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PROMOTION OF HEALTH BY WATER VEIL

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ABSTRACT

A very thin water veil like a transparent thin sheet of vinyl has been produced by shaping a double-disk nozzle in such a way to accelerate the water flow inside the nozzle.

An effect of this water veil is to clean the surrounding air and to supply humidity. Minus ions produced from the veil by Lenerd effect are considered to be effective for stimulating the metabolism and promoting the circulation of blood. In other words, it is also effective for health, beauty and preventing from growing old. It is considered that human mind can be refreshed and relaxed by being inside of this water veil.

In this paper, the numerical analysis of water veil shape using theoretical equation was performed and the shape was compared with the visualized shape. And after that the healing effect of water veil was verified using the hanging type water veil.

Keywords: water veil, healing, computer simulation, visualization of mind, brain wave

INTRODUCTION

A very thin water veil like a transparent thin sheet of vinyl has been produced by shaping a double-disk nozzle in such a way to accelerate the water flow inside the nozzle. A double-disk nozzles of stand type and hang type were developed (Nakayama Y. et al., 2002, 2006) upper side was newly developed.

An effect of this water veil is to clean the surrounding air and to supply humidity. Minus ions produced from the veil by Lenerd effect are considered to be effective for stimulating the metabolism and promoting the circulation of blood. In other words, it is also effective for health, beauty and preventing from growing old. It is considered that human mind can be refreshed and relaxed by being inside of this water veil.

In this paper, the numerical analysis of water veil shape using theoretical equation was performed and

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the shape was compared with the visualized shape. And after that the healing effect of water veil was verified using water veil S (small type), water veil M (middle type) and water veil L (large type).

WATER VEIL

Numerical Analysis

As shown in Fig. 1, the outlet point of the double-disk nozzle is taken as an origin of the coordinate axes. The vertical axis is the z -axis (positive in downward direction) and the horizontal axis is the x -axis. The parameter T denotes the surface tension, p the pressure difference between inside and outside of water veil, Q the volumetric flow rate, u_0 the outlet velocity from the nozzle, and g the gravitational acceleration.

Now, considering the surface tension T is constant, and neglecting the air resistance, the velocity of water u at an arbitrary position is given by,

$$u^2 = u_0^2 + 2gz \quad (1)$$

Putting the inclination of the water veil surface to the vertical axis as ϕ , the thickness of water veil at an arbitrary point as t , the radius of curvature as r_c and the radius of the double-disk nozzle as R , the following equation is obtained from balancing of the surface tension, pressure, gravitational force and inertia force:

$$\frac{2T}{r_c} + \frac{2T \cos \phi}{r+x} - p + g \rho t \sin \phi - \frac{u^2 \rho t}{r_c} = 0 \quad (2)$$

The motion of z direction is supposed as free fall.

$$\frac{dz}{dt} = g t \quad (3)$$

Putting $u_0 \cos \phi_0$ as initial speed, the value of z of optional point can express as follows:

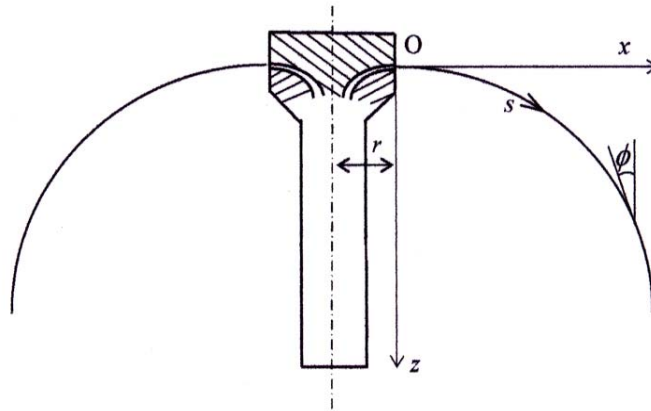


Fig. 1. Coordinate system

$$z = \frac{gt^2}{2} + u_0 \cos \phi_0 \quad (4)$$

Putting the thickness of water veil as h ,

$$h = \frac{Q}{2\pi(r_c + x)u} \quad (5)$$

Here

$$Q = 2\pi r u_0 h_0 \quad (6)$$

$$\text{Using } ds = udt \quad \frac{1}{r_c} = -\frac{d\phi/dt}{u} \quad (7)$$

From Eq. (2) and (7)

$$\frac{d\phi}{dt} = \frac{u}{u^2 \rho h - 2T} \left(\frac{2T \cos \phi}{r + x} + g \rho h \sin \phi - p \right) \quad (8)$$

From the definition of ϕ ,

$$\frac{dx}{dt} = u \sin \phi \quad (9)$$

It was difficult to calculate whole profile of water veil as the section of z - x plane was two values function. According to the above mentioned analysis, it was able to describe ϕ , z and x as the time's function. Using this result, it was able to resolve this problem.

Finally, ϕ and x are obtained by the numerical integration of Eqs (8), (9) using Runge-Kutta method. The value of z is obtained by Eqs. (3), (4). As the concrete method, MATLAB / Simulink was applied.

Experimental Apparatus

Small Size Water Veil

The experimental apparatus is shown in Fig. 2. The outside diameter of the double-disk nozzle is 5cm and the height is 17cm. The water from a pump is supplied to the nozzle through the differential pressure flow meter. The shape of the nozzle is designed to produce an accelerated flow. By adjusting the pressure control valve and changing the discharge, the outlet clearance and the outlet flow rate that form a most attractive water veil shape are obtained.

Milk was poured into the water tank to get 0.1% water solution of milk for the purpose of making the reflecting laser light. By cutting the water veil using the laser light sheet, the thickness and shape of the water veil are obtained.

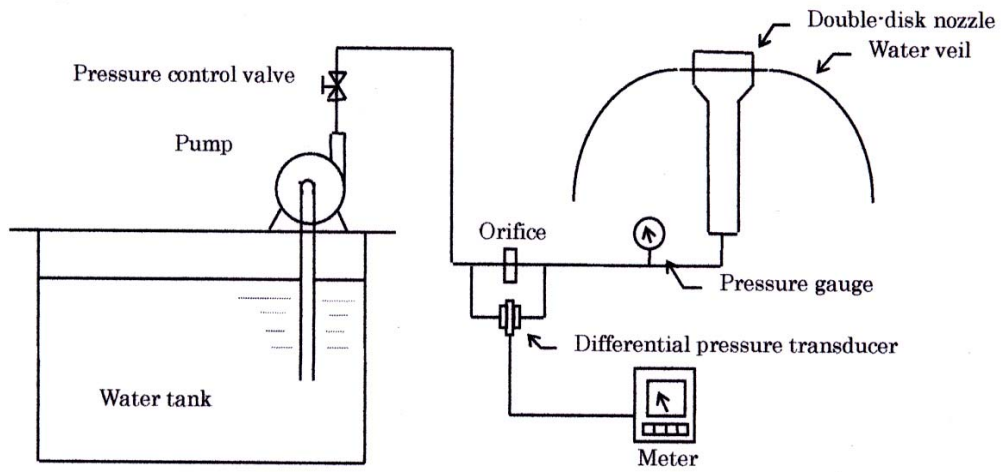


Fig. 2. Testing apparatus (small size water veil)

Large Size Water Veil

The experimental apparatus is shown in Fig.3. The outside diameter of the nozzle is 160cm and the height is 100cm. The water from a pump is supplied to the nozzle through a damper tank and an ultrasonic flow meter. The outlet clearance and the outlet flow quantity that produce a most attractive water veil shape and flow quantity are obtained by changing the rotational speed of the pump and hence changing the discharge.

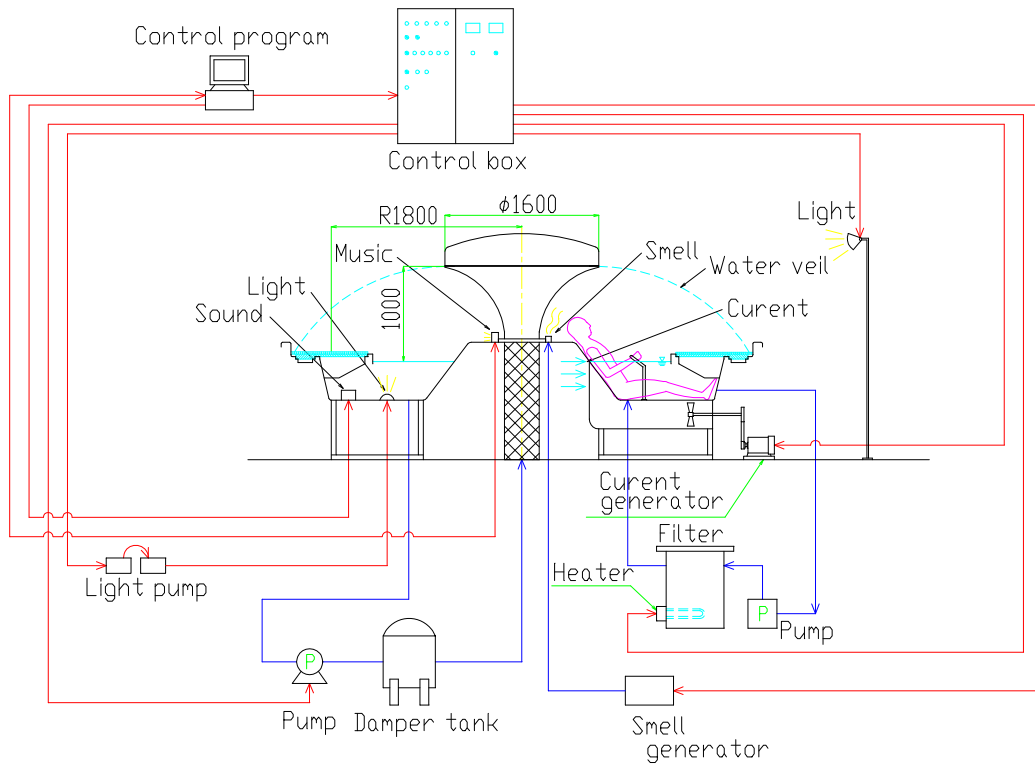


Fig. 3. Mind and body care system using water veil

Computational and Experimental Results

Small Size Water Veil

A result of the visualization experiment on the film of the water veil is shown in Fig. 4. According to this photograph, the thickness t is found to be 1.2 mm. In this case, the flow quantity Q is $1.8 \times 10^{-4} \text{ m}^3/\text{s}$, so the outlet velocity becomes 0.97m/s. The value of ϕ at the outlet is 110° .

Using the values obtained from the experiment and putting $p = 0 \text{ Pa}$, the theoretical analysis is carried out and the result is shown in Fig. 5. It is clear that the numerical results agree well with the experimental results.



Fig. 4. Visualized result of water veil

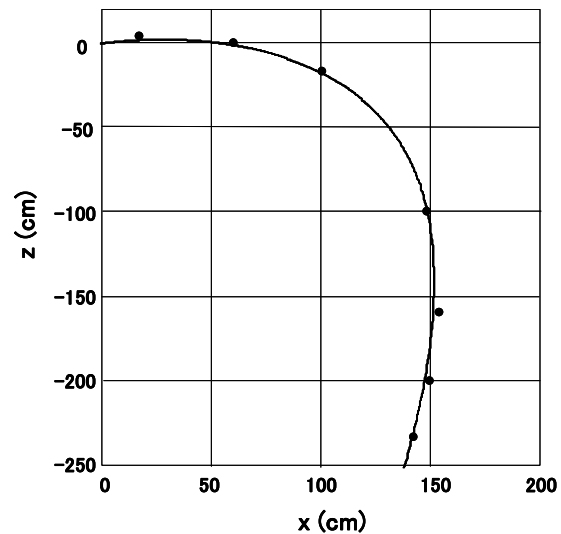


Fig. 5. Comparison of calculation and experiment

Large Size Water Veil

In this experiment, the outlet clearance of nozzle is approximately 1 mm and the volumetric flow rate is $0.033 \text{ m}^3/\text{s}$. The value of ϕ at the outlet is 110° . The photograph of the water veil taken from the side is shown in Fig. 6. From this photograph, the shape of the veil is measured. Comparison between computational and experimental results are shown in Fig. 7. It is clear that both results agree almost quite well.

The numbers of negative ion by Lenerd effect are measured to find about $15,000 \text{ ions}/\text{cm}^3$ near the water veil.

Based on these results described above, the utilization of the water veil is considered for healing of mind.



Fig. 6. Stand type large water veil

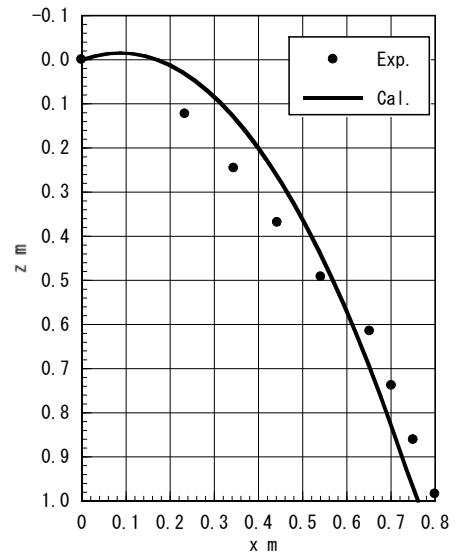


Fig. 7. Comparison of calculation and experiment

Practical Type

A water veil want to call a Aqua Veil as a pet name.

To increase the space of inside of Aqua Veil, the hanging type Aqua Veil was made as shown in Fig. 8. The diameter of the skirt of this Aqua Veil is 1.6 m and the height is 0.8 m. This Aqua Veil is for one person.

The stand types of large Aqua Veil were made as shown in Figs. 9 and 10. The diameters of the skirt of these Aqua Veils are 2.5 m and 3.6m, and the heights are 1.0 m and 1.2 m respectively. These AquaVeils are for 4 persons and 8 persons respectively.



**Fig. 8. Aqua Veil S (Small type)
(For one person)**



**Fig. 9. Aqua Veil M (Middle type)
(For 4 persons)**



**Fig. 10. Aqua Veil L (Large type)
(For 8 persons)**

VISUALIZATION OF MIND

Brain Waves

A cross-section of the cerebral cortex is shown in Fig. 11. From the close inspection of the cerebral cortex, the nervous cells called the neuron are packed in the surface layer of few mm thickness. This part is called gray matter. The layer under the gray matter appears comparatively white, consisting of axons, and hence it is called the white matter. The electric voltage inside the neuron is kept at minus 60~90 mV relative to the outside part, in other words, “the cell is polarized”. If the neuron receives the electrical signal from other neurons and is polarized (is excited), an electric current impulse is emitted in the connecting axons. A mass electric current thus generated is in the vertical direction to the cortical surface. After passing through the skull, it reaches the scalp, where the electric potential distribution is produced on the scalp. This is the brain wave.

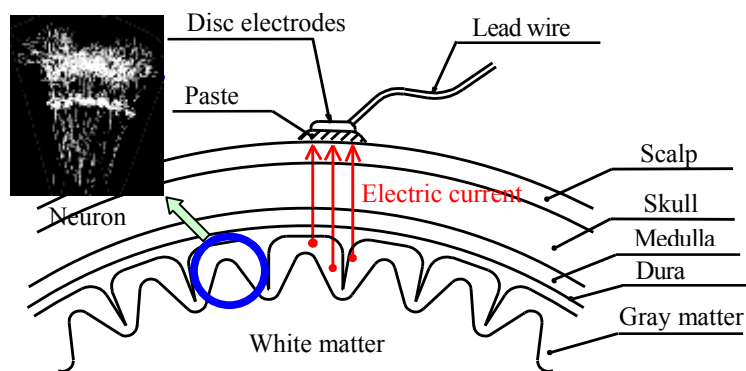


Fig. 11. Section of cerebral cortex

Measuring Method of Brain Wave

The 10 disk electrodes are attached on the scalp according to the International 10-20 Standard. A reference electrode is attached on the right earlobe. The experimental set-up for measuring of brain wave is shown in Fig. 12.



Fig. 12. Measuring state of brain wave

Frequency of Brain Wave

The brain wave in the frequency range of 5~8 Hz is called the θ wave, that in the 8~13 Hz range is known as the α wave and that in the 13~20 Hz is called the β wave. The θ wave is generated by nervous tension and worries. Concentration of mind, meditation and relaxation produce the α wave. The β wave is produced while falling into a doze and flashing of mind.

Numerical Expression of State of Mind

Human emotional state is manifested as correlations among the brain wave signals. The cross-correlation of brain waves measured at two points on the scalp is considered. For example, putting the electric potential recorded with the j th and k th electrodes as $X_j(t)$, $X_k(t)$, the cross-correlation coefficient is defined as $\langle X_j(t)X_k(t) \rangle / \sqrt{\langle X_j(t)^2 \rangle \langle X_k(t)^2 \rangle}$. The symbol $\langle \rangle$ represents the mean value of some interval over a given time span (5 sec in the present case). 45 different cross-correlation coefficients [${}_{10}C_2 = 45$] can be selected from 10 electrodes.

Using three frequency bands of the brain wave, 135 values of the cross-correlation coefficient $y_1, y_2, y_3, \dots, y_{135}$ can be selected from 10 electrodes.

The levels of 4 indices representing stress, joy, depression and relaxation are given by z_1, z_2, z_3, z_4 respectively, and these levels are expressed respectively by the following equations.

$$\begin{cases}
 z_1 = c_{1,1} y_1 + c_{1,2} y_2 + \dots + c_{1,135} y_{135} \\
 z_2 = c_{2,1} y_1 + c_{2,2} y_2 + \dots + c_{2,135} y_{135} \\
 z_3 = c_{3,1} y_1 + c_{3,2} y_2 + \dots + c_{3,135} y_{135} \\
 z_4 = c_{4,1} y_1 + c_{4,2} y_2 + \dots + c_{4,135} y_{135}
 \end{cases} \quad (10)$$

The total number of coefficients is now $135 \times 4 = 540$.

Several people who have received the training of imagining as being able to control of their emotion are requested imaging of the four pure emotional states. Now, if these are independent and hence orthogonal, the emotional state in general is expressed as a combination of these four elementary states. Hence this technique is named as Emotion Spectrum Analysis Method (short name:ESAM) (Musha T., 2000). Based on this assumption, the coefficients of Eq. (10) can be determined by setting the coefficients as those in Eq. (11).

$$\begin{cases}
 \text{Stress} & : z_1 = 1, z_2 = 0, z_3 = 0, z_4 = 0 \\
 \text{Joy} & : z_1 = 0, z_2 = 1, z_3 = 0, z_4 = 0 \\
 \text{Depression} & : z_1 = 0, z_2 = 0, z_3 = 1, z_4 = 0 \\
 \text{Relaxation} & : z_1 = 0, z_2 = 0, z_3 = 0, z_4 = 1
 \end{cases} \quad (11)$$

Using these coefficients, values of $z_1 \sim z_4$ can be obtained by inputting the 135 values of the cross-correlation coefficient measured using the ESAM.

HEALING SYSTEM

Figure 8, 9 and 10 show the healing test state in the water veil. The healing test is as follows: The brain waves of experimenters are measured before entering the water veil. After staying inside the water veil for 10 minutes, the experimenters come out from the water veil, and the brain waves are again measured. The example of these results is shown in Fig. 13. From these signals of brain waves, the ESAM characterizes the features for stress, joy, depression and relaxation. The state of mind is expressed as a combination of these four independent states of mind. The results used this method are shown in Fig. 14.

Before bathing, the values corresponding to stress are large and those corresponding to relaxation are small. However, after a bath, the values for stress become small and those for relaxation becomes large.

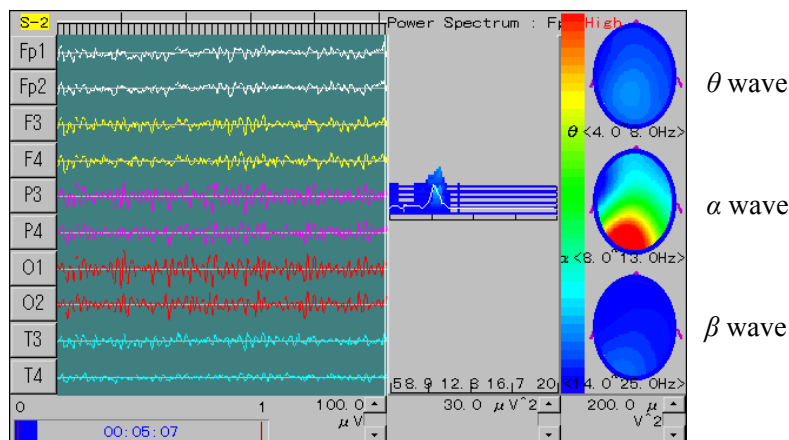


Fig. 13. Brain waves of 10 parts of head and θ , α and β waves

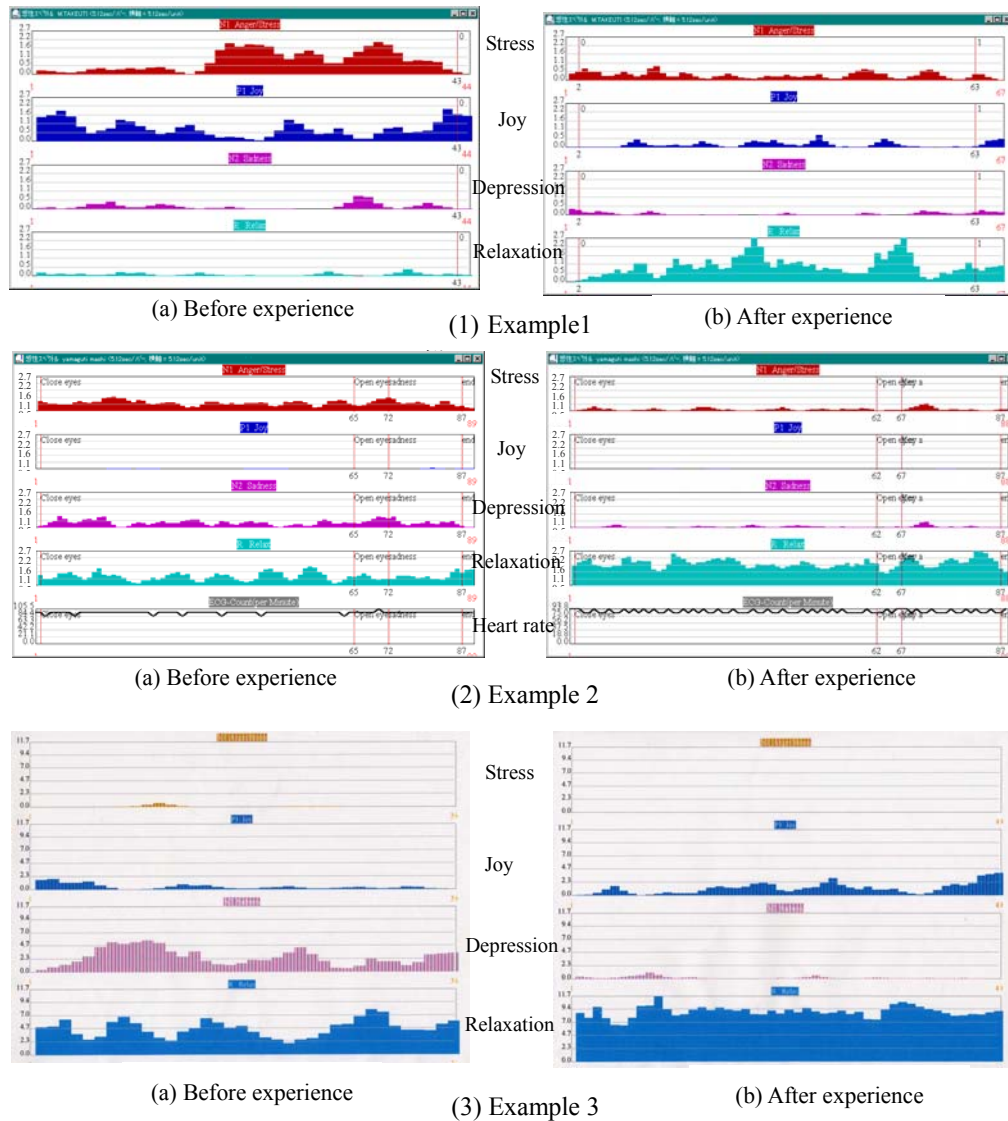


Fig.14. Comparison of brain waves before and after experience of water veil

FUTURE PROSPECTS

People today are living in a stress society, many symptoms related to the stresses started to appear. Appropriate treatments are required to remove these accumulated stresses, but in modern society especially in large cities, it is not easy to do so. The space surrounded by a thin water film called the water veil becomes a splendid environment filling cream air, suitable humidity and a large quantity of minus ion. It was made clear that by staying in this space, the brain wave changes to the α wave and increases relaxation. The present system constitutes the health industry, preventive medical industry and furthermore, a part of the healing industry.

CONCLUSION

- 1) The computational result of the newly developed water veil almost agreed with the experimental results.
- 2) The comfortable space inside water veil filled with minus ions is constructed inside the water veil and this space is found to be effective in healing of mind.
- 3) If the light, smell, music and water massage are added, it is shown that the healing effect increases further.

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