frequency range. The signal curve reflects the motor movement of the adjusting drives 7, 8. A first typically relevant frequency range is in the range of motor speed of the motors of the adjusting drives 7, 8. In this frequency range, errors on the motor itself or a driven gear are revealed. Another typical relevant frequency range corresponds to an integer fraction according to a gear ratio of the transmission, which is about 1:30 to 1:50. In this frequency range, errors are indicated in downstream gear stages or rolling bearings. A third typical frequency range is in the region of squeaking noises of hinges that are part of a furniture fitting. Form and amplitude are typical for the adjusting drive 7, 8 used on the one hand, and they provide information on the other hand about the correct function of the adjusting drives 7, 8 and their state of wear.

[0058] An overload of one of the adjusting drives 7, 8 can also be detected on the basis of the signal shape of the signals of the sensor 12. The sensor 12 can thus function, for example, as an anti-pinch protection, wherein the control device 9 stops this drive or causes it to rotate in the opposite direction when one of the adjusting drives 7, 8 is overloaded. An underload on the adjusting drive 7, 8 may also be an indication of pinching, e.g. if a furniture part (back part 4, leg part 5) is let go and the adjusting drive 7, 8 is operated almost powerless, which suggests a pinching of a body part under the downwardly moving furniture part. A load-less operated adjusting drive 7, 8 can also be identified based on the signals of the sensor 12.

[0059] In connection with FIGS. 3 and 4, a possible arrangement of the sensor 12 in the mattress 30 is shown.

[0060] FIG. 3 shows a cross section through a portion of the mattress 30 in a first embodiment. The mattress 30 has a cover 31 surrounding a core of foam material 32. Cold foam is used for example as a foam material 32.

[0061] The sensor 12 is inserted in the illustrated exemplary embodiment in a lower region of the mattress 30 in a recess which is introduced into the core of foam material 32. The sensor 12 is arranged on a sensor plate 12' and fixedly connected thereto, e.g. by an adhesive bond. The sensor plate 12' hereby serves as a receiving element (antenna) and absorbs structure-borne sound over a large area and forwards it to the sensor 12. The sensor plate 12' may, for example, be an aluminum or steel plate, so it is made of a hard material that dampens absorbed and forwarded sound as little as possible. Alternatively, it is also possible to use the hardest possible plastic as material for the sensor plate 12'.

[0062] In order to ensure protection of the sensor 12 and to achieve a good acoustic connection of the sensor 12 or the sensor plate 12' to the foam material 32, the arrangement of sensor 12 and sensor plate 12' is embedded between two protective layers 33 made from a likewise yielding material which, however, is stronger than the foam material. The material of the protective layers 33 may be made of sponge rubber or felt, for example.

[0063] Of the sensor arrangements shown, preferably several can be arranged in the mattress 30. Even with relatively small sensor plates 12', an adequately large accumulated

signal strength is then achieved in total. Smaller sensor plates 12' or sensor arrangements have the advantage over larger ones that they do not impair the sleeping comfort of the user. A suitable size of the sensor plates 12' is about 30 to 50 millimeters in diameter or edge length.

[0064] Instead of an arrangement adjacent to one of the bearing surfaces of the mattress 30, a central arrangement between the upside or underside of the mattress 30 may be provided, e.g. by making an incision in the foam material 32 from one of the sides, whereby a pocket is formed, into which the sandwich of sensor 12 and protective layers 33 is inserted. The incision can be made from a longitudinal side of the mattress 30. If a sensor 12 is to be arranged more closely in the head region or in the chest area of a person at rest, an alternative can be an incision into the mattress 30 from the transverse side.

[0065] FIG. 4 shows the arrangement of the sensor 12 in a mattress 30 formed as a spring mattress. This in turn has a cover 31 which surrounds an outer layer of a foam material 32. Inside, a spring core is formed by means of springs 34. In the illustrated embodiment, the sensor 12 is disposed in the region of the spring core, wherein one of the springs 34 ends on the sandwich of sensor 12 and protective layers 33. In this way, the corresponding spring 34 acts as a structure-borne sound receiver, i.e. as an antenna, which receives the acoustic vibrations or movements and forwards said vibrations or movements to the sensor 12, optionally amplified in a resonant manner.

[0066] In alternative embodiments, it is conceivable to arrange the arrangement of sensor 12 and protective layers 33 in a middle region of the mattress 30 in such a way that a spring 34 acts on the sensor 12 from above and from below. An arrangement within the layer of the foam material 32 analogous to the example shown in FIG. 3 is also possible.

[0067] In a further alternative embodiment, the sensor can be arranged on the inside in an optionally removable cover of the mattress. In order to be able to wash the cover anyway, the sensor can be detachably fixed, z. B. with snaps, a Velcro fastener, a zipper. Also, accommodation and positioning of the sensor can occur in a sewed bag, for example.

[0068] In this case, a structure-borne sound receiver, e.g. in the form of plastic films or plastic elements, may be arranged on the cover, with which the sensor is connected or can be connected to the aforementioned fastening means.

[0069] Alternatively, the sensor can also be fixedly coupled to the structure-borne sound receiver and this can be detachably fastened to the cover via the said fastening means.

[0070] In all the examples described so far, although the sensor is coupled to the structure-borne sound receiver, it is otherwise a unit which is separate therefrom. Alternatively, in all cases shown or described, both in the arrangement in the core of the mattress and in the arrangement in the cover, the sensor may be integrally formed with the structure-borne sound receiver. This can be done as a sensor based on a polarized plastic, e.g. fluorine-based, which has piezoelectric properties. The sensor itself can then be formed in a flat way, possibly reticulated, and in this respect unite the functions of a two-dimensional structure-borne sound receiver and a signal-emitting sensor.

[0071] In connection with FIGS. 5 to 8, the electrical contacting of a sensor 12 arranged in a mattress 30 is illustrated. The electrical contacting shown in these figures

can be used, for example, in conjunction with the sensors 12 in the exemplary embodiments of FIGS. 3 and 4. Although only the sensor 12 is shown in the respective figures, it is understood that said sensor is coupled to an element for receiving structure-borne sound, e.g. the sensor plate 12' or the spring 34, as in the exemplary embodiments of FIGS. 3 and 4.

[0072] From the bed (see reference numeral 1 in FIG. 1), only the support element 2 is shown, on which the mattress 30 is placed. The support member 2 can be, for example, a slatted frame or, in so-called box spring beds, a plate-shaped bearing surface. Instead of a control device (see reference numeral 9 in FIG. 1), which is part of an electromotive furniture drive, the evaluation unit 9' is designed in the present case to evaluate the sensor signals of the sensor 12 as a separate unit. It is understood that the evaluation unit 9' may alternatively be integrated into a control unit, which is not shown here.

[0073] In FIG. 5, electrical contacting of the sensor 12 via a sensor cable 13 and a plug contact 16 is initially shown. The plug contact 16 allows decoupling the sensor 12 from the evaluation unit 9', e.g. in order to ventilate or to exchange the mattress 30. The plug contact 16 is represented symbolically in a unipolar way. It is understood that in an embodiment of the arrangement shown, a multipole plug contact 16 can be used, which, if necessary, provides both a power supply for the sensor 12, as well as transmits signals of the sensor 12 to the evaluation unit 9'. The plug contact 16 may be positioned immediately adjacent to the mattress 30 or also via a cable section of a certain length, which allows a more flexible contacting on the support element 2 or another bed component or the evaluation unit 9'.

[0074] A further development of the arrangement of FIG. 5 is shown in the exemplary embodiment of FIG. 6. In principle, the same structure of the plug contact 16 is replaced by an array of contact surfaces 17. The contact surfaces 17 allow a contacting between the mattress 30 and the evaluation unit 9', without having to insert a plug manually. The contact surfaces 17 are each positioned on the support element 2 or the mattress 30 so that when placing the mattress 30 on the support element 2 an at least two-pole contacting takes place automatically. Again, separate contacts can be provided for a power supply and for sensor signals. The contact surfaces 17 may be arranged directly on the support element 2, or by means of a carrier element, which in turn is mounted on the support element 2. The latter offers a simple retrofit option.

[0075] It is also conceivable to both supply the sensor with power via only two contacts, as well as to transmit the signals of sensor 12 to the evaluation unit 9' in a modulated manner on the power supply. This is advantageous for the exemplary embodiment shown in FIG. 7, since the number of contacts that can be integrated usefully in the mattress or the support unit is smaller than when using the plug contact 16 of FIG. 5. The reason is that to compensate for tolerances in the positioning of the mattress 30, the contact surfaces 17 should have a certain minimum size and a certain minimum distance. A flexible material, in particular a conductive textile material, can preferably be used as material of the contact surfaces. For example, in certain regions in the mattress 30, a conductive textile, e.g. a textile threaded with a copper thread, can be used. The (counter-)contact surfaces 17 formed on the support element 2 can then be formed from a hard conductive surface.

[0076] Another arrangement for transmitting energy and sensor signals is shown in FIG. 7. In this exemplary embodiment, the electrical signals are inductively transmitted through induction coils 18. For this purpose, the primary-side induction coil 18, which is connected to the evaluation unit 9', is supplied with AC voltage. The voltage induced in the secondary-side induction coil 18 is supplied to the sensor 12 for power supply. Also in this arrangement, the sensor signal can be modulated by the sensor 12 as a high-frequency signal on the current flowing to its supply, which in turn is also transmitted by the induction coils 18 to the evaluation unit 9' after similarly inductive transmission. Such a modulation is also known as power-line modulation.

[0077] FIG. 8 shows a modification of the arrangement according to FIG. 7. In the exemplary embodiment of FIG. 8, an arrangement of induction coils 18 is also provided for the power supply of the sensor 12, which arrangement of induction coils 18 in this exemplary embodiment is coupled on the primary side to a power supply unit 9" which is separate from the evaluation unit 9'.

[0078] A transmission of the signals of the sensor 12 to the evaluation unit 9' takes place in the form of wireless signals 15 via a radio link. This can be designed, for example, according to the Bluetooth or ZigBee specification. It is understood that a division into an inductive power supply of the sensor 12 and a transmission of the sensor signals as wireless signals 15 is also possible if no separate power supply unit 9" is present, but the power supply unit 9" is integrated in the evaluation unit 9'. Even radio links with proprietary transmission protocols are conceivable.

[0079] Furthermore, the aforementioned features can be combined with each other. Thus, according to an alternative, not shown, a mattress 30 with a sensor 12 connected thereto and with an evaluation unit 9' connected thereto is conceivable. The mattress 30 thus comprises the at least one sensor 12 and the evaluation unit 9'. In this case, the evaluation unit 9' may be provided in the vicinity of a zipper of the cover 31. The evaluation unit 9' can be arranged in the edge region or in the surface region of the mattress 30.

[0080] In one embodiment, the evaluation unit 9' is designed in this case to receive at least one electric energy storage unit. A battery compartment may be provided for example. Preferably, the evaluation unit 9' has a rechargeable electric energy storage unit which is particularly suitable for supplying the evaluation unit 9' for a period of at least 24 hours. The charging of the energy storage unit takes place in an embodiment according to the description in connection with the FIG. 7 or 8, wherein in the mattress 30 or the evaluation unit 9', the secondary induction coil 18 mentioned there is arranged. Due to the aforementioned embodiment, it is now possible to provide the evaluation unit 9' with a temporary transmission of electrical energy through the induction coil 18, which is then intermediately stored by the electric energy storage unit and is available for the operation of the evaluation unit 9'.

[0081] In one embodiment, the evaluation unit 9' detects the presence of a person resting on the mattress 30 and deactivates the transmission of energy through the induction coils 18. In this way, energy is saved and a discharge of electromagnetic impurities is reduced to a minimum. In a further embodiment, the evaluation unit 9' of the mattress detects not only the signals 20 of at least one sensor 12, but also fully carries out the evaluation of the sensor signals, e.g. to determine the sleep phases and to analyze the respective

sleep phase, and summarizes after the end of the last sleep phase all measurement data to one record for wireless transmission to a mobile device **14** or for transmission in a data network. For this purpose, the evaluation unit **9'** preferably has a memory which can intermediately store the determined parameters until transmission to the mobile device **14**. In order not to lose data, even if a transmission does not take place for a long time, the memory should have a capacity large enough to accommodate data of several sleep phases, e.g. data of a week. The memory can be, for example, a non-volatile, rewritable memory, e.g. a flash memory.

LIST OF REFERENCE NUMERALS

[0082]	1 Bed
[0083]	2 Support element
[0084]	3 Middle part of the support element
[0085]	4 Back part
[0086]	5 Leg part
[0087]	6 Connection
[0088]	7, 8 Adjusting drive
[0089]	9 Control device
[0090]	9' Evaluation unit
[0091]	9" Power supply unit
[0092]	10 Handset
[0093]	11 Transmission link
[0094]	12 Sensor
[0095]	12' Sensor plate
[0096]	13 Sensor cable
[0097]	14 Mobile device
[0098]	15 Wireless signals
[0099]	16 Plug contact
[0100]	17 Contact surfaces
[0101]	18 Induction coils
[0102]	20 Signal
[0103]	21 Heartbeat peak
[0104]	22 Envelope
[0105]	23 Rising flank (inhalation)
[0106]	24 Descending flank (exhalation)
[0107]	30 Mattress
[0108]	31 Cover
[0109]	32 Foam material
[0110]	33 Protective layer
[0111]	34 Spring

1-17. (canceled)

18. A mattress for a piece of sleeping or reclining furniture, said mattress comprising:

- a sensor arranged in the mattress and configured to detect vibration, movement and/or sound; and
- an element coupled to the sensor and configured to receive structure-borne sound.

19. The mattress of claim **18**, wherein the sensor is a piezoelectric or electromagnetically operating sensor.

20. The mattress of claim **18**, wherein the sensor is embedded in a foam material of the mattress.

21. The mattress of claim **18**, further comprising two protective layers arranged within the mattress, said sensor being positioned between the two protective layers.

22. The mattress of claim **21**, wherein the protective layers comprise sponge rubber or felt.

23. The mattress of claim **18**, wherein the element is a sensor plate configured for receiving structure-borne sound, said sensor being connected to the sensor plate.

24. The mattress of claim **18**, further comprising a spring core having springs, at least one of the springs having one end resting on the sensor or on one of the protective layers, said at least one of the springs representing the element for receiving the structure-borne sound.

25. The mattress of claim **18**, further comprising an externally accessible plug contact for contacting the sensor.

26. The mattress of claim **18**, further comprising at least two conductive contact surfaces for contacting the sensor.

27. The mattress of claim **18**, further comprising an induction coil disposed in an outer region and connected to the sensor.

28. A piece of sleeping or reclining furniture, in particular bed, comprising:

- a mattress;
- a sensor configured to detect vibration, movement and/or sound and integrated in the mattress; and
- an element coupled to the sensor and configured to receive structure-borne sound.

29. The piece of sleeping or reclining furniture of claim **28**, wherein the sensor is a piezoelectric or electromagnetically operating sensor.

30. The piece of sleeping or reclining furniture of claim **28**, wherein the mattress includes foam material, said sensor being embedded in the foam material of the mattress.

31. The piece of sleeping or reclining furniture of claim **28**, wherein the mattress has accommodated therein two protective layers, said sensor being positioned between the two protective layers.

32. The piece of sleeping or reclining furniture of claim **31**, wherein the protective layers comprise sponge rubber or felt.

33. The piece of sleeping or reclining furniture of claim **28**, wherein the element is a sensor plate configured for receiving structure-borne sound, said sensor being connected to the sensor plate.

34. The piece of sleeping or reclining furniture of claim **28**, wherein the mattress includes a spring core having springs, at least one of the springs having one end resting on the sensor or on one of the protective layers, said at least one of the springs representing the element for receiving the structure-borne sound.

35. The piece of sleeping or reclining furniture of claim **28**, wherein the mattress includes an externally accessible plug contact for contacting the sensor.

36. The piece of sleeping or reclining furniture of claim **28**, wherein the mattress includes at least two conductive contact surfaces for contacting the sensor.

37. The piece of sleeping or reclining furniture of claim **28**, wherein the mattress includes an induction coil disposed in an outer region and connected to the sensor.

38. The piece of sleeping or reclining furniture of claim **28**, further comprising an evaluation unit connectable to the sensor and configured to process and evaluate a signal of the sensor and to detect a physiological parameter of a person using the piece of sleeping or reclining furniture.

39. The piece of sleeping or reclining furniture of claim **28**, wherein the physiological parameter detected by the sensor includes a heart rate, a respiratory rate, a movement state and/or a snoring state of the person.

40. The piece of sleeping or reclining furniture of claim **28**, wherein the evaluation unit includes a filter, in particular a low-pass or band-pass filter for signal processing.

41. The piece of sleeping or reclining furniture of claim **28**, further comprising:

an electromotive furniture drive including an adjusting drive for adjusting a furniture part; and
a control device configured to control the adjusting drive, said evaluation unit being coupled to the control device or integrated in the control device.

42. The piece of sleeping or reclining furniture of claim **28**, wherein the evaluation unit is configured to detect and evaluate a vibration which occurs during actuation of the adjusting drive.

43. The piece of sleeping or reclining furniture of claim **28**, wherein the evaluation unit is configured to determine a malfunction and/or overload and/or non-loading of the adjusting drive during operation.

* * * * *

专利名称(译)	床垫和睡觉或斜倚家具具有床垫		
公开(公告)号	US20190008283A1	公开(公告)日	2019-01-10
申请号	US16/067475	申请日	2016-12-30
[标]申请(专利权)人(译)	德沃特奥金有限公司		
申请(专利权)人(译)	DEWERTOKIN GMBH		
当前申请(专利权)人(译)	DEWERTOKIN GMBH		
[标]发明人	GEHRKE KARSTEN HILLE ARMIN LOLEY STEFFEN TEWS ALEXANDER		
发明人	GEHRKE, KARSTEN HILLE, ARMIN LOLEY, STEFFEN TEWS, ALEXANDER		
IPC分类号	A47C20/04 A47C31/00 A61B5/00 A61B5/113		
CPC分类号	A61B5/1135 A47C20/041 A47C31/008 A61B5/6891 A47C21/003 A61B5/4806 A61B5/725 A61B5/6892 A47C17/162 A47C17/163 A47C19/027 A47C27/00 A47C31/00 A61B5/002 A61B5/0022 A61B5/0205 A61B5/024 A61B5/02444 A61B5/0816 A61B5/1116 A61B5/1123 A61B5/4809 A61B5/746 G05B19/416 G05B2219/43196		
优先权	202015107148 2015-12-30 DE 102016109524 2016-05-24 DE 202016105633 2016-10-07 DE		
外部链接	Espacenet USPTO		

摘要(译)

本发明涉及一种用于睡觉或斜倚家具的床垫(30)，其具有至少一个布置在床垫(30)中的传感器(12)，用于感测振动，运动和/或声音。床垫(30)的特征在于床垫具有至少一个用于接收固体声的元件，至少一个传感器(12)连接到该元件上。本发明还涉及一种睡觉或斜倚的家具，特别是具有这种床垫(30)的床(1)。

