tioned vibration complementing apparatus is exemplified by the CD player integrated type, it may be an external type. Moreover, although the example in which the complementing is achieved by using the vibration signal that can introduce the preset fundamental brain activation effect in this case, the complementing can also be achieved by using a vibration signal that can introduce the fundamental brain activation effect selected from a plurality of candidates by the user.

The objective original vibration signals of this vibration complementing apparatus include vibration signals recorded in digital formats that cannot record super-high-frequency components in a storage media such as DVD videos, Blu-ray Discs and hard disks, vibration signals used in equipment using formats that can neither record nor reproduce super-high-frequency components such as VR systems, attraction systems of Theme Parks, game machines and game software, vibration signals that are transmitted and distributed via broadcastings and telecommunications using formats that cannot transmit super-high-frequency components such as telephones, TV conference systems and wireless apparatuses, and vibration signals obtained by transducing the vibration of a solid, a liquid, a gas or the like into an electric signal by a transducer by using an apparatus that can neither transduce nor transmit super-high-frequency components, besides the aforementioned CDs. Moreover, even a vibration signal recorded in a format that can record super-high-frequency components in a storage medium as described above, or even a vibration signal obtained by transducing the vibration of a solid, a liquid, a gas or the like into an electric signal by a transducer by using an apparatus that can transduce and transmit super-high-frequency components, becomes the object of this vibration complementing apparatus when the vibration does neither have the required structure nor introduce the fundamental brain activation effect.

By using this apparatus, it becomes possible to apply the vibration (hypersonic sound) that can introduce the fundamental brain activation effect to human beings by utilizing the existent huge amount of contents recording the vibration signals in the digital formats that can neither record the super-high-frequency components nor introduce the fundamental brain activation effect. Moreover, it becomes possible to form a vibration (hypersonic sound) that can introduce the fundamental brain activation effect and apply it to human beings by utilizing the contents constituted of vibration signals that do not introduce the fundamental brain activation effect and are expected to be produced continuously in the future while utilizing the formats that can record super-high-frequency components.

FIG. **62** is a perspective view showing an example of a vibration complementing apparatus to add a vibration signal that can introduce the fundamental brain activation effect to an original vibration that does not introduce the fundamental brain activation effect and is outputted from a portable player or the like according to the second preferred embodiment. FIG. **62** shows an example of a vibration complementing apparatus **621** to add a vibration signal that contains super-high-frequency components having the predetermined autocorrelation order and can introduce the fundamental brain activation effect to an original vibration signal of the signals in the digital formats that can neither record super-high-frequency components nor introduce the fundamental brain activation effect such as the signal of a portable player **621**. This vibration complementing apparatus **621** is mounted in the portable player **620** and internally integrated with a storage device such as a solid memory in which the vibration signal that contains super-high-frequency components and has the feature of the autocorrelation order satisfying the conditions of the aforementioned properties. The vibration complementing apparatus **621** has a function to read the vibration signal that can introduce the fundamental brain activation effect from the storage device, add it to the original vibration signal that does not contain the super-high-frequency components read from the solid memory or the like of the portable player **620** and thereafter output the vibration signal from the portable player. The added signal is applied to a person **623** by a headphone, earphone **622** or an apparatus **622** or the like to apply the vibration to the body surface. In this case, the applied vibration is the vibration (hypersonic sound) that can introduce the fundamental brain activation effect. Although the vibration complementing apparatus **620** is described by the example of the portable player integrated type, it may be an external type.

The objective original vibration signals of this vibration complementing apparatus **620** include signals in the digital formats that cannot record the super-high-frequency components transmitted and distributed via communications of the current one-segment or the like besides the signals of musics recorded in the digital formats that cannot record super-high-frequency components in a variety of kinds of storage media such as a solid memory.

By using the apparatus of this implemental example, it becomes possible to apply the vibration (hypersonic sound) that can introduce the fundamental brain activation effect to human beings by utilizing the contents of musics in the digital formats that can neither record super-high-frequency components nor introduce the fundamental brain activation effect for use in the existent portable player and the like.

FIG. **63** is a perspective view showing an example of a vibration complementing apparatus to add a vibration signal that can introduce the fundamental brain activation effect to an original vibration signal that does not introduce the fundamental brain activation effect and is outputted from a broadcasting receiver or the like according to the second preferred embodiment. FIG. **63** shows an example of a vibration complementing apparatus to add a vibration signal containing the super-high-frequency components that have the predetermined autocorrelation order and can introduce the fundamental brain activation effect to an original vibration signal of a vibration signal transmitted in a format that does neither contain the super-high-frequency components nor can introduce the fundamental brain activation effect, such as the signal of a broadcasting receiver such as a television receiver **630**. This vibration complementing apparatus **631** is mounted in the broadcasting receiver such as the television receiver **630** and internally integrated with a storage device such as a solid memory in which the vibration signal that contains the super-high-frequency components and has the feature of the autocorrelation order satisfying the conditions of the aforementioned properties. This vibration complementing apparatus **631** has a function to read a vibration signal that can introduce the fundamental brain activation effect from the storage device, add it to the received vibration signal that contains no super-high-frequency component and thereafter output the vibration signal. The added signal is transduced into an aerial vibration by a loudspeaker **632** or the like attached to the broadcasting receiver. In this case, the transduced aerial vibration is the vibration (hypersonic sound) that can introduce the fundamental brain activation effect. Although the vibration complementing apparatus **631** is exemplified by the integrated type, it may be an external type. Moreover, it is possible to automatically complement the stored signal or to allow the user to select his or her favorite vibration signal to achieve the complementing.

The objective original vibration signals of this vibration complementing apparatus include signals of digital formats and analog formats that cannot transmit the super-high-frequency components transmitted and distributed via communications of the current terrestrial digital broadcastings, BS digital broadcastings, analog TV broadcastings, AM radio broadcastings, FM radio broadcastings, Internet, and the like, telephone lines, wireless communications, intercoms, interphones, and the like.

By using the apparatus of the present implemental example, it becomes possible to apply a vibration (hypersonic sound) that can introduce the fundamental brain activation effect to human beings by utilizing the vibration signals transmitted by the existing broadcastings and the like.

FIG. **103** is a block diagram showing an example of an electronic musical instrument apparatus **440** including a vibration complementing apparatus to add a vibration signal that contains super-high-frequency components having the predetermined autocorrelation order to an original vibration that does not introduce the fundamental brain activation effect and is generated by giving a performance with the electronic musical instrument **441** according to the second preferred embodiment, and FIG. **104** is a perspective view showing an example of its external appearance. The electronic musical instrument **441** such as the existent digital synthesizer **444** uses a digital format that cannot perform recording and reproducing of super-high-frequency components, and therefore, the vibration of the performance sound contains no super-high-frequency component and cannot introduce the fundamental brain activation effect. Accordingly, referring to FIGS. **103** and **104**, the vibration complementing apparatus uses the vibration signal of the performance sound of the electronic musical instrument as an original vibration signal, reads a vibration signal that can introduce the fundamental brain activation effect from a complementing vibration source **442**, and adds it to the original vibration signal by an adder **443**, thereby outputting a signal (hypersonic sound signal) of the vibration that introduces the fundamental brain activation effect because it contains super-high-frequency components having the predetermined autocorrelation order. Although this vibration complementing apparatus is mounted in the electronic musical instrument **441** of FIG. **104**, it may be external or exist independently of the electronic musical instrument **441** without being limited to this. Moreover, the complementing vibration source **442** may be internally integrated with a variety of kinds of storage devices such as a solid memory in which the vibration signal that can introduce the fundamental brain activation effect is recorded or supplied as a vibration signal that is synthesized by an analog synthesizer or the like and can introduce the fundamental brain activation effect by telecommunications or the like.

Although the digital synthesizer **444** is taken as an example above, electronic musical instruments and karaoke systems and the like besides this are allowed to have the vibration signal of their performance sounds similarly complemented with a vibration signal that can introduce the fundamental brain activation effect. Otherwise, it is also possible to transduce the vibration of the performance sound of an acoustic musical instrument into an electric signal by a microphone or the like and complement it with a vibration signal that can introduce the fundamental brain activation effect. Furthermore, complementing with a vibration signal that can introduce the fundamental brain activation effect can be similarly performed by the vibration complementing apparatus also in the so-called PA (public-address) that reproduces the performance of such musical instruments, singing and the like by once transducing it into a signal in a concert hall or the like.

Next, an implemental example corresponding to a vibration complementing apparatus combined with the existent band expanding is described below.

In recent years, a variety of band expanding methods are proposed as a technique to complement a vibration signal from which the super-high-frequency components have dropped out with super-high-frequency components. However, considering that examples in which a certain kind of artificially synthesized super-high-frequency components does not develop the fundamental brain activation effect or conversely deteriorates the fundamental brain activity are reported, there is such a problem that it is necessary to carefully examine whether the structure of the super-high-frequency components artificially expanded by a band expanding method is effective and safe for human beings.

Regarding this problem, the present implemental example obtains the effects of promoting the safety of the band-expanded vibration signal, inducing the activation of the fundamental brain network, enhancing the aesthetic sensibility and ameliorating and improving the physical state by complementing with the vibration signal of a hypersonic sound or its super-high-frequency components of which the effect of introducing the fundamental brain activation effect is guaranteed.

FIG. **64** is a block diagram showing an example of a vibration complementing apparatus that use the band expanding means of the existing technology together with addition means of a vibration that can introduce the fundamental brain activation effect according to the second preferred embodiment. FIG. **64** shows a configuration constituted of a reproducing circuit **641** and a band expanding circuit (also generally referred to as a band expanding circuit) **642** for an original vibration signal that does neither contain super-high-frequency components nor introduce the fundamental brain activation effect, a reproducing circuit **643** for a vibration signal that can introduce the fundamental brain activation effect, and an adder **644** that adds these vibration signals together.

In this case is shown an example of an apparatus, in which the frequency domain of an original vibration signal that does not introduce the fundamental brain activation effect is expanded to a band of not lower than 20 kHz at the human audible frequency upper limit by using the existent band expanding circuit **642** (See, for example, the Patent Documents 6 and 7), and by adding a vibration signal that contain super-high-frequency components having the predetermined autocorrelation order and can introduce the fundamental brain activation effect to a signal, of which the super-high-frequency components are enabled to be generated but it is unclear whether the structure of the vibration satisfies the conditions capable of activating the fundamental brain, by the adder **644**, the signal is complemented with the components that satisfy the conditions of the aforementioned properties, consequently generating an output signal (hypersonic sound signal) that can introduce the fundamental brain activation effect. Many of the existent vibration signals that do not introduce the fundamental brain activation effect in a manner similar to that of the case of, for example, the instrument sound of a piano and the existent digital media such as CD, DVD, digital broadcasting scarcely contain vibration components reaching up to 20 kHz at the human audible frequency upper limit. Particularly, if only the super-high-frequency components are added to the original vibration signal when the upper limit of the band of the original vibration is far below 20 kHz, then segmentation occurs between the original vibration and the added super-high-frequency components, and an unnatural power spectrum is to result. By using the existent band expanding circuit together with the original vibration signal having such a feature, it becomes possible to eliminate the segmentation, dropout and unnatural bend in the band between the power spectrum of the audible range components and the power spectrum of the super-high-frequency components and to obtain a more smoothly linked natural power spectrum. Moreover, by virtue of a synergistic effect of the super-high-frequency components of not lower than 20 kHz at the human audible frequency upper limit generated by band expanding and the vibration signal that can introduce the fundamental brain activation effect, a greater fundamental brain activation effect can be expected. By thus generating the vibration (hypersonic sound) that introduces the fundamental brain activation because it contains super-high-frequency components having the predetermined autocorrelation order, the effects of inducing activation of the fundamental brain network system including the reward system neural circuit responsible for the generation of reactions of pleasure, beauty and emotion, and the nerve center of the autonomic neural circuit, the endocrine system and the immune system responsible for the homeostatic maintenance and biophylaxis of the whole body in a human being, enhancing the aesthetic sensibility and ameliorating and improving the physical state are obtained.

Next, an implemental example of a vibration complementing apparatus integrated with a high-pass filter is described below.

FIG. **65** is a block diagram showing an example of a vibration complementing apparatus that generates a vibration signal (hypersonic sound signal) that can introduce the fundamental brain activation effect as an output signal by adding a signal obtained by extracting the super-high-frequency components of a vibration signal that can introduce the fundamental brain activation effect to an original vibration signal according to the second preferred embodiment. Referring to FIG. **65**, by adding a signal obtained by extracting only the super-high-frequency components by filtering a vibration signal that can introduce the fundamental brain activation effect by a high-pass filter **645** or attenuating the audible range components to a considerable extent to an original vibration signal that does neither contain super-high-frequency components nor introduce the fundamental brain activation effect by the adder **644**, thereby complementing it with the components satisfying the conditions of the aforementioned properties, and an output signal (hypersonic sound signal) that can introduce the fundamental brain activation effect is generated as a result. If audible range components are contained in the vibration signal that can introduce the fundamental brain activation effect to be added to it, and when the original signal is, for example, a music, it becomes difficult to receive the original vibration as a music due to interference between both of them. Accordingly, by extracting and adding only the super-high-frequency components that are not perceivable as a sound and contained in the vibration signal that can introduce the fundamental brain activation effect, it becomes possible to introduce the fundamental brain activation effect without disturbing the reception of the audible range components of the original vibration. The high-pass filter **645** may be a band-pass filter. Moreover, the existent band expanding circuit of FIG. **64** may be used together with the original vibration signal.

FIG. **66** is a block diagram showing an example of a complementing type vibration signal generating apparatus that can introduce the fundamental brain activation effect and use the circuit of a band expanding apparatus, a high-pass filter, a gate apparatus and a voltage-controlled amplifier (VCA) together according to the second preferred embodiment. FIG. **66** shows an example of an apparatus, in which, by using the circuit of an existent band expanding circuit **653** (corresponding to **642** of FIG. **64**), a high-pass filter **663**, a gate apparatus having switches **664***a* and **664***b* controlled by a comparator **670**, and a voltage-controlled amplifier (VCA) **665** together, as described above, a signal component that can introduce the fundamental brain activation effect is added to the original vibration signal that does not introduce the fundamental brain activation effect at a level strongly correlated to the level of the original vibration, and an output signal (hypersonic sound signal) that can introduce the fundamental brain activation effect is generated as a result.

Data of the vibration signal is read from the storage device **651** of the original vibration signal that does not introduce the fundamental brain activation effect by a reproducing circuit **562**, subjected to DA conversion and thereafter to band expanding by the band expanding circuit **653** by using the known band expanding technology and then outputted to a comparator **670**, an absolute value signal detector **671** and an adder **654**. On the other hand, data of the vibration signal that can introduce the fundamental brain activation effect is read from a storage device **661** of the vibration signal by a reproducing circuit **662**, subjected to DA conversion, and thereafter outputted via a high-pass filter **663** and a switch **667***a* and via a first path of a switch **664***a* and a second path of an attenuator **666** and a switch **664***b* and via a switch **667***b* and a voltage-controlled amplifier (VCA) **665** to the adder **654**. In this case, the switches **667***a* and **667***b* are mode switches for switchover regarding whether to pass the data through the attenuator **666**, and the switches **664***a* and **664***b* are gate circuits for switchover regarding whether to pass the vibration signal of each path. The gate circuit performs control so as to turn on the switches **664***a* and **664***b* by comparing the magnitude of the vibration signal from the band expanding circuit **653** with a voltage source Vt by a comparator **670** and when it is not lower than a predetermined level. Moreover, the voltage-controlled amplifier **665** changes the level of the vibration signal from the switch **667***b* in accordance with the absolute value level of the vibration signal from the band expanding circuit **653**.

With the above-mentioned configuration, by using the existent band expanding apparatus for the original vibration signal that does not introduce the fundamental brain activation effect, it becomes possible to eliminate the segmentation and dropout in the band between the audible range components and the super-high-frequency components and to obtain a more smoothly linked natural power spectrum. Moreover, by extracting only the super-high-frequency components by filtering the vibration signal that can introduce the fundamental brain activation effect by the high-pass filter **663** and adding it to the original vibration signal, it becomes possible to generate an output signal (hypersonic sound signal) that can introduce the fundamental brain activation effect without influencing the audible range components of the original vibration signal and accordingly without disturbing listening to the audible range components of the original vibration.

The gate apparatus has the operation of opening the gate switches **664***a* and **664***b* when the level of the original vibration signal in the signal processing system exceeds a definite value to add the vibration that can introduce the fundamental brain activation effect or closing the gate switches **664***a* and **664***b* when the level does not exceed the definite value to perform no addition. By using this apparatus, it becomes possible to avoid the generation of an unnatural state such that, when the level of the original vibration is extremely low or when almost or utterly no original vibration exists, only the super-high-frequency components that do not introduce the fundamental brain activation effect under this condition exists at a high level.

The voltage-controlled amplifier (VCA) **665** has a function to change the amplification factor of the vibration that can introduce the fundamental brain activation effect to be added in correspondence with the original vibration signal level and amplify the vibration signal that can activate the fundamental brain by the amplification factor. In the case of, for example, music, of where the level of the super-high-frequency components is high when the level of the audible range components is high, it is often the case where the levels of both of them have high correlation. By using this apparatus, it becomes possible to add the vibration signal that can introduce the fundamental brain activation effect in a more natural state correlated to the level of the original vibration. Referring to FIG. **66**, these additional function apparatuses may be provided by using all of the circuit of the existent band expanding circuit **653**, high-pass filter **663**, and the gate apparatus having the switches **664***a* and **664***b* controlled by the comparator **670**, and the voltage-controlled amplifier (VCA) **665** together or using them partially solely or in combination. For example, it is acceptable to use any one of the gate apparatus and the voltage-controlled amplifier (VCA) **665** or use the band expanding circuit **653** and the high-pass filter **663** as occasion demands.

Next, an implemental example concerning a vibration complementing apparatus using a plurality of vibration signals is described below.

FIG. **67** is a block diagram showing an example of a vibration complementing apparatus capable of adding a plurality of vibrations that can introduce the fundamental brain activation effect according to the second preferred embodiment. FIG. **67** shows an example of a vibration complementing apparatus capable of selectively adding one or more from among the plurality of vibration signals that can introduce fundamental brain activation effect to an original vibration signal that does not introduce the fundamental brain activation effect.

Data of complementing vibration signals of a tropical rain forests natural environmental sound, a running water sound, an instrument sound and a synthesized sound are previously stored in vibration signal storage devices **661-1** to **661-4**, respectively, and they are read and reproduced by respective reproducing circuits **662-1** to **662-4**. Switches **681** to **684** and **685** to **688** are provided for selective switchover regarding whether to make each vibration signal pass through the voltage-controlled amplifier (VCA) **665** and whether to use it as a complementing sound source. Filters **693** and **694** are, for example, high-pass filters, band-pass filters or the like. Moreover, a control signal generating circuit **672** is a circuit such as an absolute value detector **671** to control the operation of the voltage-controlled amplifier **665**. A controller **680** controls the operations of switches **681** to **684** and **685** to **688**, passbands of filters **693** and **694** and the control signal generating circuit **672** based on a setting table of parameter setting and an operation program stored in a memory **680***m*. The setting table records settings for controlling these in accordance with the kind of the original vibration signal and/or the complementing vibration signal. In this case, the kind of the complementing vibration signal may be previously set or manually inputted as needed.

In a vibration generating apparatus including the complementing signal generating apparatus configured as above, it is possible to select any one appropriate vibration from the plurality of complementing vibration signals that can introduce the fundamental brain activation effect or to add together a plurality of them by using the controller **680**. In the case, the controller **680** controls selection and addition of the complementing vibration signals according to the setting table of the parameter setting and the operation program in the memory **680***m*. For example, it is acceptable to select a vibration having the autocorrelation order recorded in the natural environment such as a tropical rain forest as a background vibration and consistently add the same. Moreover, in a case where the original vibration signal to be complemented is a music, it is acceptable to select a signal of a vibration having the autocorrelation order recorded by using a musical instrument of the same kind as the musical instrument used in the music as a complementing vibration signal or to add together a plurality of vibrations having the autocorrelation order recorded by using each of a plurality of musical instruments used and use the same. Further, it is also possible to extract only the super-high-frequency components by filtering the selected vibration signal that can introduce the fundamental brain activation effect by the high-pass filters **693** and **694** and add the same. Moreover, the signal level of the vibration that can introduce the fundamental brain activation effect may be amplified so as to correlate to the level of the original vibration signal by using the voltage-controlled amplifier (VCA) **665**. Further, it is acceptable to adjust the gain of the amplification factor of the vibration signal that can introduce the fundamental brain activation effect with respect to the level fluctuation of the original vibration via the controller **680**.

Since the amount and time duration of the hypersonic sound signal qualified as a complementing vibration signal are witheringly smaller than those of the existent huge amount of original vibration signals that cannot introduce the fundamental brain activation effect, a small amount of complementing vibration signals is to be repetitively used. In contrast to this, the actual vibrations of high naturalness such as the tropical rain forest environmental sound do not have iterative identical vibrations. Such a problem that the vibration generated by the complementing and the actual vibrations of high naturalness have mutually different features occurs at this point.

Regarding this matter, by concurrently using a plurality of complementing vibration signals, it becomes possible to generate a vibration signal that does not generate repetition remarkably for a long time even if each individual is a complementing vibration signal of a limited time duration. For example, a complementing vibration signal group constituted of a plurality of mutually independent vibration currents produced so as not to cause expressive and functional failures by any combination is configured. In this case, after performing recording so that the time durations of the vibration signals come to have mutual prime factor relations in units of, for example, seconds, they are repetitively reproduced at an accuracy such that the mutual deviation is limited to 1/10 seconds or less. Assuming that the first one has a duration of 3181 seconds and the second one has a duration of 3667 seconds, then it takes 11,164,727 seconds, i.e., 135 days until an identical combination recurs after simultaneous start from the beginning.

The original vibration signal and the plurality of vibration signals that can introduce the fundamental brain activation effect may be signals that are inputted from an external vibration source by wire or wirelessly or signals recorded in the storage device such as a hard disk or a solid memory. Moreover, by using this vibration complementing apparatus, it becomes possible to synthesize a vibration (hypersonic sound), that has the autocorrelation order capable and can most effectively introduce the fundamental brain activation effect in accordance with the kind of the original vibration signal.

Next, as a vibration generating apparatus and method according to the second preferred embodiment, a vibration signal having the predetermined autocorrelation order is generated by performing processing based on the feature of the autocorrelation order owned by a reference surface that can introduce the fundamental brain activation effect on a vibration signal that does not introduce the fundamental brain activation effect because it satisfies neither the first property nor the second property on the autocorrelation order while containing the super-high-frequency components exceeding the human audible range upper limit, and a vibration signal (hypersonic sound signal) that introduce the fundamental brain activation effect is generated by adding the super-high-frequency components to the original vibration signal that does not introduce the fundamental brain activation effect for complementing is described.

FIG. **68** shows a block diagram of a vibration signal generating apparatus that generates a vibration signal (hypersonic sound signal) that introduce the fundamental brain activation effect by analyzing the feature of the autocorrelation order owned by the reference vibration that can introduce the fundamental brain activation effect by using autocorrelation coefficients, generating a vibration signal that has the predetermined autocorrelation order by processing the signal of a vibration (e.g., a white noise) that does not introduce the fundamental brain activation effect, because it satisfies neither the first property nor the second property on the autocorrelation order while containing the super-high-frequency components exceeding the human audible range upper limit based on the result, and by adding the super-high-frequency components to the original vibration signal that does not introduce the fundamental brain activation effect for complementing. By thus generating the vibration (hypersonic sound) that contains the super-high-frequency components having the predetermined autocorrelation order, the effects of inducing activation of the fundamental brain network system including the reward system neural circuit responsible for the generation of reactions of pleasure, beauty and emotion, and the nerve center of the autonomic neural circuit, the endocrine system and the immune system responsible for the homeostatic maintenance and biophylaxis of the whole body in a human being, enhancing the aesthetic sensibility and ameliorating and improving the physical state are obtained.

The operation of the apparatus of FIG. **68** is described below.

Referring to FIG. **68**, a reference vibration signal having definite time duration is inputted to an autocorrelation coefficient calculator, and an autocorrelation coefficient matrix of an autocorrelation model suited to a reference vibration signal is calculated by using, for example, the Yule-Walker method. A concrete calculation procedure of the autocorrelation coefficient calculator **676** is as follows.

(1) A reference vibration signal is first inputted to an AD converter **674**, and sampled by a sampling frequency $2f_N$ (f_N is the Nyquist frequency, or the highest frequency of the original signal). In this case, f_N needs to sufficiently exceed 20 kHz at the audible range upper limit (e.g., f_N=96 kHz). When the reference vibration signal is a digital signal, the AD converter **674** may be eliminated.

(2) A signal having a total duration of T seconds outputted from the AD converter **674** is inputted to the autocorrelation coefficient calculator **676** and divided into "n" unit analysis intervals of duration of T_E seconds (e.g., T=60 seconds, T_E=0.1 seconds, n=600).

(3) The time series data for an arbitrary interval is assumed to be x(t) (t=1, 2, . . . , $2f_N \times T_E$), and the autocorrelation model of m dimensions representing the current value by using the values at past "m" points is applied. That is, assuming that a1, a2, . . . , a_m are autocorrelation coefficients in the autocorrelation model of m dimensions (e.g., m=10) and $\epsilon(t)$ applied to it is a random noise, then time series data x(t) is expressed by the following equation:

$$x(t)=a_1x(t-1)+a_2x(t-2)+\ldots+a_mx(t-m)+\epsilon(t).$$

In this case, assuming that the autocorrelation function of the time series data x(t) is C_k (k=1, 2, . . . , m) (provided that k is lag time), then the simultaneous equations of the following equation (hereinafter referred to as Yule-Walker equation) holds:

$$\begin{bmatrix} C_0 & C_1 & \cdots & C_m \\ C_1 & C_0 & \cdots & C_{m-1} \\ \vdots & \vdots & \ddots & \vdots \\ C_m & C_{m-1} & \cdots & C_0 \end{bmatrix} \begin{bmatrix} 1 \\ -a_1 \\ \vdots \\ -a_m \end{bmatrix} = \begin{bmatrix} P_m \\ 0 \\ \vdots \\ 0 \end{bmatrix}$$

where P_m is the variance of a difference between a predictive value obtained from the autocorrelation coefficient of:

$$x_p(t)=a_1x(t-1)+a_2x(t-2)+\ldots+a_mx(t-m),$$

and the actually measured value x(t), and generally called the variance of prediction errors.

(4) The Yule-Walker equation, which is a simultaneous equation including m+1 equations, can be solved if there are m+1 unknowns. According to the Yule-Walker method, it is assumed that the autocorrelation function C_k is known, and m+1 variables consisting of $a_1, a_2, \ldots, a_m, P_m$ are unknowns. By using Levinson algorithm, the autocorrelation coefficients are calculated starting from m=1 by successively incrementing m by one (See, for example, the Non-Patent Document 7).

(5) For the divided unit analysis interval "i" (i=1, 2, . . . , n), the autocorrelation coefficients calculated by the aforementioned method are assumed to be $a_{i1}, a_{i2}, \ldots, a_{im}$. The autocorrelation coefficients are calculated in all the "n" unit analysis intervals, and the autocorrelation coefficient matrix A of the following equation is formed:

$$A = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1m} \\ a_{21} & a_{22} & \cdots & a_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & \cdots & a_{nm} \end{bmatrix}$$

In this equation, the i-th row is a row vector having the autocorrelation coefficients $a_{i1}, a_{i2}, \ldots, a_{im}$ of the interval "i" as the elements of the matrix A. The number of rows of the matrix A is the number of intervals (n rows), and the number of columns becomes the number of dimensions of the autocorrelation coefficients (m columns).

Although the calculation example of the autocorrelation coefficient using the Yule-Walker method is described according to the above-mentioned calculation procedure, another method such as the Bergh method or the like. In the case of the Bergh method, unknowns are m+2 variables consisting of $a_1, a_2, \ldots, a_m, P_m, C_m$ in the above-mentioned case (4). In the case, no derivation can be achieved only by m+1 simultaneous equations, and therefore, a condition such that "a sum of variance P_m of prediction errors of both of a case of prediction of the autocorrelation coefficients from the past to the future by forward convolution of time series data and a case of prediction from the future to the past by reverse convolution of time series data by reversing the order of the autocorrelation coefficients is minimized" is added as a new judgment criterion.

Assuming that $\Delta t=1/(2f_N)$ and j is an imaginary unit, then one-side power spectrum Q(f) of the time series data x(t) can be expressed by the following equation, and the information entropy density can also be obtained from it (See "supplementary explanation of the formula" described in detail later):

$$Q(f)=\frac{\Delta t P_m}{\left|1-\sum_{k=1}^{m} a_k \exp(j2\pi f_k \Delta t)\right|^2}$$

Next, concrete processing of an active processing circuit **675** is described below. In this case, the active processing circuit **675** is constituted of a convolution calculator **675*a*** and an autocorrelation coefficient controller **675*b***.

The autocorrelation coefficient matrix outputted from the autocorrelation coefficient calculator **676** is inputted to the active processing circuit **675** together with the signal of a vibration (e.g., white noise) that does not introduce the fundamental brain activation effect because it satisfies neither the first property nor the second property on the autocorrelation order while containing super-high-frequency components. In the active processing circuit **675**, a convolution calculation between the vibration signal that does not introduce the fundamental brain activation effect and the autocorrelation coefficients that are the row vectors of the autocorrelation coefficient matrix A is performed to generate a vibration signal having the properties on the aforementioned autocorrelation order.

A concrete calculation procedure in the convolution calculator inside the active processing circuit **675** is as follows.

(1) The signal of a vibration (e.g., white noise) that does not introduce the fundamental brain activation effect is first inputted to an AD converter **673** (external circuit of the circuit **675**) and sampled by the same sampling frequency $2f_N$ (f_N is the Nyquist frequency, or the maximum frequency of the original signal) as that of the reference signal. The AD converter **675** may be eliminated when the reference vibration signal is a digital signal, whereas resampling is performed by the sampling frequency $2f_N$ when the sampling frequency is different from $2f_N$.

(2) The vibration signal that does not introduce the fundamental brain activation effect and is outputted from the AD converter **673** is subsequently inputted to the active processing circuit **675**. The time series data of the signal is divided into unit intervals of duration of T_E seconds, and the time series data for the i-th interval is assumed to be the following:

$$y_i(t)(i=1,2,\ldots,n;\ t=1,2,\ldots,2f_N\times T_E).$$

(3) The autocorrelation coefficients are inputted from the autocorrelation coefficient calculator **676** to the convolution calculator **675*a*** via an autocorrelation coefficient controller **675*b*** described in the following clause. The convolution calculation of the following equation between the inputted autocorrelation coefficients $a_{i1}, a_{i2}, \ldots, a_{im}$ and the input signal $y_i(t)$ is performed:

$$z_i(t)=a_{i1}y_i(t-1)+a_{i2}y_i(t-2)+\ldots+a_{im}y_i(t-m),$$

where $z_i(t)$ is an output signal, which is obtained by the convolution calculation and serves as a vibration signal, that has the property on the autocorrelation order and can introduce the fundamental brain activation effect.

When the time duration of the vibration signal that does not introduce the fundamental brain activation effect is longer than the time duration of the reference vibration signal, the number of autocorrelation coefficient vectors for performing the convolution calculation becomes insufficient. Accordingly, the autocorrelation coefficient controller **675*b*** has a function to continuously send out autocorrelation coefficients by iterating or generating so that the convolution calculation can be continued how long the time duration of the vibration signal that does not introduce the fundamental brain activation effect is. With this function, it becomes possible to generate the vibration signal having the property on the autocorrelation order for arbitrary time duration, even when the time duration of the reference vibration signal is short. In concrete, it is performed according to the procedure described below.

(1) The autocorrelation coefficient matrix A calculated in the autocorrelation coefficient calculator **676** is inputted to the autocorrelation coefficient controller **675*b***. In the autocorrelation coefficient controller **675*b***, the autocorrelation coefficients are sequentially inputted from the first row of the autocorrelation coefficient matrix A to the convolution calculator.

(2) In a case where the inputting of the vibration signal that does not introduce the fundamental brain activation effect is still continued at the time point when the autocorrelation coefficient of the last row (n-th row) of the autocorrelation coefficient matrix A is inputted, any one of the following operations is carried out.

(2-1) Simple iteration: Returning to the first row of the autocorrelation coefficient matrix A, and the autocorrelation coefficients are inputted once again sequentially from the autocorrelation coefficient of the first row to the convolution calculator **675*a***. When the inputting of the vibration signal that does not introduce the fundamental brain activation effect is still continued at the time point of the last row (n-th row) of the autocorrelation coefficient matrix A, the same operation is performed again. The iteration is thus continued until the vibration signal that does not introduce the fundamental brain activation effect ends.

(2-2) A matrix in which the rows are replaced in a random order: A matrix B obtained by replacing the rows of the first row to the n-th row of the matrix A in a random order is generated. The autocorrelation coefficients of the generated matrix B are sequentially inputted from the autocorrelation coefficient of the first row to the convolution calculator. When the inputting of the vibration signal that does not introduce the fundamental brain activation effect is still continued at the time point of the last row (n-th row) of the autocorrelation coefficient matrix B, the rows of the first row to the n-th row of the matrix A are replaced in a random order to generate another matrix B'. The autocorrelation coefficients of the generated matrix B' are sequentially inputted from the autocorrelation coefficient of the first row to the convolution calculator **675*a***. As described above, similar operation is continued until the inputting of the vibration signal that does not introduce the fundamental brain activation effect ends. Although the example in which the rows are replaced in a random order is described according to the above-mentioned procedure example, it is acceptable to achieve the replacement in conformity to a certain rule by, for example, reversing the order of the rows, replacing the odd-number rows to the first half and replacing the even-number rows to the latter half.

(2-3) A return autocorrelation coefficient matrix in which the columns are reversed: By rearranging the m dimension autocorrelation coefficients a_{i1}, a_{i2}, . . . , a_{im} into a reverse order, i.e., a_{im}, a_{im-1}, . . . , a_{i1} regarding all the row vectors of the autocorrelation coefficient matrix A, the return autocorrelation coefficient matrix RevA of the following equation in which the columns are reversed in order is formed:

$$RevA(i,k)=A(i,m-k+1),\ (i=1, 2, \ldots, n;\ k=1,2, \ldots, m).$$

Inputting is sequentially performed from the first row of the generated matrix RevA to the convolution calculator **675***b*. When the vibration signal that does not introduce the fundamental brain activation effect is still continued at the time point of the last row (n-th row) of the autocorrelation coefficient matrix RevA, the autocorrelation coefficients are inputted from the autocorrelation coefficient matrix A and the return autocorrelation coefficient matrix RevA in a manner similar to that of the above-mentioned case. As described above, the same operation is continued until the vibration signal that does not introduce the fundamental brain activation effect ends.

A matrix in which the columns are reversed and the rows are replaced may be generated. Moreover, the operations of (2-1) to (2-3) may be carried out in combination.

Although the example in which the single reference vibration signal is inputted is described in the example of the above-mentioned procedure, a plurality of autocorrelation coefficient matrixes generated by inputting a plurality of reference vibration signals may be inputted from those arranged in an arbitrary order.

By adding the vibration signal that has the property on the autocorrelation order and can introduce the fundamental brain activation effect generated by this apparatus to the original vibration signal that does not introduce the fundamental brain activation effect, it becomes possible to generate a vibration signal that can introduce the fundamental brain activation effect. In the case where the output signal of this apparatus is added to the original vibration, it is acceptable to use together one or a plurality of circuits of the high-pass filter **663**, the gate circuit having the comparator **670** and the switches **664***a* and **664***b*, the voltage-controlled amplifier **665** and so on in FIG. **66** as described above.

As described above, by using this apparatus, it becomes possible to generate a signal that has a variety of kinds of structures and does not exist in the nature while having the feature of the autocorrelation order capable of introducing the fundamental brain activation effect for a free time duration.

FIG. **69** is a block diagram showing a modified preferred embodiment of the vibration signal generating apparatus of FIG. **68**. FIG. **69** shows an example of an apparatus that generates a vibration (hypersonic sound) that can introduce the fundamental brain activation effect by enhancing or imparting the first property or the second property on the autocorrelation order and adding an output signal to an original vibration signal. In this case, the original vibration signal that cannot introduce the fundamental brain activation effect because it contains no super-high-frequency component is inputted to a band expanding circuit **653** and has its band expanded by using the existent band expanding means, and its output signal is inputted to the active processing circuit **675**. On the other hand, an autocorrelation coefficient set generated by a method similar to that of FIG. **68** is inputted to the active processing circuit **675**, a convolution calculation is performed between both of them, and the calculation result is outputted as a signal. The outputted signal is a vibration signal, that has the property of the autocorrelation order similar to that of a reference vibration and can introduce the fundamental brain activation effect. The outputted signal has its audible range removed by a high-pass filter **678**, and thereafter added to the original vibration signal that cannot introduce the fundamental brain activation effect because it contains no super-high-frequency component in an adder **679**. A signal of the addition result is outputted, subjected to DA conversion by a reproducing circuit **677** and outputted. The outputted vibration is a vibration (hypersonic sound) that can introduce the fundamental brain activation effect. In the addition stage, it is acceptable to adjust the timing of the two vibration signals added together by using a delay circuit, adjust the delay of time necessary for band expanding and convolution calculation or take other measures.

By using this apparatus, it becomes possible to generate a vibration (hypersonic sound signal) that can introduce the fundamental brain activation effect from the vibration signals that cannot introduce the fundamental brain activation effect, such as vibration signals recorded in the digital formats capable of recording super-high-frequency components in the storage media of the conventional CDs, MDs, memories, hard disks, media players by network transmission, portable telephones, DVD videos, DVD audios, Blu-ray Discs, and PC data files, and signals in the digital formats capable of recording super-high-frequency components transmitted and distributed by the current terrestrial digital broadcastings, BS digital broadcastings, communications of Internet and telephone lines. Moreover, even in the case of vibration signals recorded in the formats capable of recording super-high-frequency components in the storage media as described above or even in the case of vibration signals obtained by transducing the vibrations of a solid, a liquid, a gas or the like into electrical variations by using an apparatus capable of transducing and transmitting super-high-frequency components, when the vibration does not introduce the fundamental brain activation effect, it becomes possible to generate a vibration (hypersonic sound) that can introduce the fundamental brain activation effect from the vibration signal by this apparatus. By thus generating the vibration (hypersonic sound) that contains the super-high-frequency components having the predetermined autocorrelation order, the effects of inducing activation of the fundamental brain and the fundamental brain network (fundamental brain network system) including the reward system neural circuit responsible for the generation of reactions of pleasure, beauty and emotion, and the nerve center of the autonomic neural circuit, the endocrine system and the immune system responsible for the homeostatic maintenance and biophylaxis of the whole body in a human being, consequently enhancing the aesthetic sensibility and ameliorating and improving the physical state are obtained.

FIG. **70** is a block diagram showing an example of an apparatus that generates a vibration (hypersonic sound) that can introduce the fundamental brain activation effect by processing the 1-bit quantization noise owned by the high-speed sampling 1-bit quantization system according to the second preferred embodiment. FIG. **70** is a modified preferred embodiment of the apparatus of FIG. **68** and generates a vibration signal (hypersonic sound signal) that can introduce the fundamental brain activation effect by imparting the first property or the second property on the autocorrelation order to the 1-bit quantization noise owned by a vibration signal that is digitalized by the high-speed sampling 1-bit quantization system and recorded in the existent SACD (Super Audio CD), a hard disk, a solid memory or the like.

Referring to FIG. **70**, an SACD **695** is inserted into the drive of an SACD player **696**, and its output signal is outputted to an adder **679** via a low-pass filter **697** having a cutoff frequency of, for example, 20 kHz and outputted to an adder **679** via a high-pass filter **698** having a cutoff frequency of, for example, 30 kHz, an active processing circuit **675** and a high-pass filter **699** having a cutoff frequency of, for example, 20 kHz. The adder **679** adds together the inputted two digital signals, and outputs a digital signal of the addition result to a reproducing circuit **677**. Then, the reproducing circuit **677** subjects the inputted digital signal to DA conversion, and outputs the resulting signal. It is noted that an AD converter **674** and an autocorrelation coefficient calculator **676** for processing a reference vibration signal are connected to the active processing circuit **675** in a manner similar to that of the apparatuses of FIGS. **68** and **69**.

When a digital signal recorded by using the high-speed sampling 1-bit quantization system is reproduced, the 1-bit quantization noise theoretically accompanies with a definite dispersion about a specific frequency depending on the sampling frequency and the ΔΣ calculation order. The noise is generated in a frequency domain at and around 50 kHz in the current SACD contents or the like adopting a sampling frequency of 2.8 Mbps and, in addition, it does not introduce the fundamental brain activation effect because it has no appropriate autocorrelation order. Accordingly, currently in order to remove the noise, a low-pass filter is provided in the SACD player to remove the super-high-frequency components of not lower than about 50 kHz.

In the present implemental example, the 1-bit quantization noise is utilized as a super-high-frequency signal material. A 1-bit quantization noise extracted by a high-pass filter **698** without intervention of the low-pass filter described in the preceding paragraph from an analog signal obtained by converting the digital signal recorded in the SACD **695** is inputted to the active processing circuit **675**, while the autocorrelation coefficient set obtained from the reference vibration signal is inputted to the active processing circuit **675** to perform a high-speed convolution calculation between both of them, and a signal of the calculation result is outputted. By adding this signal to the reproduction signal of the SACD contents that does not introduce the fundamental brain activation effect or audible range components obtained by filtering it by the low-pass filter **697**, it becomes possible to generate a vibration signal (hypersonic sound signal) that can introduce the fundamental brain activation effect. By using this apparatus, a vibration (hypersonic sound) that can introduce the fundamental brain activation effect can be reproduced when the contents recorded by the high-speed sampling 1-bit quantization system inclusive of the conventional SACD contents are reproduced. By thus generating the vibration (hypersonic sound) that can introduce the fundamental brain activation effect because it contains super-high-frequency components having the predetermined autocorrelation order contained, the effects of inducing activation of the fundamental brain network system including the reward system neural circuit responsible for the generation of reactions of pleasure, beauty and emotion, and the nerve center of the autonomic neural circuit, the endocrine system and the immune system responsible for the homeostatic maintenance and biophylaxis of the whole body in a human being, enhancing the aesthetic sensibility and ameliorating and improving the physical state are obtained. In the addition stage, it is acceptable to adjust the timing of the two vibration signals added together by using a delay circuit, adjust the delay of time necessary for the convolution calculation or take similar measures. Although the reproduction signal from the SACD **695** is shown as the object in the figure, this may be a media reproduction signal of a hard disk, a solid memory or the like or a signal that is transmitted and distributed by a network or the like.

FIG. **71** is a block diagram showing a vibration signal generating apparatus that generates a vibration signal (hypersonic sound signal) that introduces the fundamental brain activation effect by analyzing the feature of the autocorrelation order owned by the reference vibration that can introduce the fundamental brain activation effect by using autocorrelation coefficients, generating a vibration signal having the predetermined autocorrelation order by processing the signal of a vibration (e.g., a white noise) that does not introduce the fundamental brain activation effect, because it satisfies neither the first property nor the second property on the autocorrelation order while containing the super-high-frequency components exceeding the human audible range upper limit based on the result, and by adding the super-high-frequency components to the original vibration signal that does not introduce the fundamental brain activation effect for complementing. By using the transfer function, it becomes possible to perform processing in the frequency domain, and provide a function to perform automatic equalizing in accordance with the changes in the reference vibration. By thus generating the vibration (hypersonic sound) that can introduce the fundamental brain activation because it contains super-high-frequency components having the predetermined autocorrelation order, the effects of inducing activation of the fundamental brain network (fundamental brain network system) including the reward system neural circuit responsible for the generation of reactions of pleasure, beauty and emotion, and the nerve center of the autonomic neural circuit, the endocrine system and the immune system responsible for the homeostatic maintenance and biophylaxis of the whole body in a human being, enhancing the aesthetic sensibility and ameliorating and improving the physical state are obtained.

The operation of the apparatus of FIG. **71** is described below.

Referring to FIG. **71**, a transfer function is first calculated from a reference vibration signal having certain time duration. The concrete calculation procedure is as follows.

(1) A reference vibration signal (standard vibration signal) is first inputted to an AD converter **674**, and sampled by a sampling frequency $2f_N$ (f_N is the Nyquist frequency) by a quantization bit count of not less than 12 bits. In this case, f_N needs to sufficiently exceed 20 kHz at the audible frequency range upper limit (e.g., f_N=96 kHz). When the reference vibration signal is a digital signal, the AD converter **674** may be eliminated.

(2) A signal having a total duration of T seconds outputted from the AD converter **674** is inputted to a transfer function calculator **676*a*** and divided into "n" unit analysis intervals of duration of T_E seconds (e.g., T=60 seconds, T_E=0.1 seconds, n=600).

(3) A system that outputs a reference signal when a white noise is inputted every divided unit analysis interval is assumed, and its transfer function is assumed to be H(jω) (j is imaginary unit, ω is angular frequency, ω=2πf, provided that f is frequency). Assuming that a function obtained by subjecting time series data of the white noise to Laplace transform and expressing it by a frequency domain is W(jω) and a function obtained by subjecting time series data of the reference signal to Laplace transform and expressing it by a frequency domain is X(jω), then the following equation of multiplication can be simply given:

$$X(j\omega)=H(j\omega)\cdot W(j\omega).$$

(4) The transfer function $H(j\omega)$ is expressed by the following equation by using coefficients $\{a_1, a_2, \ldots, a_m\}$, $\{b_1, b_2, \ldots, b_l\}$:

$$H(j\omega) = \frac{a_m(j\omega)^m + a_{m-1}(j\omega)^{m-1} + \ldots + a_1 j\omega + a_0}{b_l(j\omega)^l + b_{n-1}(j\omega)^{l-1} + \ldots + b_1 j\omega + b_0}$$

(5) The transfer function is calculated for all of the "n" unit analysis intervals in the divided unit analysis interval "i" (i=1, 2, . . . , n) to form a transfer function matrix A. In the transfer function matrix A, the i-th row is a row vector constituted of the coefficients $\{a_{i1}, a_{i2}, \ldots, a_{im}, b_{i1}, b_{i2}, \ldots, b_{il}\}$ of the transfer function in the interval "i". The number of rows of the matrix A becomes the number of intervals (n rows), and the number of columns of the matrix A becomes a sum ((m+l) columns) of the dimensions of the coefficients of the transfer function.

On the other hand, the signal of a vibration (e.g., white noise) that does not introduce the fundamental brain activation effect is first inputted to the AD converter **673** and sampled by the same sampling frequency $2f_N$ (f_N is the Nyquist frequency) as that of the reference signal. When the reference vibration signal is a digital signal, the AD converter **673** may be eliminated. However, when the sampling frequency is different from $2f_N$, resampling is performed by the sampling frequency $2f_N$. The vibration signal that does not introduce the fundamental brain activation effect and is outputted from the AD converter is subsequently inputted to a frequency converter **673***a*, and a signal $Y(j\omega)$ obtained by Fast Fourier Transform (FFT) from the time domain to the frequency domain is generated.

The transfer function matrix A outputted from the transfer function calculator **673***a* and the vibration signal $Y(j\omega)$ that does not introduce the fundamental brain activation effect and is converted into the frequency domain are both inputted to the active processing circuit **675**A.

The active processing circuit **675**A is constituted of a multiplier **675***c* and a transfer function controller **675***d*. The operation of the transfer function controller **675***d* is described in detail in the following clause. A transfer function $H(j\omega)$ is inputted from the transfer function calculator **676***a* to the multiplier **675***c* via the transfer function controller **675***d*. Multiplication is performed between the inputted transfer function $H(j\omega)$ and the vibration signals $Y(j\omega)$ that do not introduce the fundamental brain activation effect and is converted into the frequency domain, and a signal $Z(j\omega)$ of the following equation is generated:

$$Z(j\omega)=H(j\omega)\cdot Y(j\omega).$$

Subsequently, the signal $Z(j\omega)$ is converted into a time series signal, and a signal having a property on the autocorrelation order is generated.

When the time duration of the vibration signal that does not introduce the fundamental brain activation effect is longer than the time duration of the reference vibration signal, the number of transfer functions for performing the multiplication becomes insufficient. Accordingly, the transfer function controller **675***d* has a function to continuously send out the transfer functions by iterating or generating so that the multiplication can be continued how long the time duration of the vibration signal that does not introduce the fundamental brain activation effect is. With this function, it becomes possible to generate the vibration signal having the property on the autocorrelation order for an arbitrary time duration, even when the time duration of the reference vibration signal is short. In concrete, it is performed according to the procedure described below.

(1) The transfer function matrix A calculated in the transfer function calculator **676***a* is inputted to the transfer function controller **675***d*. In the transfer function controller **675***d*, the transfer function coefficients are sequentially read from the first row of the transfer function matrix A, and the transfer function is inputted to the multiplier **675***c*.

(2) when the inputting of the vibration signal that does not introduce the fundamental brain activation effect is still continued at the time point of read of the transfer function coefficients of the last row (n-th row) of the transfer function matrix A, either one of the following operations is carried out.

(2-1) Simple iteration: The transfer function controller **675***d* returns to the first row of the transfer function matrix A, reads once again the transfer function coefficients of the first row and sequentially inputs the transfer function to the multiplier **675***c*. When the inputting of the vibration signal that does not introduce the fundamental brain activation effect is still continued at the time point of the last row (n-th row) of the transfer function matrix A, the same operation is performed once again. The iteration is thus continued until the vibration signal that does not introduce the fundamental brain activation effect ends.

(2-2) Matrix in which the rows are replaced in a random order: The transfer function controller **675***d* generates a matrix B in which the rows of the first row to the n-th row of the matrix A are replaced in a random order. The transfer function coefficients are read from the first row of the generated matrix B, and the transfer functions are sequentially inputted to the multiplier **675***c*. When the vibration signal that does not introduce the fundamental brain activation effect is still continued at the time point of the last row (n-th row) of the transfer function matrix B, the rows of the first row to the n-th row of the matrix A are replaced once again in a random order to generate another matrix B'. The transfer function coefficients are sequentially read from the first row of the generated matrix B', and the transfer function is inputted to the multiplier **675***c*. Similar operation is thus continued until the inputting of the vibration signal that does not introduce the fundamental brain activation effect ends. Although the example in which the rows are replaced in a random order in described according to the above-mentioned procedure example, it is acceptable to achieve the replacement in conformity to a certain rule by, for example, reversing the order of the rows, replacing the odd-number rows to the first half and replacing the even-number rows to the latter half.

Although the example in which the single reference vibration signal is inputted is described according to the above-mentioned procedure example, it is also acceptable to read the transfer function coefficients from an arrangement such that a plurality of transfer function matrixes generated by inputting a plurality of reference vibration signals are arranged in an arbitrary order.

By adding the vibration signal that has the property on the autocorrelation order and can introduce the fundamental brain activation effect generated by this apparatus to the original vibration signal that does not introduce the fundamental brain activation effect, it becomes possible to generate a vibration signal that can introduce the fundamental brain activation effect. In the case where the output signal of this apparatus is added to the original vibration, it is acceptable to use together one or a plurality of circuits of the high-pass filter **663**, the gate circuit having the comparator **670** and the switches **664***a* and **664***b*, the voltage-controlled amplifier **665** and so on in FIG. **66**.

As described above, it becomes possible to generate a signal having a variety of kinds of structures that do not naturally exist while having the feature of the autocorrelation order that can introduce the fundamental brain activation effect for a free time duration.

Next, an implemental example corresponding to a vibration generating apparatus that performs enhancement and impartation of effective vibration components and attenuation and removal of unnecessary vibration components by using an elastic vibrating object is described below.

FIG. **72** is a block diagram showing a vibration generating apparatus (apparatus example using a moving magnet type fluctuation detector device) that can introduce the fundamental brain activation effect using an elastic vibrating object according to the second preferred embodiment. Referring to FIG. **72**, by applying a vibration that contains super-high-frequency components exceeding the human audible range upper limit and has at least either one of the first property and the second property on the predetermined autocorrelation order, a vibration that does not contain super-high-frequency components themselves or a variation that contains neither the first property nor the second property on the predetermined autocorrelation order although it has super-high-frequency components to an elastic vibrating object of metal or the like, it is possible to enhance the super-high-frequency components owned by the vibration and enhance the predetermined property on the autocorrelation order by utilizing the physical characteristics of elasticity, natural vibration, stress strain and so on or to impart the super-high-frequency components that are not owned by the vibration and impart the predetermined property on the autocorrelation order. Furthermore, the vibration not having the aforementioned properties of the vibrations can be attenuated or removed. By thus generating the vibration (hypersonic sound) that can introduce the fundamental brain activation because it contains super-high-frequency components having the predetermined autocorrelation order, the effects of inducing activation of the fundamental brain and the fundamental brain network (fundamental brain network system) including the reward system neural circuit responsible for the generation of reactions of pleasure, beauty and emotion, and the nerve center of the autonomic neural circuit, the endocrine system and the immune system responsible for the homeostatic maintenance and biophylaxis of the whole body in a human being, consequently enhancing the aesthetic sensibility and ameliorating and improving the physical state are obtained.

Referring to FIG. **72**, an electric signal of a vibration that can introduce the fundamental brain activation effect or a vibration that does not satisfy it is transduced into an elastic vibration by an actuator **701**, and a vibration propagated to the other end of an elastic vibrating object **702** is retransduced into an electric signal by a moving magnet type fluctuation detector device **703**. In the propagation process on this elastic vibrating object **702**, the super-high-frequency components exceeding the human audible range upper limit and the first property or the second property on the autocorrelation order are enhanced or imparted by the physical vibration characteristics of elasticity, natural vibration, stress and strain and so on owned by the elastic vibrating object **702** and the vibration characteristics of a peripheral vibration transmission medium **706** or their interactions. Moreover, a vibration (e.g., rectangular wave) having a structure that can exist as a vibration signal in an electric signal but hardly or impossibly exists in the elastic vibration is transduced into a vibration that is attenuated while propagating through the elastic vibrating object or able to introduce the fundamental brain activation effect.

The kind of the actuator **701** can be provided by a dynamic coil type that drives a coil by an electromagnetic force generated in accordance with an inputted current, a piezoelectric device type that deforms in accordance with an inputted voltage, a supermagnetostrictive device type of which the size changes in accordance with an inputted current, or the like. Moreover, it is possible to use a variety of kinds of metals, alloys, resins, ceramics, glass, rocks, woods, bamboo, secretions from living things such as ivory, tortoiseshell, animal's bone and corals, hunks of meats, bodies of animals and plants and so on for the material of the elastic vibrating object **702**. The elastic vibrating object **702** is peripherally filled with a vibration transmission medium (oil, aqueous solution, organic solvent, etc.) **706**. Moreover, the shape of the vibration transmission medium filled container **700** for the filling of the vibration transmission medium **706** may be any one of shapes of high symmetric properties such as rectangular parallelepiped and oval or shapes of high asymmetric properties. In the implemental example of FIG. **72**, the moving magnet type fluctuation detector device **703** that generates an electric signal in accordance with the displacement acceleration of the magnet is used as a functional device for detecting a vibration from the elastic vibrating object **702** and transducing it into an electric signal. In this case, the moving magnet type fluctuation detector device **703** is configured of a coil **705** wound around the outer periphery of a moving magnet **704**, and an output electric signal is obtained from both ends of the coil **705**.

In the present implemental example, by transducing the electric signal of a vibration that can introduce the fundamental brain activation effect or cannot introduce it into an elastic vibration by an actuator **701**, applying it to the elastic vibrating object **702**, and processing the applied vibration by using the vibration characteristic owned by the applied elastic vibrating object **702**, the super-high-frequency components exceeding the human audible range upper limit and at least either one of the first property and the second property on the autocorrelation order in the signal are enhanced or imparted, and by attenuating or removing the vibration components that cannot exist in the natural elastic vibrating object although it can exist as an electric signal and do not introduce the fundamental brain activation effect or transducing it into a vibration that can introduce the fundamental brain activation effect, the effect of the vibration that can introduce the fundamental brain activation effect can be enhanced. The signal (hypersonic sound signal) of the vibration that contain the super-high-frequency components having the predetermined autocorrelation order and can introduce the fundamental brain activation effect generated as described above may be used as a complementing vibration signal in the vibration complementing apparatus according to the second preferred embodiment described in detail hereinabove with reference to FIGS. **59** to **67**. That is, by using the generated vibration signal itself or extracting the super-high-frequency components from it and adding it to the original vibration signal that does not introduce the fundamental brain activation effect for the achievement of complementing, a vibration signal (hypersonic sound signal) that introduces the fundamental brain activation effect can be generated.

Although the elastic vibrating object **702** is supported so as to be positioned in the vibration transmission medium **706** inside the medium filled container **700** in the above-mentioned implemental example, the present invention is not limited to this, and the elastic vibrating object **702** may be vibrated in a free space without the vibration transmission medium **706**.

FIG. **73** is a block diagram showing a vibration generating apparatus (apparatus example using a capacitor type fluctuation detector device **710**) that can introduce the fundamental brain activation effect using an elastic vibrating object according to the second preferred embodiment. FIG. **73** shows a capacitor type fluctuation detector device **710** that generates an electric signal by a change in an electrostatic capacity in accordance with the displacement of a movable electrode. The capacitor type fluctuation detector device **710** is constituted by interposing a movable electrode **711** connected to one end of the elastic vibrating object **702** between one pair of stationary electrodes **712** and **713** to which a predetermined bias voltage is applied by a predetermined bias voltage source **714** and obtains an output electric signal from the movable electrode **711** and one stationary electrode **713**.

Besides this, it is acceptable to use the systems of a moving coil type that generates an electric signal in accordance with the displacement acceleration of a coil, a piezoelectric device type that generates a voltage change in accordance with a change in an applied pressure, a supermagnetostrictive device type that generates an electric signal in accordance with a change in size, a laser Doppler type that transduces a positional displacement into an electric signal in a noncontact manner by utilizing optical reflection or the like. The thus generated vibration signal (hypersonic sound signal) that can introduce the fundamental brain activation effect or the super-high-frequency components extracted from it may be used as a complementing vibration signal in the vibration complementing apparatus described in detail hereinabove.

FIG. **74** is a block diagram showing a vibration generating apparatus that can introduce the fundamental brain activation effect using a spiral spring elastic vibrating object according to the second preferred embodiment. Although the elastic vibrating object **702** has the plate-like shape in FIGS. **72** to **73**, an elastic vibrating object **720** having a spiral spring shape is used in FIG. **74**. With this arrangement, by indirectly transmitting the vibration in a portion of the elastic vibrating object **720** to other portions via the infilling vibration transmission medium **706**, the super-high-frequency components exceeding the human audible range upper limit and the property of their autocorrelation order are enhanced or imparted, and the vibration not having the property of the vibrations can be expected to be attenuated or removed. An actuator **701** is connected to one end of the elastic vibrating object **720**, while a fluctuation detector device **710** is connected to other end. Then, an output signal is obtained from the coil-shaped other end of the elastic vibrating object **720**. In this case, the shape of the elastic vibrating object **720** may be a coil-like shape of a spiral spring wound more densely, a wave-like shape or the like. These elastic vibrating bodies having the spiral spring shape, coil shape or wave shape may simply have the shapes unchanged or allowed to have their one end or both ends connected to a lever-like shape. In this case, the lever-shaped structure also functions as an elastic vibrating object and contributes to the generation of a vibration (hypersonic sound) that can introduce the fundamental brain activation effect. The thus generated vibration signal (hypersonic sound signal) that can introduce the fundamental brain activation effect or the super-high-frequency components extracted from it may be used as a complementing vibration signal in the vibration complementing apparatus described in detail hereinabove.

FIG. **75** is a block diagram showing a vibration (hypersonic sound) generating apparatus (apparatus example in which an elastic vibrating object is served as a fluctuation detecting coil) that can introduce the fundamental brain activation effect using an elastic vibrating object according to the second preferred embodiment. FIG. **75** is a modified preferred embodiment in which the elastic vibrating object itself of FIG. **72** is made to function as a coil for vibration signal detection. Referring to FIG. **75**, a fluctuation detecting coil **730** with an elastic vibrating object is constituted by winding an elastic vibrating object using a conductor, and this is interposed between one pair of permanent magnets **731** and **732**, constituting a movement generating structure similar to the fluctuation detector device. With this arrangement, it becomes possible to transduce the entire vibration of a propagation to the other end of a vibration given to one end of the fluctuation detecting coil **730** with an elastic vibrating object from the actuator **701** into an electric signal. Moreover, since the fluctuation detecting coil **730** with an elastic vibrating object has a coil-like shape, it is herein actualized that the super-high-frequency components exceeding the human audible range upper limit and the property of their autocorrelation order due to the interactions of vibrations by way of the vibration transmission medium **706** shown in FIG. **72** are enhanced or imparted, and the vibration not having the properties of the vibrations are attenuated or removed or transduced into a vibration that can introduce the fundamental brain activation effect. The conductor wound around the coil may be provided by one having a planar shape besides the linear one. The fluctuation detecting coil with an elastic vibrating object may simply have the shapes unchanged or allowed to have their one end or both ends connected to a lever-like shape. In this case, the lever-shaped structure also functions as an elastic vibrating object and contributes to the generation of a vibration (hypersonic sound) that can introduce the fundamental brain activation effect. The thus generated vibration signal (hypersonic sound signal) that can introduce the fundamental brain activation effect or the super-high-frequency components extracted from it may be used as a complementing vibration signal in the vibration complementing apparatus described in detail hereinabove.

FIG. **76** is a block diagram showing a vibration generating apparatus (apparatus example in which an elastic vibrating object is made to function as a fluctuation detecting coil) that can introduce the fundamental brain activation effect using an elastic vibrating object according to the second preferred embodiment. FIG. **76** is a modified preferred embodiment of a positional relation between the fluctuation detecting coil **730** with an elastic vibrating object and a stationary magnet. Referring to FIG. **76**, the fluctuation detecting coil **730** with an elastic vibrating object is constituted by being wound around an N-pole magnet **731** and interposing them between one pair of S-pole magnets **732** and **732**. Then, an output signal is obtained from both ends of the fluctuation detecting coil **730**. The shape of the fluctuation detecting coil **730** and the positional relation among the stationary magnets **731**, **732** and **732** may be other than the illustrated example. The fluctuation detecting coil with an elastic vibrating object may simply have the shape unchanged or allowed to have their one end or both ends connected to a lever-like shape. In this case, the lever-shaped structure also functions as an elastic vibrating object and contributes to the generation of a vibration (hypersonic sound) that can introduce the fundamental brain activation effect. The thus generated vibration signal (hypersonic sound signal) that can introduce the fundamental brain activation effect or the super-high-frequency components extracted from it may be used as a complementing vibration signal in the vibration complementing apparatus described in detail hereinabove.

FIG. **77** is a block diagram showing a vibration generating apparatus (apparatus example in which a plurality of vibration generating apparatuses are concurrently used by using an elastic vibrating object) that can introduce the fundamental brain activation effect using an elastic vibrating object according to the second preferred embodiment. FIG. **77** is an example in which a vibration generating apparatus that can introduce the fundamental brain activation effect and is shown in FIGS. **72** to **76** is used concurrently in a plurality of channels. Referring to FIG. **77**, there is a configuration of a plurality of actuators **701**, a plurality of elastic vibrating bodies **750** and a plurality of fluctuation detector devices **751**, which are connected correspondingly. In this case, elastic vibrations are allowed to be transmitted mutually by filling spaces between the elastic vibration bodies **750** with a vibration transmission medium (oil, aqueous solution, organic solvent, etc.) **706**, and this makes it possible to induce cross modulation due to the interactions among the individual channels to enhance or impart the super-high-frequency components exceeding the audible range upper limit and the property on the predetermined autocorrelation order, and to attenuate or remove the vibration not having the property of the vibrations. For example, a plurality of output signals may be added together by an adder. Although only the example of FIG. **72** has the multiple use arrangement for simplicity in the figures, it is acceptable to use another example or mix them together. The thus generated vibration signal (hypersonic sound signal) that can introduce the fundamental brain activation effect or the super-high-frequency components extracted from it may be used as a complementing vibration signal in the vibration complementing apparatus described in detail hereinabove.

Next, an implemental example corresponding to a vibration signal that is recorded in a recording medium and a vibration signal that is transmitted and distributed by telecommunications is described below.

An example of "Blu-ray Disc version AKIRA soundtrack" (composed by Shoji Yamashiro) is described as an example of a vibration signal obtained by recording a vibration signal (hypersonic sound signal) that can introduce the fundamental brain activation effect synthesized by using a vibration signal generating apparatus including a vibration complementing apparatus into a Blu-ray Disc. Moreover, experimental results indicating that the fundamental brain activation effect is introduced by electroencephalographic recording are described.

The synthetic vibration signal used for the experiment is the "Blu-ray Disc version AKIRA soundtrack" (composed by Shoji Yamashiro). The past AKIRA soundtrack of a DVD or the like can neither record nor reproduce the band components of not lower than 24 kHz because the vibration signal has been recorded by a digital format of a sampling frequency of 48 kHz and a quantization bit count of 16 bits, and therefore, it cannot introduce the fundamental brain activation effect by recording and reproducing a hypersonic sound. Accordingly, the vibration signal of the "Blu-ray Disc version AKIRA soundtrack" was formed by using the signal of the "DVD version AKIRA soundtrack" as an original vibration, expanding the band of the signal, synthesizing an output signal by adding the super-high-frequency components of the tropical rain forest environmental sound that could typically introduce the fundamental brain activation effect and the like by using a vibration signal generating apparatus including the vibration complementing apparatus shown in FIG. **66** and recording it in a Blu-ray Disc in the digital format of a sampling frequency of 192 kHz and a quantization bit count of 24 bits.

FIG. **78** is a spectral diagram showing a power spectrum of the vibration signal recorded in the soundtracks of the "DVD version AKIRA" and the "Blu-ray Disc version AKIRA" measured in the second preferred embodiment. Referring to FIG. **78**, the average FFT power spectrums of the vibration signals of an identical part of the "DVD version AKIRA soundtrack" of the original vibration signal and the "Blu-ray Disc version AKIRA soundtrack" synthesized by the vibration signal generating apparatus including the vibration complementing apparatus are compared with each other. As is apparent from FIG. **78**, the synthesized vibration signal of the "Blu-ray Disc version AKIRA soundtrack" contained abundant super-high-frequency components exceeding 90 kHz and sufficiently had the super-high-frequency components of the essential components capable of introducing the fundamental brain activation effect.

FIG. **79** is a graph showing a local exponent of fractal dimension of the vibration signal of the "Blu-ray Disc version AKIRA soundtrack" measured in the second preferred embodiment. FIG. **79** shows the result of examining the first property on the autocorrelation order of the "Blu-ray Disc version AKIRA soundtrack" synthesized by the aforementioned method. As is apparent from FIG. **79**, the "local exponent of fractal dimension" of the vibration signal of the "Blu-ray Disc version AKIRA soundtrack" is consistently not smaller than 2.2 when the spectro-temporal index is between 2^{-1} and 2^{-5}, and its fluctuation range has a value within 0.4. For the above-mentioned reasons, the vibration signal of the "Blu-ray Disc version AKIRA soundtrack" satisfies the first property on the autocorrelation order.

FIG. **80** is a graph showing an information entropy density of the vibration signal of the "Blu-ray Disc version AKIRA soundtrack" measured in the second preferred embodiment, and FIG. **81** is a graph showing an entropy variation index (EV-index) of the vibration signal of the "Blu-ray Disc version AKIRA soundtrack" measured in the second preferred embodiment. As is apparent from FIG. **80**, the information entropy density of this vibration signal consistently has a value of not smaller than −5 and smaller than zero. As is apparent from FIG. **81**, the entropy variation index (EV-index) of this vibration signal has a value of not smaller than 0.001. For the above-mentioned reasons, the vibration signal of the "Blu-ray Disc version AKIRA soundtrack" satisfies the second property on the autocorrelation order.

FIG. **82** is a graph showing a deep brain activity index (DBA-index) recorded from a listener under a high-cut sound condition and a full-range sound condition generated by using the "Blu-ray Disc version AKIRA soundtrack" measured in the second preferred embodiment. The present inventor and others recorded the brain wave during listening in order to examine whether the vibration generated by using the "Blu-ray Disc version AKIRA soundtrack" introduced the fundamental brain activation effect. The DBA-indexes were calculated and compared between the listening condition of the full-range sound obtained by reproducing the vibration signal of the "Blu-ray Disc version AKIRA soundtrack" unchanged in the state in which the super-high-frequency components were contained and the listening condition of the high-cut sound having a feature similar to that of the "DVD version AKIRA soundtrack" obtained by removing the frequency components of not lower than 24 kHz from it. FIG. **82** shows the results. In the measurement, the DBA-index was obtained from each of ten test human subjects under both the conditions, and a statistical examination was performed based on those data. It was clarified that the DBA-index indicated a statistically significantly high value and the fundamental brain was activated in the full-range sound condition in comparison with the high-cut sound condition.

FIG. **83** is a graph and a table showing an impression evaluation of sounds by the listeners on the high-cut sound condition and the full-range sound condition generated by using the "Blu-ray Disc version AKIRA soundtrack" measured in the second preferred embodiment. Fourteen evaluation words expressing the impression of the sound were shown on the questionnaire used for answers, and they were made to perform evaluations by five-rank evaluation. The answers of nine test human subjects in total were analyzed.

The left chart of FIG. **83** is one in which a difference is obtained by subtracting the impression grade of sound in the high-cut sound condition from the impression grade of the sound in the full-range sound condition regarding each test human subject, and averages are obtained regarding all the test human subjects and plotted. This numerical value indicated that the sound in the full-range sound condition was more positively evaluated as it was greater and defined as "favorability rating". The right chart of FIG. **83** shows the results of examination by the signed rank test of Wilcoxon (Wilcoxon) as to whether a significance exists in the bias of the "favorability rating".

As a result, the favorability of the sound impression was higher in the full-range sound condition than in the high-cut sound condition concerning all the evaluation words. In particular, the evaluation words of the six items: "impressed by sound", "sound quality is good", "sound volume is more plentiful", "deep bass is rich", "sound reverberates sweetly" and "sound separation is good and not collapsed even at full blast" are evaluated statistical significantly positively with $p<0.05$ (mark ** in the right figure of FIG. **83**). Moreover, with regard to the evaluation words of the two items: "sound is smooth" and "loudspeaker sounds are heard to be interlinked", are positively evaluated with a high tendency of $p<0.10$ (mark * in the right figure of FIG. **83**). This indicated that the full-range sound induced the activation of the fundamental brain and the fundamental brain network (fundamental brain network system) including the reward system neural circuit of the brain responsible for the generation of reactions of pleasure, beauty and emotion in a human being, consequently enhancing the aesthetic sensibility to sounds and further intensifying the impressions of pleasure, beauty and so on.

In using the vibration generating apparatuses as described above in various facilities, it is acceptable to control on/off and the level of the hypersonic sound signal in accordance with the existence and the number of people. That is, for example, when even a person enters a room, the event is automatically sensed by a sensor of infrared rays or the like to turn on the vibration signal or turn off the vibration signal when all of them leave the room. Otherwise, a method for turning on/off also the vibration signal in accordance with turning on/off the illumination interlockedly with the illumination power can be considered. Moreover, a method for interlocking it with a room entering/leaving control system of a card key or the like is possible. Further, a system for automatically counting the number of people who have entered a room and increasing or decreasing the level of the hypersonic sound signal in accordance with an increase and decrease in the number of people can be considered.

Moreover, by applying the vibration generating apparatus of the second preferred embodiment, the original vibration signal that does not introduce the fundamental brain activation effect and accompanies an unpleasant sensation because it contains no super-high-frequency component or has neither the first property nor the second property on the autocorrelation order while containing the super-high-frequency components is complemented with the vibration (hypersonic sound) that can introduce the fundamental brain activation effect, by which the effects of suppressing the deterioration in the fundamental brain activity and alleviating the unpleasant sensation can be developed.

In this case, it is acceptable to use an apparatus that absorbs and removes the vibration accompanied by unpleasant sensation in combination with the vibration complementing apparatus. For example, by combining it with a vibration absorbing apparatus that selectively absorbs the vibration in the audible range, a vibration removing apparatus that uses the existent active servo technology or the like, the unpleasant sensation can be effectively alleviated.

Moreover, in this case, it is acceptable to use the circuit of a vibration detector apparatus and a gate apparatus and (or) a voltage-controlled amplifier (VCA) together with the vibration complementing apparatus. This makes it possible to complement an unpleasant sound existing in an environment with a vibration (hypersonic sound) that can introduce the fundamental brain activation effect adjusted to an appropriate level in accordance with the state of existence and the level of the sound.

For example, by installing in a station a vibration complementing apparatus for a vibration accompanied by unpleasant sensation such as arrival sounds and departure sounds of trains in the station, premises announcement sounds, vending machine manipulation sounds and the like and adding a vibration (hypersonic sound) that contains super-high-frequency components having the predetermined autocorrelation order and can introduce the fundamental brain activation effect, the effects of suppressing the deterioration in the fundamental brain activity and alleviating the unpleasant sensation can be produced.

FIG. **89** is an external view showing an example of a vibration generating apparatus **962***a* mounted in a station yard according to a modified preferred embodiment of the second preferred embodiment. For example, by integrating the public-address system installed in a premises with a vibration complementing apparatus **961** for the recorded arrival and departure chimes and recorded announcement, a vibration (hypersonic sound) that can introduce the fundamental brain activation effect is generated for complementing, by which the effects of suppressing the deterioration in the fundamental brain activity and alleviating the unpleasant sensation can be developed.

Moreover, by using a detection generating apparatus **962** with a built-in premises sound detector apparatus **962***b* and a gate circuit or a voltage-controlled amplifier (VCA) for, for example, vibrations that do not introduce the fundamental brain activation effect and are generated on site and have impetuous sound volume variation, such as arrival sounds and departure sounds of trains, announcement voiced by station attendants, vending machine manipulation sounds and other environmental noises, the vibrations can be effectively complemented. The gate circuit has the operation of producing the effect of complementing with the vibration that can introduce the fundamental brain activation effect by opening the switch of the gate circuit when the vibration level detected by the premises sound detector apparatus **962***b* exceeds a definite value or not producing the effect of complementing by closing the switch of the gate circuit when the level does not exceed the definite value. The voltage-controlled amplifier (VCA) has the operation of producing the effect of complementing with the vibration that can introduce the fundamental brain activation effect at a level tightly correlated to the vibration level detected by the premises sound detector apparatus. As a result, by producing the effect of complementing with the vibration that can introduce the fundamental brain activation effect at a level appropriately adjusted to the state of the existence of vibrations in the premises, the effects of effectively suppressing the deterioration in the fundamental brain activity and alleviating the unpleasant sensation can be developed.

Besides these, by similarly installing a vibration complementing apparatus for vibrations accompanied by unpleasant sensation, such as automobile noises, motorbike noises, airplane noises, ocean vessel noises, mechanical noises in factories, traffic noises in cities, and configuration noises in configuration sites and adding a vibration that contains the super-high-frequency components having the predetermined autocorrelation order and can introduce the fundamental brain activation effect, the effects of suppressing the deterioration in the fundamental brain activity and alleviating the unpleasant sensation can be developed.

Besides these, by complementing stresses caused by presence in an unpleasant public space such as a packed train, a crowd home, a queue of a ticket machine, a theme park or the like, a people jam crush in an urban district or the like or irritative feelings that tend to occur in play facilities, racetracks and so on with a vibration (hypersonic sound) that can introduce the fundamental brain activation effect because it contains super-high-frequency components having the predetermined autocorrelation order in the space, the effects of suppressing the deterioration in the fundamental brain activity and alleviating the stresses can be developed. With this arrangement, it can be expected to alleviate the human irritative feelings and exert a pervasive effect for reducing violent behaviors and so on.

Moreover, by producing the effect of complementing with a vibration (hypersonic sound) that can introduce the fundamental brain activation effect because it contains super-high-frequency components having the predetermined autocorrelation order in operating rooms and treatment chambers in hospitals and clinics, nurse's offices and dispensaries in schools and companies, and the like, the effects of suppressing the deterioration in the fundamental brain activity of patients, visitors and the like in the room and alleviating the stresses caused by pains and sufferings can be expected.

Third Preferred Embodiment

In the third preferred embodiment according to the present invention, complex sensory information means for comprehensively working on a plurality of sensory systems is provided. The means is to solve such a problem that, as a result of the trade-off state in the information capacity usable between mutually different pieces of sensory information due to a tendency of the occurrence of restrictions in the capacity of recordable and transmittable information and the information transmission rate of various kinds of sensory information and consequent strain on the data saving of a part of sensory information, a possible deterioration in the expressive effect owned by the sensory information and double ruin due to an effort to make both of them effective are avoided. As a background of the means for solving this problem, the present inventor and others paid attention to the actual state in which the generation of reactions of pleasure, beauty, and emotion in a human being were unitarily comprehensively managed by the reward system neural circuit of the brain, the fact that the reward system neural circuit was included in the fundamental brain and the fundamental brain network and the activity was identified to the activity of the whole fundamental brain and the phenomenon that the fundamental brain and the fundamental brain network were activated by a hypersonic sound. By making examinations based on these, the present inventor and others discovered the phenomena that, when a hypersonic effect was introduced by making the sound information contained in the complex sensory information have an appropriate structure to activate the fundamental brain and the fundamental brain network (fundamental brain network system) including the reward system neural circuit of the brain unitarily comprehensively responsible for the generation of reactions of pleasure, beauty and emotion in a human being, the aesthetic sensibility to a variety of kinds of sensory information inputs other than the auditory sensation was also enhanced in parallel with an increase in the aesthetic sensibility to sounds, developing the effects of enhancing the reactions of pleasure, beauty and emotion, and obtained an idea to apply it.

The vibration generating apparatus and method according to the third preferred embodiment is characterized in that, by applying a hypersonic sound, i.e., a vibration containing audible range components and super-high-frequency components having the feature of the predetermined autocorrelation order while applying predetermined information to a person concerning at least one of visual sensation, gustatory sensation, somatic sensation and olfactory sensation other than the auditory sensation to the person, the fundamental brain and the fundamental brain network (fundamental brain network system) including the reward system neural circuit of the brain unitarily comprehensively responsible for the generation of reactions of pleasure, beauty and emotion in a human being are activated, thereby enhancing also the aesthetic sensibility to a variety of kinds of sensory information inputs other than the auditory sensation and improving the expressive effect of the sensory information other than the auditory sensation.

That is, in the third preferred embodiment, an example of an apparatus and method that enhances the aesthetic sensibility to the sensory inputs (meaning visual sensation, gustatory sensation, somatic sensation and olfactory sensation) other than the auditory sensation and can improve the expressive effect as the entire sensory system by complex sensory information generating means for comprehensively working on a plurality of sensory systems is described.

In recent years, regarding the contents that synthetically work on a plurality of sensory systems such as video and audio contents recorded in large-capacity package media that are recently rapidly popularized and videos and audios that are distributed and delivered by using Internet and the like, there is such a problem that the information capacity usable for videos and the information capacity usable for audios are in a trade-off state due to restrictions in the capacity of recordable and transmittable information and the information transmission rate, and the image quality and the sound quality of the contents are consequently in an antinomy state. Against the problems, the present inventor and others discovered the phenomena that, when a hypersonic effect was introduced by making the sound information contained in the complex sensory information have an appropriate structure to activate the fundamental brain and the fundamental brain network (fundamental brain network system) including the reward system neural circuit of the brain unitarily comprehensively responsible for the generation of pleasure, beauty and emotion in the recipient, the aesthetic sensibility to a variety of kinds of sensory information inputs other than the auditory sensation was also enhanced in parallel with an increase in the aesthetic sensibility to sound, and the effects of enhancing the reactions of pleasure, beauty and emotion were developed, and invented an apparatus and method for solving the problems by applying it.

The present preferred embodiment is the complex sensory information generating means of the so-called composite art and the like that include the generation of a sound, i.e., an elastic vibration in an expressive style for comprehensively working on the plurality of sensory systems, such as video package media, movies, television broadcastings, Internet distribution videos and theatrical arts. By containing sound information as an essential element that constitutes the complex sensory information and making it as a vibration that contains audible range components and super-high-frequency components having the predetermined autocorrelation order, the activation effect of the recipient's fundamental brain and fundamental brain network (fundamental brain network system) can be introduced. As a result, the reward system neural circuit of the brain, which is the essential element of the fundamental brain and fundamental brain network (fundamental brain network system) and unitarily comprehensively responsible for the generation of reactions of pleasure, beauty and emotion in a human being are activated, by which the aesthetic sensibility induced by not only the auditory sensation but also sensory information induced by sensations other than the auditory sensation are comprehensively enhanced. As a result, the expressive effects introduced by the sensory information other than the auditory sensation, such as screen images, pictorial images, and visual information of lives that constitute the complex sensory information generating means are enhanced, and sensuous artistic value such as moving impression are remarkably heightened.

FIG. **84** shows an example in which, an increase in the moving impression of screen image expression and an improvement in the image quality are induced by forming a sound to be put in a soundtrack in video-and-audio complex package media such as a Blu-ray Disc into a vibration, that has audible range components and the feature of the predetermined autocorrelation order and can introduce the fundamental brain activation effect, i.e., a hypersonic sound. The aesthetic sensibility to screen images of a viewer who is watching the screen images of a Blu-ray Disc is enhanced, and his or her pleasure, beauty and emotion can be heightened. The video and audio system of FIG. **84** is constituted of a display **852**, a Blu-ray Disc player **854** in which a Blu-ray Disc **853** is mounted, an AV amplifier **855**, and a 5.1-ch surround loudspeaker system **856**. Moreover, when the vibration signal recorded in the soundtrack of the video-and-audio complex package media of the Blu-ray Disc or the like is a vibration that does neither contain super-high-frequency components nor introduce the fundamental brain activation effect, it is complemented with a vibration that can introduce the fundamental brain activation effect at terminal equipment by the various kinds of apparatuses and methods described in the second preferred embodiment or the like and then reproduced.

An example of an experiment to evaluate a difference in the impression of the screen image caused by a difference as to whether the sound has the fundamental brain activation effect by using the "Blu-ray Disc version AKIRA" as an example of the complex sensory information that comprehensively works on the plurality of sensory systems is described below.

The screen image of the "Blu-ray Disc version AKIRA" used for the experiment is obtained by recording the screen image of an animation movie presented in a theater into the image track of the Blu-ray Disc.

The sound is edited for the "Blu-ray Disc version AKIRA soundtrack". The past AKIRA soundtrack, of which the vibration signal has been recorded in DVDs in the digital format of a sampling frequency of 48 kHz and a quantization bit count of 16 bits, can neither record nor reproduce the band components of not lower than the Nyquist frequency of 24 kHz, or a half of the sampling frequency and is therefore unable to introduce the fundamental brain activation effect. Accordingly, the audio signal for the DVD version AKIRA soundtrack" was used as an original vibration, and the signal was subjected to band expansion. In addition, by synthesizing an output signal by adding a tropical rain forest environmental sound that is a typical vibration that could introduce the fundamental brain activation effect, and the super-high-frequency components exceeding the audible range upper limit extracted from it and so on to the sound by using the vibration signal generating apparatus including the vibration complementing apparatus shown in FIG. **66** and recording it into a Blu-ray Disc in the digital format of a sampling frequency of 192 kHz and a quantization bit count of 24 bits, the vibration signal of the "Blu-ray Disc version AKIRA soundtrack" was formed and recorded into a Blu-ray Disc. As shown in FIGS. **78** to **81**, this sound is a sound that sufficiently contains the super-high-frequency components having the two properties on the autocorrelation order and can introduce the fundamental brain activation effect.

In the experiment, an identical screen image was consistently presented, while the sound was presented under the blindfold by switchover between two conditions. That is, one of them presented the vibration signal of the "Blu-ray Disc version AKIRA soundtrack" unchanged as the original in the state of a vibration signal (full-range sound) that contained super-high-frequency components having the property on the autocorrelation order and could introduce the fundamental brain activation effect, and the other presented a sound reproduced in the state of a vibration signal (high-cut signal) that could not introduce the fundamental brain activation effect obtained by removing the frequency components of not lower than 24 kHz from it by a low-pass filter. The experiment presented and compared two kinds of sounds with a screen image reproduced from an utterly identical image data under the blindfold.

The test human subjects were made to answer respective impressions by a questionnaire about the images under the full-range sound condition that could introduce the fundamental brain activation effect and the high-cut sound condition that could not introduce the fundamental brain activation effect. Twelve evaluation words expressing the impressions about the screen image were shown on the questionnaire, and the subjects were made to perform evaluations by five-rank evaluation. The answers of ten test human subjects in total were analyzed.

FIG. **85** shows the experimental results. The left chart is one in which a difference is obtained by subtracting the impression grade of the screen image in the high-cut sound condition from the impression grade of the screen image in the full-range sound condition regarding each test human subject, and averages are obtained regarding all the test human subjects and plotted. This numerical value indicates that the sound in the full-range sound condition is more positively evaluated as it is greater and defined hereinbefore as "favorability rating". The right chart shows the results of examination by the signed rank test of Wilcoxon (Wilcoxon) as to whether a significance exists in the bias of the "favorability rating".

As a result, it was clarified that the screen image that the viewer watched while receiving the full-range sound having the fundamental brain activation effect had a higher favorability rating and was received more beautifully and movingly than the screen image that the viewer watched while receiving the high-cut sound having no such an effect regardless of that the identical screen image reproduced from utterly identical image data under the completely identical condition was consistently prescribed in the experiment. In particular, the evaluation words: "impressed by screen image" and "image quality is good" are evaluated statistically significantly positively with $p<0.05$ (mark ** in the right figure of FIG. **85**). Moreover, with regard to the evaluation words of the seven items of "motion picture movement is smooth", "depiction of picture is accurate", "background picture is realistic", "screen texture is fine", "nuance of picture is rich", "depth is felt on screen" and "color is vivid" are positively evaluated with a high tendency of $p<0.10$ (mark * in the right figure of FIG. **85**). Besides these, the evaluation words: "image contrast is high and clearly viewed", "easy to view" and "coloration is complicated" are positively evaluated.

As described above, regarding the video-and-audio complex package media of "Blu-ray Disc version AKIRA", the screen image, which was reproduced from the identical image data under the identical conditions and had no difference as the image itself, was received as those having mutually different image qualities depending on whether the sound of the soundtrack that was concurrently reproduced and presented to the viewer introduced the fundamental brain activation effect, and it was statistically significantly indicated that the viewer received the screen image as one having higher image quality and more moving when the hypersonic sound capable of introducing the fundamental brain activation effect was presented than when the contrary sound was presented.

As described above, the effectiveness of the aforementioned idea of the inventor and others were proven. That is, the inventor and others paid attention to the actual state in which the generation of reactions of pleasure, beauty, and emotion in a human being were unitarily comprehensively managed by the reward system neural circuit of the brain, the fact that the reward system neural circuit was included in the fundamental brain and the fundamental brain network and the phenomenon that the fundamental brain and the fundamental brain network were activated by a hypersonic sound, and obtained an idea that, the aesthetic sensibility to a variety of kinds of sensory information inputs other than the auditory sensation was also enhanced in parallel with an increase in the aesthetic sensibility to sounds, developing the effects of enhancing the reactions of pleasure, beauty and emotion when a hypersonic effect was introduced by making the sound information contained in the complex sensory information have an appropriate structure to activate the fundamental brain and the fundamental brain network (fundamental brain network system) including the reward system neural circuit of the brain unitarily comprehensively responsible for the generation of reactions of pleasure, beauty and emotion in a human being, and obtained an idea to apply it. The above-mentioned experimental results proved that the idea hit the mark.

The evaluation words: "depiction of picture is accurate", "screen texture is fine" and "background picture is realistic" by which the favorability rating is raised by this experimental results surprisingly coincide with the evaluations that indicate an increase in the image quality characteristically appearing when the information capacity consumed for the image data is increased to densify the screen image. The evaluation results indicate the amazing fact that an effect equivalent to increasing the information capacity distributed to the image data can be introduced by giving the property of the autocorrelation order that introduces the fundamental brain activation effect to the sound information presented simultaneously with the image. That is, the contents, which comprehensively works on the plurality of sensory systems as described above, have such a serious problem that, due to restrictions in the recordable and transmittable information capacity and the information transmission rate, a trade-off relation results between different sorts of sensory information such as image quality and sound quality to give a strain to partial sensory information, consequently causing a deterioration in the expressive effect owned by the sensory information and double ruin as a result of trying to make use of each other. Regarding this fateful problem owned by the complex sensory information generating means, it is indicated that superb solution means can be provided by using the apparatus and method of the present invention. In general, it is necessary for improvements in the image quality to achieve technological development requiring a huge cost and system of the contents, such as, first of all, an increase in the recordable data capacity, further developments in the data compression technology and data transfer technology, and development of hardware for reproduction. However, by using the apparatus and method of the present invention, it becomes possible to solve the problems by inducing the image quality improvement effect by an extremely realistic acoustic technology and method without depending on the developments in advanced information processing related technologies as described above.

Next, application examples of the third preferred embodiment are described.

FIG. **86** is a perspective view showing an example of an apparatus that can enhance the aesthetic sensibility of the viewer, improve the television image quality, and let the viewer receive the vision more pleasantly, beautifully and movingly by applying a vibration that can introduce the fundamental brain activation effect from a loudspeaker that reproduces the television sound to the viewer by transmitting a vibration signal (hypersonic sound signal) that can introduce the fundamental brain activation effect in television broadcastings.

When the sound source itself to be broadcasted is a vibration (hypersonic sound signal) that contain super-high-frequency components having the property of the autocorrelation order and can introduce the fundamental brain activation effect, a television signal that has this effect by actualizing the broad-banded sound standard can be transmitted although the sound standard of the current television broadcastings can neither contain nor transmit the super-high-frequency components. Moreover, it may be transmitted by using high-speed large-capacity Internet communications or the like.

Moreover, when the sound source to be broadcasted is a vibration that cannot introduce the fundamental brain activation effect, by transmitting it after complementing it with a vibration signal (hypersonic sound signal) that can introduce the fundamental brain activation effect by various kinds of complementing apparatuses and complementing methods described in the second preferred embodiment at the time of editing it in the broadcasting station, it is also possible to activate the reward system neural circuit, enhance the recipient's aesthetic sensibility, heighten the pleasure, beauty and emotion and achieve an improvement in the received image quality. Also, in the case, it can be transmitted by actualizing the broadbanded sound standard although the sound standard of the current television broadcastings can neither contain nor transmit the super-high-frequency components. Moreover, it may be transmitted by using high-speed large-capacity Internet communications or the like.

Further, when the vibration signal transmitted to broadcasting peripheral equipment such as the current digital television and the like is a vibration signal that can neither contain super-high-frequency components nor introduce the fundamental brain activation effect, it is acceptable to complement it with a vibration (hypersonic sound) that can introduce the fundamental brain activation effect in the peripheral equipment by the various kinds of apparatuses and methods described in the second preferred embodiment and reproduce it. By so doing, it is also possible to activate the reward system neural circuit, enhance the recipient's aesthetic sensibility, achieve an improvement in the received image quality and enhance the pleasure, beauty and emotion.

The apparatus also includes the current terrestrial digital broadcastings (including one-segment broadcastings), BS digital broadcastings, analog TV broadcastings and video and audio contents that are transmitted and distributed by the communications of Internet or the like as the objects thereof.

Other application examples are described. The following includes more positive application examples paying attention not to a solution for such a problem that the qualities of different sorts of sensory information fall into the antinomy state due to the trade-off relation because of the technological constraints but to the fact that the hypersonic sound activates the fundamental brain by the complex sensory information generating means for working on the plurality of sensory systems and induces the effect of activating the reward system having the function unitarily comprehensively responsible for the generation of pleasure, beauty and emotion in a human being. For example, by constituting the vibration of the music to which the audiences listen as a hypersonic sound that can introduce the fundamental brain activation effect having the predetermined autocorrelation order in a case of, for example, a dance performance in a theater, the aesthetic sensibility of the audiences is enhanced to make them feel the dance more beautifully and pleasantly. This example can be applied also to other live performances, art museums, museums, art galleries, jewelry shops, boutiques, cosmetics departments and so on.

As application examples to other sensations, by constituting the music to which the guests listen as a hypersonic sound that can introduce the fundamental brain activation effect in, for example, a music restaurant, the guest's gustatory sensibility is enhanced, making him or her feel the dish more delicious. This example can be applied also to tea shops, dining rooms, bars and so on.

Moreover, by constituting the music received by the guest as a hypersonic sound that can introduce the fundamental brain activation effect in a case of bathing and massage and music in a music spa or the like, the sensibility of the guest's somatic sensation is enhanced, allowing him or her to physically feel the bathing or massage more pleasantly.

Further, by constituting the sound received by the passengers or trainmen as a hypersonic sound that can introduce the fundamental brain activation effect in vehicles of railways, cars, airplanes, ocean vessels, rockets and so on, the favorability rating of the somatic sensations of the passengers or trainmen are enhanced, allowing them to physically feel comfortable ride quality.

Moreover, by constituting the aroma and music received by the guest as a hypersonic sound that can introduce the fundamental brain activation effect in a case of music aroma therapy and the like, the sensibility of the guest's olfactory sensation is enhanced, allowing him or her to feel more pleasant aroma and inducing higher healing effects.

As described above, by applying a hypersonic sound, i.e., a vibration that contains audible range components and super-high-frequency components having the feature of the predetermined autocorrelation order to a human being while applying predetermined information to the person regarding at least one of visual sensation, gustatory sensation, somatic sensation and olfactory sensation other than the auditory sensation, the fundamental brain and the fundamental brain network (fundamental brain network system) including the reward system neural circuit, which is the brain function region unitarily comprehensively responsible for the generation of reactions of pleasure, beauty and emotion in the human being are activated, by which the aesthetic sensibility to sensory inputs other than the auditory sensation is also enhanced, allowing the expressive effect of the sensory information other than the auditory sensation to be heightened.

Fourth Preferred Embodiment

Next, in the fourth preferred embodiment, a vibration generating apparatus and method characterized in that two effects of sensitization and comforting of sensation are developed or intensified in a coexistent state by enhancing the activity of the entire fundamental brain network system by applying the vibration generating apparatuses described in the first through third preferred embodiments is described.

There is a problem of the occurrence of an antinomy phenomenon such that the "necessary information cannot be caught unless the sound volume is increased" and "it becomes noisy and unpleasant if the sound volume is increased" when a sound aimed for information transmission by, for example, public-address broadcasting coexists with other sounds, such as a remarkable background noise, which have properties of disturbing the transmission. Problems similar to this exist under various situations, and, for example, the sound effects of audio and video contents and the sound effects of a theatrical performance have the antinomy problem such that the "intended artistic effects cannot be obtained unless the sound volume is increased" and "it becomes unpleasant if the sound volume is increased".

In order to solve this problem without contradiction, it becomes possible to develop or enhance both of sensitization and comforting of the sound perception by enhancing the activity of the entire fundamental brain network system, activating the thalamus and the brain stem that are included in the system and have the operation of sensitizing the sensibility to the general sensory information inputs (excluding the olfactory sensation) and concurrently activating in parallel the reward system neural circuit that is included in the same system and has an operation to generate a pleasurable sensation and alleviate unpleasant sensation, with the complementing of a vibration (hypersonic sound) that contains super-high-frequency components having the feature of the autocorrelation order.

First of all, the two effects of a vibration that can introduce the hypersonic effect, i.e., a hypersonic sound is described with the grounds thereof.

The first effect is the effect of sensitizing the sensibility to the sensory information inputs by enhancing the activity of the thalamus and the brain stem included in the listener's fundamental brain network system and making him or her more clearly recognize the sensory information of the sound or the like. This is proven by the results of the following psychological experiments. That is, the three conditions of a condition that a vibration (hypersonic sound) that could introduce the fundamental brain activation effect because of the contained super-high-frequency components having the predetermined autocorrelation order was presented, a condition that a vibration (audible sound) that did neither contain the super-high-frequency components nor could introduce the fundamental brain activation effect was presented, and a condition that no particular sound was presented were daily set in a library. Questionnaire investigation was carried out on one hundred or more test human subjects who stayed for several minutes to several tens of minutes in the library when they left the room to inquire a difference in their conscious senses between before entering the room and at the time of leaving the room.

As a result, the answers that "the sound became clearly heard" and "things became clearly seen" at the time of leaving the room than before entering the room frequently occurred with an extremely high statistical significance on the days when the hypersonic sound was presented in the library in comparison with the days when the audible sound was presented and the days when no particular sound was presented (See FIG. **105**). That is, it was proven that the sensibility to the sensory information inputs became sensitized by the fundamental brain activation effect, and the consciousness that the visual and auditory information was recognized more clearly was heightened.

The second effect is the effect of enhancing the aesthetic sensibility to the sensory information by similarly inducing the activation of the reward system neural circuit included in the listener's fundamental brain network system and making him or her feel comfortable a vibration input at full blast. This is proved from the results of the following behavioral experiments. That is, the test human subject is made to hear a sound at full blast and to select his or her favorite sound volume by freely adjusting the sound volume by using an adjuster for increasing and decreasing the sound volume. In this case, the test human subject cannot see the scale for the volume adjustment. As a result of this experiment, the finally adjusted sound volume becomes statistically significantly increased when the listener is made to hear the vibration (hypersonic sound) that can introduce the fundamental brain activation effect because it contains super-high-frequency components having the predetermined autocorrelation order than when the listener is made to hear the vibration (audible sound) that cannot introduce the fundamental brain activation effect (hypersonic effect) because it contains no super-high-frequency component (See FIG. **106**). Moreover, a tendency of gradually turning up the volume is observed while repeating. For this reason, it can be understood that a larger sound volume is selected due to a high comfortable sensation in the case of the hypersonic sound, by contrast to which the sound volume is set smaller conversely due to a high unpleasant sensation in the case of the audible sound. The above indicates that the listener's comfortable sensation to the vibration input at full blast can be heightened by presenting the hypersonic sound.

Moreover, when the super-high-frequency components contained in the hypersonic sound were further enhanced by a similar experiment, the test human subjects adjusted the level so that the sound volume was further raised (See FIG. **107**). In this case, it was indicated that the favorite volumes set by these test human subjects were increased with a high correlation to the DBA-index, or the index of the fundamental brain activity.

As described above, the hypersonic sound introduces the two effects of heightening the degree of awakening by sensitizing the sensibility to the sensory inputs including the auditory sensation by the activation of the thalamus and the brain stem and introducing a cognition improving effect, and introducing an improvement in the sense of comfort and alleviating the unpleasant sensation by the activation of the reward system in a state in a coexistent state.

An implemental example obtained by applying the feature of the coexistence of the two effects is described below. The first example is an example of public-address broadcasting for the purpose of transmitting information to the passengers in a station yard. Announcement sounds and broadcast sounds issued in a station yard need to be reliably transmitted to the users, and therefore, a sound volume required for the purpose must be secured. In particular, "the necessary information cannot be caught unless the sound volume is increased" in many cases where background noises are significant, and therefore, the users must be exposed to the public-address sounds at full blast in terms of achieving the purpose of information transmission, and this inevitably leads to such a problem that the unpleasant sensation of "noisy" and so on is caused.

In addition, also when the sound to be subjected to the public-address broadcasting is an audio signal that has been already recorded or artificially generated and when the response characteristics of the public-address broadcasting system are not sufficient in the frequency domain of not lower than the audible frequency range, the user is exposed to the public-address sound that lacks the super-high-frequency components at full blast even when a live sound is subjected to the public-address broadcasting, and this possibly causes a risk of deteriorating the fundamental brain activity (See FIGS. **90** and **17**). The deterioration in the fundamental brain activity induces a stress reaction such as an increase in the adrenaline concentration, further intensifying the unpleasant sensation of "noisy" and the like and leads to irritative feelings. As described above, in addition to the disadvantage that the necessary information is not effectively transmitted, there is such a serious problem that the risk of triggering violent behaviors and abnormal behaviors rises.

Solution measures against such a problem is described below. In this case, the configuration of the sounds existing in the station yard are classified into "transmission sound (audible sound)=sounds of announcement and chime that transmit information necessary for user", "background noise (audible sound)=noises in station yard, train noises, BGM, and other sounds that disturb transmission", "hypersonic sound", and "super-high-frequency components of hypersonic sound" (expressed as "hypersonic sound or its super-high-frequency components" when either one of both is valid).

The transmission sound (audible sound) is complemented with a hypersonic sound or its super-high-frequency components by installing a vibration generating apparatus to which any one of the first to third preferred embodiments is applied. The vibration for complementing may be the hypersonic sound itself like, for example, a tropical rain forest environmental sound that does not disturb the transmission of the necessary information or only the super-high-frequency components of the hypersonic sound. With this arrangement, the regions of the thalamus and the brain stem belonging to the fundamental brain network system are activated to enhance the sensibility and the degree of awakening to sensory information inputs, and this induces the effects of improving the cognition of the sound and transmitting the transmission sound (audible sound) to be easily caught even if the user is in a space having significant background noises. In this case, in addition to the aforementioned effects, the reward system neural circuit of the brain that similarly belongs to the fundamental brain network system and is responsible for the generation of reactions of pleasure, beauty and emotion in a human being is activated in parallel, and the aesthetic sensibility to sensory information inputted to the user is enhanced. Therefore, the comfortable sensation even to the transmission sound (audible sound) at full blast is increased, and the unpleasant feelings and irritative feelings such as "noisy" can be alleviated. In this case, the comfortable sensation to the sound at full blast is further increased as the power ratio of the super-high-frequency components of the hypersonic sound is increased.

Concrete examples of vibration complementing apparatuses and methods for complementing with a hypersonic sound or its super-high-frequency components are described below.

(1) As shown in FIG. **108**, the transmission sound (audible sound) and the hypersonic sound or its super-high-frequency components are recorded in mixture at a prescribed balance, and its signal is reproduced by using a public-address system **472** having a faithful response performance. In this case, the vibration complementing apparatus is constituted of a vibration signal reproducing apparatus **470** that reproduces a vibration signal by using a recording medium **470***d* in which the transmission sound (audible sound) and the hypersonic sound or its super-high-frequency components are recorded in mixture, a vibration signal amplifier **471**, and the public-address system **472**.

(2) As shown in FIG. **109**, the transmission sound (audible sound) and the hypersonic sound or its super-high-frequency components are generated by using public-address systems **472** and **472** that are varied depending on different sound sources. In this case, the transmission sound (audible sound) and the hypersonic sound or its super-high-frequency components can be severally independently controlled in level. In this case, the vibration complementing apparatus is constituted of:

(a) a first apparatus that includes a microphone **473** that collects the transmission sound (audible sound), the vibration signal amplifier **471**, and the public-address system **472**; and

(b) a second apparatus that includes a vibration signal reproducing apparatus **470** that reproduces the vibration signal by using the recording medium **470***d* in which the hypersonic sound or its super-high-frequency components are recorded, the vibration signal amplifier **471**, and the public-address system **472**.

(3) This is a modified preferred embodiment of the above-mentioned case (2), in which the transmission sound (audible sound) and the hypersonic sound or its super-high-frequency components are synthesized on the spot and generated from one public-address system **472** as shown in FIG. **110**. The vibration complementing apparatus is constituted of the microphone **473** that collects the transmission sound (audible sound), the vibration signal reproducing apparatus **470** that reproduces the vibration signal by using the recording medium **470***d* in which the hypersonic sound or its super-high-frequency components are recorded, a vibration signal addition adjuster **474**, the vibration signal amplifier **471**, and the public-address system **472**. The vibration signal addition adjuster **474** adjusts the levels of inputted two signals, adds them together, and outputs the resultant to the public-address system **472** via the vibration signal amplifier **471**.

(4) This is an example in which an adjusting function is further incorporated into the above-mentioned case (3). As shown in FIG. **111**, a background noise (audible sound) is collected by a microphone **475**, the feature of the background noise (audible sound) is measured by a vibration measuring instrument **476** based on the collected vibration signal, and the measured data is inputted to the vibration signal addition adjuster **474**. The other configurations include the configuration of the above-mentioned case (3). The vibration signal addition adjuster **474** has a function to adjust the transmission sound (audible sound) and the hypersonic sound or its super-high-frequency components in accordance with the feature of the background noise (audible sound). As examples of the adjustment function, there is, for example, a function to turn on the hypersonic sound or its super-high-frequency components when the noise level of the background noise (audible sound) exceeds a definite value or a function to amplify the level of the transmission sound (audible sound) and the hypersonic sound or its super-high-frequency components by an amplification factor correlated to the noise level of the background noise (audible sound) or a function to analyze the feature of the autocorrelation order of the background noise (audible sound) and emphasize or suppress the feature of the autocorrelation order of the hypersonic sound or its super-high-frequency components, or the like.

FIG. **112** shows an example in which the vibration generating apparatus is installed by various installation methods in a station yard **480**. In FIG. **112**, reference numeral **481** is a pillar mounted type vibration generating apparatus, **482** is a signal receiver of the transmission sound (audible sound) such as an announcement sound, **483** is a super-high-frequency vibration signal receiver, **484** is a loudspeaker (public-address system) that generates a transmission sound (audible sound), and **489** is a super-high-frequency vibration generating apparatus. Reference numeral **485** is a ceiling embedded type vibration generating apparatus with a built-in memory **485***m* that stores a super-high-frequency vibration signal, **486** is a hypersonic sound generating apparatus, **487** is a loudspeaker (public-address system) that generates a hypersonic sound or its super-high-frequency components together with the transmission sound (audible sound), and **488** is a person. This vibration generating apparatus may be newly installed or additionally incorporated into the existent premises public-address system. Moreover, the signal of the vibration may be externally inputted by wire or provided by receiving a signal externally transmitted wirelessly (electromagnetic wave, infrared rays, LAN, Bluetooth (registered trademark), etc.) Otherwise, it may be recorded in a memory and integrated into each vibration generating apparatus. Moreover, it may be artificially generated in the vibration generating apparatus. Moreover, it is acceptable to generate a vibration from the entire housing of the public-address system or generate a vibration from a cable and its sheath, a peripheral ceiling or wall, a pillar, an architectural material or the like.

Similar examples of this implemental example are described. Applications can also be provided for various kinds of announcements of departure and arrival guidance, boarding guidance, accident information, and schedule changes in airports and vehicles, evacuation guidance broadcastings at streets, underground shopping centers, event sites, amusement parks, and stadiums, cases where public-address broadcastings and the like intended for information transmission in spaces having significant background noises are performed such as indoor broadcastings in public institutions and factories.

Moreover, in the disaster sites of fire, earthquake and accident, it is important to appropriately guide the victims by an evacuation guidance with a broadcast sound or a public-address sound, and there is a risk that it cannot be caught due to masking by the background noises of a large sound volume, and this leads to such a problem that a group panic easily occurs. In contrast to this, by providing a complementing vibration that can introduce the fundamental brain activation effect in a space, the victims' sensibilities to the sensory information input are sensitized to allow them to easily catch the vocal information of the evacuation guidance for the victims, and the reward system neural circuit is activated to alleviate the insecurity feelings. It consequently becomes helpful for appropriately guiding the victims without causing the group panic.

Further, there is such a problem that the driver and fellow passengers in a car become irritated by congestion and getting sleepy on an expressway or an ordinary road. With regard to this, a hypersonic sound signal is transmitted together with traffic information transmitted to the car or independently. The vehicle running on the road generates a hypersonic sound by transducing the received signal into an aerial vibration by receiving this vibration signal together with traffic information or solely or using the vibration signal generating apparatus installed in the vehicle. With this arrangement, the degree of awakening of the driver and the fellow passengers is heightened, and this leads to an effect of improving cognition to the traffic information. In addition, the abilities of cognition and judgment to visual information inputs are heightened, inducing an accident preventing effect, and it is expected to alleviate the irritative feelings due to the congestion.

Likewise, it is sometimes the case where broadcast sounds intended for information transmission of guidance of users or the like are hardly caught due to masking by significant background noises in public institutions such as airports, outdoor and indoor event sites, hospitals, schools, and libraries, facilities such as concert halls, department stores, and amusement parks, and other public spaces having significant background noises, such as shopping streets, station squares and parks. With regard to this, by complementing with a hypersonic sound that can introduce the fundamental brain activation effect in a space, the users' sensibilities to sensory information inputs are sensitized to allow the broadcast sound to be easily caught, and the reward system neural circuit is activated to alleviate the unpleasant sensation and irritative feelings such as "noisy", allowing the comfort to be improved.

Next, coexistence of the two effects of the vibration that can introduce the hypersonic effect, i.e., the hypersonic sound is described below by taking the movie BD "AKIRA" as an example of the second implemental example utilized for enhancing the artistic expression effect.

For example, three factors of the movie sound are called DMS obtained from the capital letters of D (Dialogue), M (Music), and S (Sound effect). Among these, regarding S (sound effect), a sense of presence is increased and stage effects such as an increase in thrill are obtained as the sound volume is increased. However, if the sound volume is increased, there is such an inevitable problem that "unpleasant" and "noisy" reactions occurs.

With regard to this problem, in the BD "AKIRA", movie sounds were classified into "dialogue and music (audible sound), "sound effect (audible sound)=sound intended for stage effect dramatic impacts", "hypersonic sound", and "super-high-frequency component of hypersonic sound" (expressed as "hypersonic sound or its super-high-frequency components" when either one of both is valid). By complementing not only the "dialogue and music (audible sound)" but also the "sound effects (audible sound)" with a hypersonic sound or its super-high-frequency components, it is successful to remarkably boost the stage effects by compatibly heightening the comfortable sensation with a large sound volume without causing the noisy reaction. Asakura Reiji's says, "the range of sound is exceptionally wide, and the impression is "unnoisy" at a word. It was my first experience to see a movie where such unnoisy action scenes continued. There were many ordinary tiring DVD/BD action movies though having punches, but this "AKIRA" was ferment, exciting in the best sense, and attentive surround" (from the BD "AKIRA" liner notes).

As similar examples of this kind, there are movies, plays and musicals in theaters, television broadcastings, live performances and so on. Concrete examples of methods for complementing the audible sound with the hypersonic sound are described below.

(1) An audible sound and a hypersonic sound or its super-high-frequency components are elaborated in package media by previously deciding the balance.

(2) A case where an audible sound and a hypersonic sound or its super-high-frequency components are transmitted by previously deciding the balance in a manner similar to that of programs that are broadcasted and distributed.

(3) An audible sound and a hypersonic sound or its super-high-frequency components are controlled on the spot in a manner similar to that of lives.

(4) Also in the package media, broadcastings, and distributed programs, an audible sound and the super-high-frequency components of a hypersonic sound are put in another track or other package media, and the balance between both of them is made controllable at the time of reproducing.

Next, a third implemental example, in which the coexistence of the two effects of a vibration that can introduce the hypersonic effect, i.e., a hypersonic sound is utilized for attracting customers and enhancing the business effects, is described below. In play facilities such as video arcades and pachinko parlors, actions for enhancing the guests' excitability and the like are produced by exposing the guests to a BGM at full blast, explosive sounds of game machines, gushing pachinko ball sounds and the like, trying to link it to the attraction and business effects. However, the exposure to the sound at full blast inevitably causes the problem of the "unpleasant" and "noisy" reactions.

Further, when a sound containing no super-high-frequency component such as a CD is used for the in-store BGM or the like, there are the risks of causing deteriorations in the fundamental brain activities of guests and clerks, increasing irritative feelings, and this leads to stress reactions such as an increase in the adrenaline concentration, and triggering violent behaviors and abnormal behaviors. In particular, negative influences on the play facilities where youth tend to gather are serious problems.

Regarding the problems as described above, in play facilities such as video arcades and pachinko parlors, by complementing the audible sounds (in-store BGMs, conversational voices, game machine sounds, gushing pachinko ball sounds, etc.) with a hypersonic sound or its super-high-frequency components in the store, it becomes difficult to cause the "unpleasant" and "noisy" reactions in spite of the large sound volume that sufficiently achieves the purpose of enhancing the excitability of the guests. Moreover, it contributes to preventing deteriorations in the fundamental brain activities of guests and clerks, suppressing generation of irritative feelings and stresses, and preventing violent behaviors and abnormal behaviors. As similar examples of this kind, there are discotiques, music tearooms, and face-to-face demonstration sales (e.g., cattail oil sales, etc.)

The vibration generating apparatuses described in the first to third preferred embodiments of the present application can be applied to the vibration generating apparatus for achieving this. This vibration generating apparatus may be incorporated into the in-store walls, ceilings, internal trim parts, individual game machines, pachinko machines and the like or externally attached. The sound source may be previously recorded in a recording medium or transmitted by broadcastings and telecommunications.

Concrete examples of the complementing method are described below.

(1) An audible sound and a hypersonic sound or is super-high-frequency components are recorded at a previously decided balance, and the signal is reproduced by using a public-address system having a faithful response performance.

(2) A case where an audible sound and a hypersonic sound or is super-high-frequency components are generated by a