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(54) **Title**: BREATHING APPARATUS FOR IMPROVING THE BODILY APPEARANCE

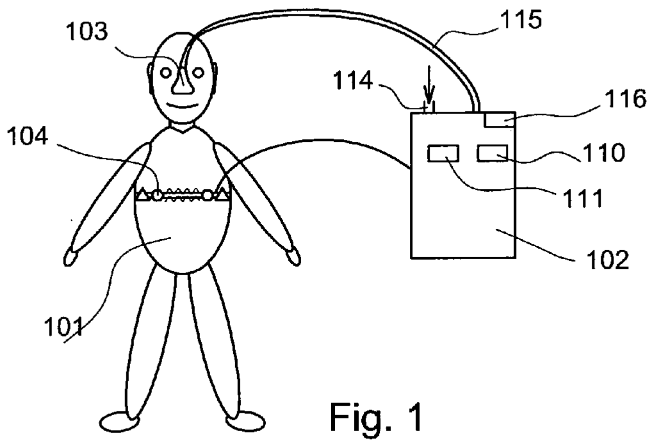

Fig. 1

(57) **Abstract**: The invention relates a breathing apparatus and to a method for providing a cooled breathing gas to a person, in particular to an apparatus and a method for improving the bodily appearance of a person. The breathing apparatus provides a breathing gas comprising an additive in the form of droplets or frozen particles. The breathing apparatus comprises a gas conditioning conduit, gas propulsion means for generating a flow of breathing gas via the gas conditioning conduit, additive injection means for injecting the additive, preferably water droplets or ice particles, into the gas conditioning conduit. Cooling means are provided for cooling the breathing gas and the additive while being transported via the gas conditioning conduit, and a mask is provided for providing the breathing gas to the breathing ducts of a person, preferably via the nose. The breathing apparatus further comprises a control system for controlling the breathing apparatus such that the heat transfer from the body of the person breathing the breathing gas to the breathing gas and additive is high enough to stimulate the metabolism of a person to burn more energy, and is low enough to prevent the body from getting hypothermic.

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Breathing apparatus for improving the bodily appearance

TECHNICAL FIELD AND BACKGROUND OF THE INVENTION

The invention relates a breathing apparatus and to a method for providing a cooled breathing gas to a person, in particular to an apparatus and a method for improving the bodily appearance of a person.

Many people want to improve their bodily appearance by losing fat. To lose fat, the body, more in particular the metabolic system of the body, needs to burn more energy, i.e. calories, than are provided by food intake. Known diet methods include restriction of the intake of calories, and exercising to increase the burning of calories.

However, losing fat via known diet methods takes a long period of time, even when combined with exercising. Many people are not capable of maintaining a reduced calorie intake and/or an increased exercise level over a long period of time and therefore do not achieve the amount of fat loss aimed for. Many people even gain fat in spite of there efforts. Also, even when the diet results in a loss of fat, for a variety of reasons, most people regain the lost fat over time, the so called JoJo effect.

The JoJo effect typically plays a role when a person tries to loose fat by reduction of the calorie intake over a period of time. The metabolic system of a person reacts to lowering or increasing the calorie intake by respectively increasing or decreasing its efficiency in the burning of calories. In reaction to a reduced calorie intake, the metabolic system of the person adapts by burning calories at a lower rate. When the person ends his diet, and increases his calorie intake, the metabolism will need time to adapt. During the transitional period, the metabolic system will still require relatively few calories while the intake of calories has already increased. Thus, the person will regain at least a significant part of the fat he has lost.

SUMMARY OF THE INVENTION

The object of the invention is to provide an apparatus and a method to facilitate loss of calories. More in particular, the object of the invention is to efficiently transfer heat out of the body of a person to cause an increase in the burning of calories in that body for compensating for the heat loss. The object of the invention is achieved by an apparatus according to claim 1 and a method according to claim 20.

An apparatus according to the invention is designed for providing a cooled breathing gas comprising an additive to the breathing ducts of a person. The breathing ducts, i.e. nose, mouth, throat and lungs, are designed for warming a breathing gas, and are saturated with blood for providing heating energy. Cooling the breathing ducts is therefore a very efficient way to transfer heat from the body to the breathing gas and the additive. Furthermore, by providing an additive more heat can be transferred from the body than by using only a breathing gas. Due to the cooling effect of the breathing gas and the additive, heat, i.e. energy, is efficiently transferred via the breathing gas and the additive out of the body of the person breathing the gas. Thus the apparatus can be used to increase the burning of calories in the person's body, resulting in loss of fat and corresponding weight loss.

The breathing apparatus is designed for providing the breathing gas comprising an additive, in the form of droplets or frozen particles, to the breathing ducts of a person. Preferably, the additive is H2O injected into the breathing gas in the form of small droplets or ice particles. It is noted that besides the additive other materials such as gasses, for example oxygen, or small grains, for example grains of salt, can be injected into the breathing gas. In this text the term additive is reserved for the material which is added to the breathing gas to transfer heat from the body of the person breathing the breathing gas, in particular H2O in the form of small airborne droplets or airborne ice particles.

In a preferred embodiment, the additive comprises frozen particles of a substance having a phase change, changing from solid to liquid and/or gas, below 37 degrees Celsius, i.e. the core body temperature of a healthy person. This phase change typically requires a lot of energy, transferring extra energy from the body of the person breathing the breathing gas.

Preferably, the temperature of the breathing gas and the additive is such that the additive changes from a solid state into a fluid state and/or into the gaseous state within the breathing ducts of the person breathing the breathing gas, in particular in the back of the nose or throat such that remaining liquid can be swallowed by the person and does not run out of the nose of the person. Thus, a significant part of the additive is no longer part of the exhaled breathing gas and remains in the persons' body where it is further warmed, draining extra energy from the body.

An apparatus according to the invention is able to efficiently remove large amounts of heath from the body for stimulating the metabolism of the person breathing the breathing gas to burn extra calories. This is in particular beneficial when the breathing apparatus is used in combination with exercising. In such a situation the body already generates extra heath by muscle exercise, requiring substantial cooling of the body to stimulate the metabolism in burning extra calories for warming the breathing gas. The increased heat transfer by use of an additive in combination with the breathing gas stimulates the burning of extra calories even during exercises.

Also, by cooling the body of the user during exercising, less natural body fluid is lost via transpiration. In addition, a substantial part of the additive may remain in fluid form in the body of the person breathing the breathing gas. Thus, the intake of fluid by the person during exercise is less critical and the risk of dehydration is reduced. Furthermore, after exercising the breathing apparatus may be used to reduce the temperature of the body to a normal level more quickly, thus enhancing the recuperation of the body.

Also, by nature the mucous membrane comprised in the breathing ducts, lungs and nasal cavity is humid. During intense exercise, especially when breathing dry ambient air, a lot of the fluid of the mucous membrane escapes the body by simply breathing ambient air. A breathing apparatus according to the invention can be used prior to, during, or after exercising to moisturise the mucous membrane by depositing the fluid additive.

The apparatus is furthermore provided with a control system for controlling the breathing apparatus, in particular for controlling one or more of the process parameters. The process parameters can be controlled such that the heat transfer from the body of a person to the breathing gas is high enough to stimulate the metabolism of that person to burn more calories for keeping the core body temperature at about 37 degrees. Furthermore, the parameters can be controlled such that the heat transfer from the body of a person breathing to the breathing gas is low enough to prevent the core body temperature of the person breathing the breathing gas to drop below the 36 degrees Celsius.

Thus it is possible to provide a person with a breathing gas for a prolonged period of time, for example over a period of several hours, without the risk of inducing hypothermia i.e. lowering the core body temperature of that person below a temperature of 35 degrees Celsius. Hypothermia is unwanted since causes he metabolism and essential body functions to shut down.

By providing a healthy person with a breathing gas comprising an additive according to the invention, the energy consumption of the body of that person can be substantially increased over a long period of time without the risk of inducing hypothermia. Thus the apparatus can be used to obtain an improvement in the appearance of the user's body through loss of fat.

In a preferred embodiment the control system comprises one or more sensors to monitor one or more properties related to the core body temperature of the person breathing the breathing gas, for example the skin temperature of that person or the exhaled breathing gas temperature, and to use the information related to the core body temperature provided by the one or more sensors in a feedback loop to control the process parameters such that the measured parameter is maintained within a specific range. Thus the breathing apparatus actively prevents cooling the body into a hypothermic state.

In a further preferred embodiment, the control system is provided with sensors for measuring the skin temperature of the person breathing the breathing gas, and is designed to use this information in a feedback loop to control the process parameters such that the skin temperature is maintained within a range of -1 and +1 degree Celsius with respect to a set threshold temperature.

An apparatus and a method according to the invention can be used in conjunction with other weight loss techniques to accelerate the weight loss. In a preferred embodiment according to the invention, an apparatus is combined with other weight loss apparatuses. For example, an apparatus according to the invention can be combined with a fitness apparatus such as an ergo meter, tread mill, or rowing machines.

Thus, the invention provides an apparatus and a method to facilitate loss of calories, more in particular, to efficiently transfer heat out of the body of a person to cause an increase in the burning of calories in that body for compensating for the heat loss.

Particular elaborations and embodiments of the invention are set forth in the dependent claims.

Further objects, embodiments and elaborations of the apparatus and the method according to the invention will be apparent from the following description, in which the invention is further illustrated and elucidated on the basis of a number of exemplary embodiments, of which some are shown in the schematic drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is schematic view of a person using a breathing apparatus according to the invention;

Fig. 2 is a schematic view in cross section of a breathing apparatus according to the invention; and

Fig. 3 is a diagram of the control system.

MODES FOR CARRYING OUT THE INVENTION

Fig 1 shows a schematic view of a person 101 using a breathing apparatus 102 according to the invention. It is noted that for reasons of explanatory convenience, the figures are simplified and ratios are adapted. For example, in fig. 1 the size of the breathing apparatus relative to the person does not indicate the actual size of the breathing apparatus. In practice, the size and weight of the breathing apparatus are preferably such that a person can easily lift the apparatus and move the apparatus inbetween locations. Thus the apparatus can for example be placed on or under a desk for using the apparatus during work, onto the front seat of a car for using the apparatus while driving, or to a position next to the bed, for using the apparatus while sleeping. Preferably, the size of the breathing apparatus is such that the apparatus can be worn on the body of the person using the apparatus, for example via a belt or in a back pack.

With a breathing apparatus according to the invention a person can use a breathing gas comprising an additive to improve his bodily appearance. In particular, he can use the breathing gas for cooling his breathing ducts to stimulate his body into burning calories. The apparatus comprises a control system for controlling the breathing apparatus such that the heat transfer from the body of the person breathing the breathing gas to the breathing gas and additive is high enough to stimulate the metabolism of a person to burn more energy, and is low enough to prevent the body from getting hypothermic.

The breathing apparatus shown in Fig. 1 comprises a gas inlet 114 for drawing in ambient air for use as a breathing gas. In the preferred embodiment shown, the breathing apparatus is provided with sensors 116 for providing information to the control system, for example the ambient air temperature. It furthermore comprises a mask 115, in the form of a nose cap 103 and a flexible conduit 115 for connecting the mask to a gas outlet, to provide the breathing gas comprising an additive to the breathing ducts of the person. The preferred embodiment shown is further provided with a breast band 104 comprising sensors for detecting physical properties of the person breathing the breathing gas.

As a breathing gas any breathing gas which is physiologically acceptable can be used. The breathing gas provided is preferably ambient air, or a supply of compressed air from a canister.

As an additive, preferably water is used, for example tap water or as a saline solution, which is injected in the form of small droplets or ice particles into the breathing gas. Depending on, amongst others, temperature of the breathing gas, the breathing gas may be provided to the person comprising ice particles, droplets or a mixture of both.

The breathing gas and the additive will be cooled by the breathing apparatus to a temperature below 37 degrees Celsius. When the person inhales the breathing gas, the body of the person will warm the gas and the additive such that heat energy will be transferred from the body to the gas and additive. Preferably the additive is frozen water, and the temperatures of the breathing gas and the additive are such that the body of the person breathing the breathing gas will melt the ice particles. The phase change of the frozen water into liquid water requires extra energy compared to simply warming ice particles or droplets. Thus, by providing an additive which melts in the body, more in particular the breathing ducts will drain extra energy from the body.

Preferably, the temperatures of the breathing gas and the ice particles are such that all ice particles melt in the breathing ducts, i.e. the nose, lungs and mouth, of the person breathing the breathing gas, such that no ice particles are present in the exhaled breathing gas. More preferably, the breathing gas is provided to the breathing ducts via the nose, and the temperatures of the breathing gas and the ice particles are such that all ice particles melt within the nasal cavity, such that the liquidised additive runs into the back of the throat and can be swallowed by the person breathing the breathing gas.

Preferably, the temperature of the breathing gas and the ice particles is about -3^0 C when entering the nose of the breathing creature, such that at least a substantial part of the ice particles melts before the breathing gas is exhaled again. For example, a sensor may be provided in the mask to monitor the diameter of the ice particles in the breathing gas and/or the temperature of the breathing gas, which information can be used to adjust the process parameters. To prevent the breathing gas and the ice particles from warming up in the flexible duct connecting the mask to the gas outlet of the breathing apparatus, the duct can for example be isolated and/or provided with cooling means.

The apparatus is preferably designed as a portable apparatus such that it can be moved by the user from one place to another. For example the apparatus may be provided with a grip or strap for carrying the apparatus. Thus the apparatus can be placed next to the bed for use while sleeping, or next to the couch for use while watching TV, or next to a desk for use while working.

In a preferred embodiment the apparatus is designed as a portable breathing apparatus which can be worn on the body, in a backpack or via a belt, for use of the apparatus during walking or while commuting to work. Preferably the apparatus is designed for wearing on the body exercising, for example walking, jogging, cycling, etc.

In the preferred embodiment shown in Fig. 1, the mask is configured to in use be placed over the nose of a person. Preferably the mask is positioned by positioning means in the form of an adjustable band. The mask is designed to deliver the breathing gas and additive to the nose of the person, while leaving the mouth free for exhaling the warmed breathing gas.

Thus, the person can inhale the breathing gas provided by the breathing apparatus via his nose and exhale the breathing gas via his mouth. Thus, the gas conditioning means do not obstruct exhaling the breathing gas. Furthermore, the biological function of the nose is to warm air on inhalation and remove moisture on exhalation. Thus, a breathing gas inhaled via the nose will be warmed more than a breathing gas inhaled via the mouth. Therefore, providing the breathing gas via the nose will draw more energy from the body from the breathing creature.

Preferably the mask comprises a gas outlet positioned adjacent to, or in the opening of the user's nose. Thus, the breathing gas and additive are delivered directly to the breathing ducts of the nose, and the risk of ice particles melting prior to entering the nose is minimised.

In an alternative embodiment, the mask covers the mouth or part of the mouth to deliver the breathing gas to the mouth and the nose. Such a mask is preferably provided with a valve which, directs a flow of breathing gas from the breathing apparatus into the mouth and nose when the person inhales, and, upon breathing out of the person wearing the mask, directs the flow of exhaled breathing gas into the ambient air. Thus the flow of exhaled breathing gas is prevented from mixing with the breathing gas not yet inhaled, and does not warm the breathing gas and additive prior to entering the breathing ducts.

In an alternative embodiment, the mask delivers the breathing gas to the mouth only, and the person exhales the breathing gas via his nose.

Furthermore, the mask and/or the conduit connecting the mask to the gas conditioning apparatus, is preferably designed to be disconnected from the apparatus to enable use of the apparatus with different gas masks. Thus a user can replace the gas mask.

For example in a gym or fitness centre, the breathing apparatus may be mounted to sports equipment such as an exercise machine or ergo meter, for example a stationary bicycle, treadmill or rowing machine. A user of the exercise machine can use his personal mask to provide him with breathing gas from the breathing apparatus. Because each user can connect his own mask to the apparatus, multiple users can subsequently use the apparatus, without the need of the mask to be cleaned each time a person ahs finished using the apparatus.

In a further preferred embodiment, the apparatus is provided with means for connecting multiple masks, thus enabling multiple users to use the same apparatus at the same time. In a preferred embodiment the apparatus comprises detection means for detecting how many users are connected to adjust the provision of breathing gas in relation to the number of detected users.

It is noted that breathing masks for providing a person with a flow of breathing gas are generally known as such and will therefore not be further elaborated upon herein.

The apparatus shown in Fig.1 is furthermore provided with a user interface comprising a display 110 for providing visual information, and a control panel 111 for operating the breathing apparatus by the person breathing the breathing gas. Thus the person can adjust the process parameters and adjust the heat transfer to suit his situation. For example, when the person is sitting at a desk he will need less cooling than when he is walking or exercising. Via the control panel he will for example be able to adjust the temperature of the breathing gas or the amount of ice particles in the breathing gas.

Preferably, the control system is designed to indicate the person using the apparatus which settings of the process parameters are safe to use in his situation, i.e. which settings do not result in hypothermia. In a further preferred embodiment, the control system and the process parameters are designed to prevent settings which might cool a person into hypothermia. In a further embodiment, the control system is provided with sensors for actively monitoring the condition of the person, preferably his core body temperature, breathing the breathing gas, and is furthermore designed to use the obtained information to adjust the process parameters to prevent the temperature of the body to severely drop in temperature.

Fig. 2 shows a schematic view in cross section of a breathing apparatus 200 according to the invention for providing a breathing gas comprising an additive in the form of water droplets or vapour. The breathing apparatus comprises a control system, comprising a processor 213, for controlling the breathing apparatus such that the heat transfer from the body of the person breathing the breathing gas to the breathing gas and additive is high enough to stimulate the metabolism of a person to burn more energy, and is low enough to prevent the body from getting hypothermic.

The breathing apparatus comprises a gas conditioning conduit 202, which extends between a gas inlet 114 and a gas outlet 115. Via the conduit 202 a breathing gas is transported through the apparatus. The breathing apparatus is furthermore provided with gas providing means (not shown in Fig. 2), comprising a mask for providing the breathing gas to the breathing ducts of a person, preferably via the nose, and a connection conduit for connecting the mask to the gas outlet 115.

In the embodiment shown ambient air is used as a breathing gas. The breathing gas is drawn into the gas conditioning unit via the inlet 114.

In an alternative embodiment, the breathing gas may for example also be provided from a pressurised reservoir. Such a reservoir may for example be a refillable reservoir received within the apparatus or for example be a separate canister connectable to the air inlet of the apparatus.

For example, when the ambient air is relatively warm it may be profitable to provide the breathing apparatus with a breathing gas which is already cooled, thus limiting the work cooling to be done by the cooling means of the breathing apparatus. By providing the breathing apparatus with a cooled and pressurized breathing gas the cooling means may be limited in size and energy consumption. Thus the breathing apparatus can be small and easy to handle.

Furthermore, when the breathing gas is provided under pressure, it may not be necessary to use a fan, or similar means such as a bellow, to drive the breathing gas via the transport ducts. The gas flow can simply be regulated using an adjustable valve.

In an alternative embodiment, the breathing gas is provided to the breathing apparatus by a pre-processing apparatus. Such a pre-processing apparatus may comprise for example filter means or cooling means for respectively filtering or cooling the breathing gas. Thus the breathing apparatus does not need to perform these tasks, or less extensive, enabling a breathing apparatus with a compact and light design, facilitating wearing the apparatus on the body.

In the embodiment shown the apparatus is provided with gas propulsion means in the form of an air pump 201, for generating a flow of breathing gas via the gas conditioning conduit from the inlet to the outlet. Alternatively, the gas propulsion means could be provided in the form of a fan or any other means suited for generating a gas flow.

Downstream of the air pump 201, the gas conditioning conduit 202 is provided with cooling means for cooling the breathing gas and the additive in that gas, in the form of a heat exchanger. The heat exchanger comprises a cooling circuit in which a cooling medium is circulated for cooling the breathing gas. A first part 210 of the cooling circuit extends within the gas conditionings conduit 202 for cooling the breathing gas and an additive in that gas. A second part of the cooling circuit 204 extends outside the gas conditionings conduit 202 and serves for cooling the cooling medium.

Preferably, the gas conditioning conduit is along most of its length provided with cooling means. In a preferred embodiment, the trajectory for cooling of the breathing gas extends about 24 meters or more. To keep the conditionings conduit compact, it is preferably extends along a spiral shaped trajectory. In Fig. 2 this spiral shaped trajectory is indicated by the zigzag shaped form of the conditionings conduit comprising the cooling means.

Alternative ways of cooling the breathing gas can be used. For example, it In an alternative embodiment, the cooling means can be provided in the form of a cooling body such as a block of ice or a bag of cooled liquid. Such a cooling body can be cooled by external means, for example in a fridge. The cooling body is placed in the breathing apparatus in contact with the conditioning conduit for cooling the conduit and thus the breathing gas and the additive in the breathing gas. The use of a cooling body allows for a breathing apparatus having a simple design.

Along the cooling trajectory of the conditioning conduit according to the invention, the breathing apparatus is provided with additive injection means for injecting the additive in the form of droplets or in the form of ice particles, into the gas conditioning conduit. Preferably, the injection means comprise an atomizer, preferably an ultrasonic atomizer, for introducing fine droplets of water or saline (a sterile solution of sodium chloride in water) which form a mist in the breathing gas. Preferably, the droplets have a size smaller than 5 micrometers. Due to the small size of the droplets quickly freeze and turn into ice particles.

In the embodiment shown in Fig. 2 the injection means are designed for injecting water in the form of small droplets into the breathing gas. The injection means comprise a water reservoir 205, which can be filled via an inlet 206, and a pump 208 for transporting the water from the reservoir to the additive injection means in the sidewall of the gas conditioning conduit. Furthermore, in the embodiment shown, the cooling means are provided with a trajectory 207 for cooling the water prior to being injected, such that the droplets can be easily turned into ice without extensive cooling by the breathing gas. By providing the fluid via anti-drip nozzles, fluid freezing to the nozzle outlets may be prevented.

Furthermore, as is shown in Fig. 2, the injection means are preferably positioned at intervals along the gas conditioning conduit. This to facilitate the absorption of the droplets by the breathing gas, the droplets are added to the breathing gas in little concentrations and in intermediate steps. Thus the breathing gas, while transported via the conditioning conduit, is subsequently subjected to stages of cooling the flow of breathing gas, droplets and/or formed ice particles, and to stages of adding more droplets to the flow of breathing gas. The breathing gas is preferably also cooled during and after the adding of the droplets to prevent the temperature of the breathing gas to rise above the freezing point of the added fluid.

For example, the flow of breathing air is cooled to a temperature of -30 degrees Celsius, after which, small water droplets are injected into the flow of breathing gas. The droplets are cooled by the breathing gas to below freezing point and will turn into ice particles. The cooling of the droplets raises the temperature of the breathing gas. The flow of breathing gas comprising the ice particles is subsequently cooled again such that the temperature of the breathing gas drops to -30 degrees Celsius, after which small water droplets are injected into the flow of breathing gas, etc. Preferably, the water droplets and/or water vapour in the breathing gas are frozen into ice particles before new droplets are added to the flow of breathing gas to prevent the ice particles form sticking together into one big clump of ice.

Preferably, the additive is cooled to near freezing prior to injecting the additive in the breathing gas. After injection into the breathing gas, the droplets are further cooled by the breathing gas to a temperature below freezing point, such that the droplets turn into ice particles. In a preferred embodiment, prior to being injected into the breathing gas, the additive is cooled to its freezing point and kept from freezing by circulating the water. When the additive is injected into the breathing gas, the droplets will instantly freeze.

Preferably, the breathing gas has a temperature between 0 and -15 degrees Celsius, preferably between -2,5 and -3,5 degrees Celsius, more preferably about -3 degrees Celsius. This temperature range stimulates the growth from ice crystals into snow flakes, which essentially are ice crystals formed by dendrites and snow plates sticking together. Ice crystals, and snowflakes in particular, have a relatively large surface to volume ratio when compared to spherical shaped ice particles such as hail stones. The large surface enables easy heat consumption, and therefore ice particles and snow flake will melt relatively quickly in the breathing ducts of the person breathing the breathing gas. This limits the chance that they leave the breathing ducts of the person breathing the breathing gas without melting, and therefore maximises the heat transfer from the body of the person.

Preferably, the injection means are designed for injecting droplets of different sizes and at different rates. By adjusting the size and/or volume of the injected droplets, the cooling capacity of the breathing gas comprising the additive can be adjusted. In a further embodiment, the apparatus is designed to provide a breathing gas with an additive in the form of a mix of both of droplets and frozen particles. The droplets preventing especially the breathing duct from dehydrating by the cold air, while the ice particles enable a high heat transfer from the body of the person breathing the breathing gas.

A person breathing the breathing gas provided by the breathing apparatus is capable of operating via an interface (not showing Fig. 2) the control system for controlling the breathing apparatus such that the heat transfer from the body of the person breathing the breathing gas is high enough to stimulate the metabolism of a person to burn more energy, and is low enough to prevent the body from getting hypothermic. Thus, the breathing apparatus can be used to provide a person with a cooled breathing apparatus comprising an additive, without the person getting hypothermic.

The control system is designed for at least controlling one or more of the following process parameters: the volume of the breathing gas provided per time unit, the volume of the additive provided per time unit, the temperature of the breathing gas, the temperature of the additive, or the size of the ice particles or droplets.

For example, a control system can be designed for controlling the volume of the breathing gas provided per time unit by adjusting the speed of the air pump 201, and/or for controlling the volume of the additive provided per time unit by adjusting the speed of the water pump 208, and/or for controlling the temperature of the breathing gas by controlling the heat exchanger to lower the temperature of the cooling medium, and/or for controlling the temperature of the additive by adjusting the volume of ice particles injected into the flow of breathing gas, and/or for controlling the size of the ice particles or droplets by controlling the injection means to adjust the size of droplets injected into the breathing gas.

The breathing apparatus is provided with a power source 211, which can be provided in the form of an exchangeable battery pack, a rechargeable battery pack and/or a wire to be connected to a power circuit. The power source is used to provide power to the breathing apparatus, for example the air pump, the control system and the cooling means of the breathing apparatus.

The preferred embodiment shown in Fig. 2 is furthermore provided with a cleaning system 212 which enables the draining of condensation fluid from the conditioning conduit and for transporting this condensation fluid back into the water reservoir. After the condensation fluid is removed, the conditioning conduit can be dried by ventilating it with a flow of breathing gas generated by the air pump 201.

In a preferred embodiment, the control system of the breathing apparatus comprises one or more sensors to monitor one or more process parameters and to use this information in a feedback loop to control one or more of the process parameters.

For example, the control system may be provided with a temperature sensor at the gas outlet and/or the mask for measuring the temperature of the breathing gas, or with a sensor for detecting the size of frozen particles injected in the breathing gas

Furthermore, the control system preferably comprises one or more sensors to monitor one or more properties related to the core body temperature of the person breathing the breathing gas, for example the skin temperature of that person or the exhaled breathing gas temperature. The control system can use this information to adjust the process parameters. For example, when the person has a high heart frequency and a low skin temperature, the control system may limit the cooling effect of the breathing gas to prevent the body of the person from quickly dropping in temperature. Also, the control system may provide the person using the apparatus with an audio signal and/or visual signal when the measured temperature or another measured entity such as the heart frequency, drops below a threshold value. The threshold value can be a fixed value, can be selected by the control system or can be entered by the person using the apparatus, and who, on basis of experience or preference, can choose for a specific threshold value.

The control system may furthermore be provided with sensors for detecting external properties, for example the temperature and humidity of the ambient air, and use this information to control the process parameters. For example, the apparatus may use ambient air to provide a breathing gas. When the temperature of the ambient air increases, for example because the breathing apparatus is moved to another room or from inside a house to outside, the cooling means have to be adjusted to provide extra cooling power. The external properties may also influence the condition of the person. For example when the ambient air is warm and humid the person will lose little heat energy through transpiration and the core body temperature will drop less quickly compared to when the ambient air is dry and cold. Therefore, the cooling effect of the provided breathing gas can be increased without the risk of cooling the body of the person into hypothermia.

Sensors for detecting for example the heart frequency, the skin or the muscle activity could be pasted onto the skin could be clamped to the finger or ear of the person breathing the breathing gas. In a preferred embodiment, sensors and control system are designed for transferring the information wireless. Thus the person is not limited in his movements by wires connecting the sensors to the control system.

In a preferred embodiment, the breathing apparatus is provided with a sensor upper body belt or with a wrist band, which the user can wear around his upper body part or wrist respectively, for detecting physical properties related to the core body temperature of the person. The belt or band can be provided with sensors for detecting for example the heart frequency, skin temperature, etc.

Fig. 1 shows a perspective view of a person using a breathing apparatus according to the invention wearing an upper body belt 104. In a preferred embodiment, the upper body belt is configured for detecting breathing frequency of the person breathing the breathing gas. Upon inhaling, the circumference of the upper body part expands, and upon exhaling the circumference of the upper body part reduces. The upper body belt is preferably configured for detecting the expansion of the upper body part, for example via a sensor for detecting stretching of the band, or of a particular part of the band. The extend of the expansion of the upper body part and the frequency of the expansion are indicators of the breathing frequency of, and the inhaled/exhaled volume by the person wearing the upper body belt. Thus the breathing frequency can be registered in simple manner without the need of sensors measuring the flow of breathing gas.

In a further embodiment, the control system may be designed for receiving user specific information via a user interface, such as age, gender, body weight and length, or trainings program information. The user interface may be provided with a keyboard for entering the information by hand, or with a slot for receiving a memory card containing the information. Thus, information specific to the user of the breathing apparatus can be entered quickly and easy. Furthermore, the control system preferably comprises a memory for storing the user specific information such that the information at a later time can be retrieved by the user from the memory.

The breathing apparatus can use this specific user information, to control the process parameters. Furthermore, in combination with user information actively received via sensors, such as the skin temperature, this user specific information can be used to monitor the condition of the person breathing the breathing gas.

Fig. 3 shows a diagram of the control system, with arrows indicating the flow of information. On the left of the control system are shown an examples of information provided by the sensors of the control system, such as the skin temperature of the person breathing the breathing gas. In addition information can be provided to the control system from other sources, such as a memory stick, the control system of a fitness apparatus, etc. Furthermore, the control system receives information via the user interface, which is indicated in the top. This information, such as a preferred threshold temperature, is entered into the control system via the user interface by the person breathing the breathing gas.

The control system also provides information to the person breathing the breathing gas via a display, which is shown at the bottom. The information may for example relate to the process parameters and/or information obtained via the sensors and/or further information, such as an estimation of the extra calories burned by breathing the breathing gas.

The control system uses the provided information to control the process parameters, in particular via controlling the hardware of the apparatus, of which examples are shown on the right. To process the information, the control system is provided with software (not shown in the diagram), for example for linking a measured skin temperature to the probable core body temperature of a person, and for selecting the correct settings of the process parameters to stimulate the burning of calories while preventing the person from getting hypothermic.

Furthermore, the software preferably provides safety values relating to the process parameters and to the condition of the person breathing the breathing gas. For example, when the control system measures a skin temperature below such a safety value, for example 35 degrees Celsius, indicating severe cooling of the body, it may switch off the breathing apparatus. In a preferred embodiment the breathing apparatus is provided with heating means such that when the measured skin temperature drops below the safety value, the control system can stop cooling the breathing gas and switch on the heating means for providing a warmed breathing to increase the body temperature.

Furthermore, the control system may run a program for estimating the amount of calories burnt by the person breathing the breathing gas. This information is presented to the person breathing the breathing gas via the display and may also be stored in the memory for later retrieval. In a further embodiment, the breathing apparatus is provided with means for connecting the control system to a computer system or the internet for storing and retrieving information. The information provided by the sensors is preferably used by the control system to monitor the process parameters, and to prevent the body of the person to cool to severely drop in temperature. Preferably, the control system monitors a property related to the core body temperature of the person breathing the breathing gas, such as his skin temperature or the temperature of the exhaled breathing gas, and controls the process parameters such that the property will not drop below or rise above a threshold value, or will remain within a range relative to a threshold value.

In a preferred embodiment, the control system uses the information related to the core body temperature provided by the one or more sensors in a feedback loop to control the process parameters such that the measured properties is maintained within a specific range. It noted that especially a change of skin temperature and a change in heart frequency are believed to be accurate indicators for the change in core body temperature.

For example, the control system may comprise one or more sensors for measuring the skin temperature, preferably near the arm pit, of the person breathing the breathing gas. The skin temperature is linked to the core body temperature of the person breathing the breathing gas. When the core body temperature drops due to the transfer of heat energy from the body, the skin temperature will drop also. Thus, the skin temperature information can be used by the control system in a feedback loop to control the process parameters. When the skin temperature drops below a threshold value, the control system can, for example by lowering the volume of additive injected into the breathing gas, limit the energy transferred from the body of the person breathing the breathing gas to prevent the apparatus form cooling the person into hypothermia.

Preferably, the control system is designed to maintain the skin temperature within a range relative to a threshold temperature. For example, the control system may monitor the skin temperature, and adjust the process parameters such that the skin temperature will remain within a range from 1 degree below and 1 degree above a threshold temperature.

The range and threshold temperature can be set by the person or the control system. The control system may for example use user specific information entered by the user, such as length, gender or age, or information obtained via on or more sensors, such as heart frequency or skin temperature, to select and set a threshold value and/or a range relative to a threshold temperature.

In a preferred embodiment, the control system obtains this information while the person is breathing the breathing gas. In a further preferred embodiment, the control system collects such information prior to providing the person with the breathing gas. For example, the apparatus may first register the heart frequency and skin temperature of the person over a time interval of 30 seconds and use this information to set the threshold values, prior to providing the breathing gas comprising the additive. Alternatively, based on the information of the user, the control system may present the person with a limited number of threshold values, or a limited range, from which or wherein the person can select a save to use threshold value of his preference.

Also, the control system may use this information to adjust the process parameters. For example, when the person has a high heart frequency and a low skin temperature, the control system may limit the cooling effect of the breathing gas to prevent a quick drop in temperature of the body of the person breathing the breathing gas.

A breathing apparatus according to the invention is designed for cooling a person over a prolonged period of time, preferably for more than 1 hour, to stimulate the body of that person to burn extra calories, without lowering the core body temperature of that person below 36 degrees Celsius. Therefore, the injection means may for example be designed to inject a volume of additive in the range of 0,1 to 2,5 litres per hour into the breathing gas, such that the maximum cooling capacity of the breathing apparatus is restricted, and the breathing apparatus is not able to cool the core temperature of a healthy full grown person into hypothermia. In an alternative embodiment for example the control system of the breathing apparatus may limit the cooling capacity of the breathing apparatus by restricting the maximum amount of additive to be injected into the breathing gas. Preferably, the apparatus, in particular the control system is designed for adding no more than 0,5 litres of ice particles to a flow of breathing gas of 300 litres per hour for a person during limited physical activity, for example when the person breathing the breathing gas is sleeping, and to no more than 2,0 litres of ice particles to a flow of breathing gas of 1200 litres per hour for a person during high physical activity, for example a person jogging.

The invention furthermore provides a method for improving the bodily appearance of a person's body through inducing weight loss. The method comprises the following steps.

Providing a flow of breathing gas, injecting an additive in the flow of breathing gas. Furthermore, cooling the flow of breathing gas and the additive to a temperature below 37 degrees Celsius, preferably to a temperature below 0 degrees Celsius, such that the body of a person breathing the breathing gas will warm the breathing gas and the additive comprised therein. Providing the breathing gas comprising the additive to the breathing ducts of the person, and increasing the metabolism of that person by cooling his breathing ducts with the breathing gas.

A further preferred method also comprises the step of measuring the body temperature of the person breathing the breathing gas, and controlling the flow of breathing gas and/or the injection of additive and/or the cooling of the flow of breathing gas and/or the cooling of the additive in dependence of the measured body temperature, to obtain a maximum cooling effect without lowering the body temperature of the person below 36 degrees Celsius.

A further preferred embodiment also comprises the step of injecting the additive in the form of small droplets, wherein the flow of breathing gas has a temperature below the freezing point of the additive such that the droplets turn into ice particles.

It is noted that the method and apparatus are suitably used with humans, preferably with moderate overweight humans, i.e. having a Body Mass Index in de range of 25-30, for losing fat to obtain an improvement in bodily appearance, i.e. achieve a cosmetic improvement of the body. The apparatus can furthermore be used by a person who wants to prevent gaining weight. For example a person who can not exercise for a period of time due to a sports injury, and who does not want to change his diet, may use the apparatus to prevent gaining weight during this period. To further increase the burning of calories, the person breathing the breathing gas may exercise while breathing the breathing gas. In a preferred embodiment, the breathing apparatus is designed such that it can be worn on the body. Thus the breathing apparatus enables the person breathing the breathing gas to exercise, for example by walking or using a fitness apparatus, while breathing the breathing gas and to thus to stimulate the burning of energy, i.e. calories. The invention also provides a fitness system comprising a fitness apparatus, for example a stationary bicycle, treadmill or rowing machine and a breathing apparatus according to the invention, for providing a person using the fitness apparatus with a conditioned breathing gas. The breathing apparatus, or part thereof, can also be integrated into a fitness apparatus.

In a further preferred embodiment, the control system of the breathing apparatus is designed for connecting to the control system of a fitness apparatus, such that the control systems can exchange information. Thus the control system of the breathing apparatus can for example adjust the process parameters in accordance with a training program running on the control system of the fitness apparatus. For example, a person may choose a training program on a treadmill alternating fast running with walking. Since the control system of the breathing apparatus is linked to the control system of the treadmill, it can for example increase the heat transfer while the person is running, and drop the heat transfer when the person is walking. In a further embodiment, the control system of the breathing apparatus is integrated with a control system of a fitness apparatus.

The invention furthermore provides a gym or fitness centre comprising a breathing apparatus according to the invention for providing a person using the gym with a conditioned breathing gas. The breathing apparatus may be part of a fitness apparatus or may be situated in the fitness centre for providing one or more person with a breathing gas according to the invention.

Alternatively, the breathing apparatus can also be used for providing a person with a breathing gas after exercising to reduce the temperature of the body to a normal level more quickly, thus enhancing the recuperation of the body.

In a further preferred embodiment the breathing apparatus are configured to add oxygen to the breathing gas, thus providing a user with extra energy during exercising. Also, an aromatic substance may be added to the breathing gas. For example by adding menthol aroma the gas user may experience a sense of freshness which motivates him during exercising. For example by adding lavender aroma the breathing gas may relax the user which may be beneficial when the apparatus is used during sleep. Furthermore, a medicine may be added to the breathing gas, for example insulin for use by diabetics or bronchodilators for the treatment of asthma.

An apparatus according to the invention may also be provided with means for treating air, such as a filter for removing pollutants such as grains of dust from ambient air to be used as a breathing gas.

In a further alternative embodiment the additive injection means are designed for injecting ice particles into the flow of breathing gas. For example, the injection means may comprise at least one cooling element for forming a body of ice thereupon, preferably by way of guiding moist air along a cooled surface of the cooling element. The cooling element is movably supported relative to a scraper body for moving the body of ice along the scraper body to generate small ice particles. In a further alternative the rasp or grater is also formed by a body of ice. By guiding the breathing gas along the ice being crunched or gartered, the particles of ice may be introduced onto the stream of breathing gas.

In an alternative embodiment, an apparatus according to the invention comprises cooling means configured to expand a pressurised breathing gas to lower the temperature of the breathing gas. Preferably, the additive injection means are furthermore configured to add a fluid in the form of vapour or gas to the breathing gas prior to expanding, for forming ice particles within the breathing gas upon expansion. The vapour or gas may also be added during the expansion of the breathing gas.

In a further embodiment according to the invention, the apparatus the warming means are designed to warm a medium, preferably the additive, for circulating the cooling conduits of the cooling pads. Thus the cooling pads can also be used for warming parts of the body.

In a further preferred embodiment, the breathing apparatus is provided with grain injection means for injecting small grains, also called nano-particles, such as small grains of salt, clay or sand, into the breathing gas, to trigger the forming of ice crystals out of cooled water droplets or water vapour. The airborne grains form a core to which the water molecules can attach, and thus stimulate the forming of ice crystals in the breathing gas. It is noted that small quantities of grains may be sufficient. In a preferred embodiment, the particles are provided in a replaceable cartridge which can be received in the breathing apparatus such that the grain injection means can inject controlled amounts of grains into the breathing gas. When all grains are used the cartridge can be replaced and/or refilled.

For example when the breathing gas is guided via a filter to remove pollutants prior to entering the gas conditioning conduit, it is beneficial to introduce a controlled amount of grains into the breathing gas.

In a preferred embodiment, the breathing gas is guided via extra filters to remove all pollutants, natural airborne particles and grains from the breathing gas prior to entering the gas conditioning conduit. Since airborne grains are needed for triggering the forming of ice particles, such a purified breathing gas is unfit for forming ice particles. By subsequently injecting a controlled amount of grains, the amount of ice particles formed in the breathing gas can be controlled.

Furthermore, by controlling the amount of grains injected into the breathing gas the size of the ice particles can be controlled. For example, when a constant volume of water vapour is added to the breathing gas, injecting a small amount of grains will lead to a small amount of large ice particles, while a large amount of grains will lead to a large amount of small ice particles.

A breathing apparatus according to the invention may be provided with an active or a passive system, or both. With an active system the flow of breathing gas is synchronized with the breathing frequency of the person breathing the breathing gas, such that the volume of breathing provided at the mask is maximal when the person inhales en minimal when the person exhales. Preferably, the volume of provided breathing gas matches the volume of breathing gas inhaled by the person. In an alternative embodiment, the person may inhale ambient air as well as breathing gas provided by the apparatus, for example because the breathing mask does not cover the entire nose openings and/or the person inhales ambient air via his mouth while inhaling the provided breathing gas via his nose.

Preferably, the control system is provided with one or more sensors to monitor the breathing frequency of the person breathing the breathing gas. For example, the nose mask may be provided with a sensor which is positioned at the underside of the mask, near the mouth of the person breathing the breathing gas, to detect the breathing frequency of that person by measuring the flow of the exhaled breathing gas. Also, the person breathing the breathing gas may be provided with an upper body band for detecting the breathing frequency by detecting the pattern of expansion of the upper body part due to breathing. The control system is furthermore designed to use the information provided to control the gas propulsion means to provide a flow of breathing gas having a frequency corresponding to the breathing frequency of the person. An active system is especially suitable for providing a breathing gas to a sleeping user. In a preferred embodiment, shown in Fig. 2, the active system comprises with a pair of automated bellows 203, for generating a flow of breathing gas which fits a breathing pattern of a person breathing the breathing gas. Systems for generating a frequency in a breathing gas are generally known. Any device for creating a rhythmic adaptation in the volume of a flow of breathing gas to match the breathing of the person using the breathing apparatus can be suitable for an apparatus according to the invention. As an alternative to an active system, a passive system can be used. With a passive system the breathing gas is provided at a constant speed and pressure, which makes it easier to manage the flow and cooling of the breathing gas by a control system.

To further increase the burning of calories, in addition to breathing the breathing gas, the person breathing the breathing gas may cool his body by additional cooling means. In a preferred embodiment according to the invention, the breathing apparatus is provided with one or more cooling pads which can be worn externally on the body for cooling the body via the skin,> The apparatus furthermore comprises cooling means for cooling the pads. The cooling pads comprise a cooling surface for cooling the skin of a person and cooling conduits for circulating a cooling liquid through the cooling pad to cool the cooling pad, in particular the cooling surface.

The cooling pads can be placed on body parts, for example the upper legs or stomach area, to cool the body. In a preferred embodiment, the cooling pads can be worn on the body. For example, the cooling pads can be integrated in a vest or in a belt which can be worn on the upper body. In a preferred embodiment, the cooling means for cooling the pads are also used for cooling the breathing gas and/or the additive. As an alternative, the cooled additive, preferably cooled water, can be used to circulate via the cooling conduits of the cooling pads. Thus, the additive can be used to cool the body via the skin as well as via the breathing ducts, and no extra heat exchanger or cooling medium is needed.

It is noted that the apparatus and the cooling pads are designed such that the skin will not be cooled to an extend that it gets injured or will freeze. For example, the control system can be provided with sensors to monitor the temperature of the cooling medium in the cooling pads, and/or the temperature of the cooling surface of the cooling pads.

In a further preferred embodiment, the breathing apparatus comprises warming means for warming the breathing gas and the additive. Thus the breathing apparatus can also be used for warming the body, or for providing a person with a breathing gas of a temperature higher than the temperature of the ambient air. For example when a person has used the apparatus during a work out he can switch the apparatus to warming the breathing gas during the cool down afterwards. The apparatus is configured for providing the temperature of the breathing gas and the additive such that the body of the person is not warmed into hyperthermia, i.e. a core body temperature above 40 degrees Celsius. Preferably the breathing apparatus is provided with a control system for managing the temperature of the breathing gas and the additive, preferably such that the warming means warm a breathing gas to about 37 to 38 degrees for warming the core body temperature of the person breathing the breathing gas to about 37 degrees Celsius.

For example, when the breathing apparatus is used to warm ambient air from a temperature of 18 degrees to a temperature of 37 degrees, the body of the person breathing the warmed breathing gas does not need to burn calories to warm the inhaled breathing gas. By breathing such a warmed breathing gas instead of the cooler ambient air, the body saves energy.

Furthermore, by injecting water vapour or small droplets into the breathing gas, a breathing gas having an air humidity of 100% and a temperature of about 37 degrees Celsius can be provided. Such a breathing gas prevents the evaporation of moist from the mucous membrane. This severely slows down the cooling down of the body which typically loses most energy via heat transfer form the breathing ducts to breathed air, in particular by evaporation of moist form the mucous membrane.

Furthermore, by providing a person with a warmed breathing gas over a period of time the apparatus can also be used for a person to lessen the burning of calories by his body. Such an apparatus is in particular suited for persons who want to improve their bodily appearance by saving energy, inducing weight gain and fat accumulation.

The present invention relates to a method and apparatus for generating a heat transfer from a body of a person to a breathing gas comprising an additive. More particularly, the present invention is directed to a method of, and apparatus for, increased burning of calories, by providing a breathing gas with an additive. This contributes to a negative energy balance. To fill this shortage, the body will burn fat to get energy. By burning the fat the body will lose weight (1kg fat is about 1,3 liters in volume).

An apparatus according to the invention can be used for increasing the energy consumption of a passive person. For example a person may use the apparatus while sleeping, watching television, driving a car, sunbathing at the beach or sitting behind a pc, thus stimulating his metabolism to reduce weight or to prevent weight gain.

Also, an apparatus according to the invention may be used for increasing the metabolism of an active person. For example a person may use the apparatus while jogging to further increase the energy consumption of his body. Furthermore, when used during exercising, the cooling effect of the breathing gas may prevent overheating of the body and allow the person to exercise for a prolonged period of time. Thus the invention provides an apparatus for enhancing the physical condition, and hence the performance of a person.

It is noted that the method and apparatus are particularly suitable for healthy non obese persons having a Body Mass Index of 20-25, or persons having a moderate overweight or a Body Mass Index of 25-30, to maintain a specific weigh without exercising, to prevent weight gain after for example a vacation, or for inducing weight loss to improve their bodily appearance.

In a further embodiment the additive is water injected into the breathing gas in a gaseous form. This water vapour is subsequently cooled by the breathing gas into small droplets or ice particles prior to entering the breathing ducts of the person breathing the breathing gas.

From the foregoing, it will be clear to the skilled person, that within the framework of the invention as set forth in the claims also many variations other than the examples described above are conceivable. For instance, in the embodiment shown in Fig. 2, the breathing apparatus comprises gas propulsion means in the form of an air pump. In an alternative embodiment, the air propulsion means may for example comprise a mechanical ventilator or any other means suitable for generating a gas flow. Also, in addition, or as an alternative, to gas propulsion means provided in the gas conditioning conduit, gas propulsion means can be provided in the mask or the conduit connecting the mask to the gas conditioning conduit. Also, the gas conditioning conduit may be provided with multiple gas inlets and/or multiple gas propulsion means along the length of the conduit

It is noted that the ice particles can be formed in different ways. For example, the additive can be added in the form of a fluid, vapour, steam or droplets, to a cooled breathing gas

Furthermore, the injection means may for example be configured to generate particles of ice and to inject these ice particles into the flow of breathing gas. For example, the apparatus may comprise cooling elements to freeze water into bodies of ice, or the apparatus may comprise a space for storing bodies of ice formed outside the apparatus, for example in a separate fridge. The apparatus may further comprise automatic means for crunching the bodies of ice into small ice particles or for example a rasp for grating the body of ice to generate small ice particles, which ice particles are then added to the flow of breathing gas.

Also, the gas conditioning conduit and the cooling means can be configured to cool the breathing gas and the additive by exposing them to frost, or to an alternative cooling medium.

Also, the control system can be designed to control the parameters relative to each other to simplify managing by the user, who for example only one needs to enter one parameter or a user profile such as "low intensity" for use of the apparatus while sleeping, "medium intensity"for using the apparatus while sitting down, or "high intensity" for use of the apparatus during exercising.

Other variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing the claimed invention, from study of the drawings, the disclosure, and the appended claims. In the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article "a" or "an" does not exclude a plurality. A single processor or other unit may fulfill the functions of several items recited in the claims. The mere act that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measured cannot be used to advantage. Any reference signs in the claims should not be construed as limiting the scope.

CLAIMS

1. Breathing apparatus for providing a breathing gas to a person, the breathing gas comprising an additive in the form of droplets or frozen particles, the breathing apparatus comprising:

-a gas conditioning conduit, which extends between a gas inlet and a gas outlet;

-gas propulsion means for generating a flow of breathing gas via the gas conditioning conduit from the inlet to the outlet;

-additive injection means for injecting the additive, preferably water droplets or ice particles, into the gas conditioning conduit;

-cooling means for cooling the breathing gas and the additive while being transported via the gas conditioning conduit;

-a mask for providing the breathing gas to the breathing ducts of a person, preferably via the nose, and a connection conduit for connecting the mask to the gas outlet;

-a user interface for use by the person breathing the breathing gas to operate a control system; and

-a control system for controlling the breathing apparatus such that the heat transfer from the body of the person breathing the breathing gas to the breathing gas and additive is high enough to stimulate the metabolism of the person to burn more energy, and is low enough to prevent the body from getting hypothermic, wherein the control system is designed for at least controlling one or more of the process parameters below:

-the volume of the breathing gas provided per time unit;

-the volume of the additive provided per time unit;

-the temperature of the breathing gas;

-the temperature of the additive;

-the size of the frozen particles or droplets.

2. Breathing apparatus according to claim 1, wherein the control system comprises one or more sensors to monitor the one or more process parameters and to use this information in a feedback loop to control one or more of the process parameters.

3. Breathing apparatus according to claim 1 or 2, wherein the control system comprises one or more sensors to monitor one or more properties related to the core body temperature of the person breathing the breathing gas, for example the skin temperature of that person or the exhaled breathing gas temperature.

4. Breathing apparatus according to claim 3, wherein the control system is designed to provide the person using the apparatus with an audio signal and/or visual signal when the measured temperature drops below a threshold temperature.

5. Breathing apparatus, according to claim 3 or 4, wherein the control system is designed to use the information related to the core body temperature provided by the one or more sensors in a feedback loop to control the process parameters such that the measured property is maintained within a range.

6. Breathing apparatus according to claim 5, wherein the control system comprises one or more sensors for measuring the skin temperature, preferably near the arm pit, of the person breathing the breathing gas, and wherein the control system is designed to use this information in a feedback loop to control the process parameters such that the skin temperature is maintained within a range, preferably within a range of -1 and +1 degree Celsius with respect to a set threshold temperature, which threshold temperature is set by the control system or by the person.

7. Breathing apparatus according to any one of the claims 2-6, wherein the breathing gas comprises ice particles and the control system is designed to use the information provided by the one or more sensors in a feedback loop to control the process parameters such that ice particles melt before leaving the breathing ducts, preferably melt within the nasal cavity and/or the back of the throat, of a person breathing the breathing gas.

8. Breathing apparatus according to any one of the preceding claims, wherein the control system is designed for receiving user specific data such as age, gender, body weight and length, or trainings program information, via a user interface such as a keyboard or touch screen, or from a computer, memory stick etc, and wherein the control system uses this information to control the process parameters.

9. Breathing apparatus according to claim 8, wherein the control system comprises a memory for storing the user specific information such that the information can be retrieved by the user at a later time.

10. Breathing apparatus according to any one of the previous claims, wherein the control system is designed for receiving information from, or is integrated with, a control system of a fitness apparatus, for example a treadmill or ergometer.

11. Breathing apparatus according to any one of the preceding claims, wherein the control system comprises one or more sensors to monitor the breathing rhythm and/or volume of the person breathing the breathing gas, and the control system is designed to use this information to control the gas propulsion means to provide a flow of breathing gas having a frequency and/or volume corresponding to the breathing frequency.

12. Breathing apparatus according to any one of the preceding claims, wherein the injection means are designed to inject the additive in the form of droplets, and wherein the breathing gas has a temperature between 0 and -15 degrees Celsius, preferably between -2,5 and -3,5 degrees Celsius, more preferably about -3 degrees Celsius.

13. Breathing apparatus, according to any one of the preceding claims, wherein the injection means are designed to inject the additive in the form of droplets, and wherein the injection means are provided at intervals along the gas conditioning conduit, such that the breathing gas is successively subjected to stages of cooling the breathing gas and to stages of injecting droplets into the breathing gas.

14. Breathing apparatus, according to any one of the preceding claims, wherein the injection means are designed to inject a volume of additive in the range of 0,1 to 2,5 litres per hour into the breathing gas.

15. Breathing apparatus, according to any one of the preceding claims, wherein the apparatus is provided with one or more cooling pads which can be worn externally on the body for cooling the body via the outer surface, i.e. skin, and the apparatus furthermore comprises cooling means for cooling the pads.

16. Breathing apparatus according to claim 15, wherein the cooling means for cooling the breathing gas and/or the additive are designed for in addition cooling the cooling pads.

17. Breathing apparatus, according to any one of the preceding claims, wherein the apparatus is designed to be worn on the body of a person, preferably during exercise, while providing the person with the breathing gas comprising the additive.

18. Use of a breathing apparatus according to any one of the previous claims, for cooling a person over a prolonged period of time, preferably for more than 1 hour, to stimulate the body of that person to burn extra calories, without lowering the core body temperature of that person below 36 degrees Celsius.

19. Use of a breathing gas comprising particles of frozen water to improve the bodily appearance of a person, by cooling the breathing ducts of that person to stimulate the metabolism of the body of that person into burning calories, wherein the temperature and volume of the breathing gas and ice particles is such that the core body temperature of that person is not lowered below 36 degrees Celsius.

20. Method for improvement in the bodily appearance of a person through inducing weight loss, comprising the steps of:

providing a flow of breathing gas;

injecting an additive in the flow of breathing gas;

cooling the flow of breathing gas and the additive to a temperature below 37 degrees Celsius, preferably to a temperature below 0 degrees C; and

providing the breathing gas comprising the additive to the breathing ducts of the person, and increasing the metabolism of that person by cooling his breathing ducts with the breathing gas.

21. Method according to claim 20, further comprising the step of:

monitoring the body temperature of the person breathing the breathing gas; and

controlling the flow rate of breathing gas and/or the injection of additive and/or the cooling of the flow of breathing gas and/or the additive in dependence of the measured body temperature to obtain a maximum cooling effect without lowering the body temperature of the person below 36 degrees Celsius.

22. Method according to claim 20 or 21, wherein the additive is injected in the form of small droplets, and wherein the flow of breathing gas has a temperature below the freezing point of the additive such that the droplets turn into ice particles.

23. Method according to any of the claims 20-22, wherein an apparatus according to any one of the claims 1-17 is used for cooling the breathing gas and the additive.

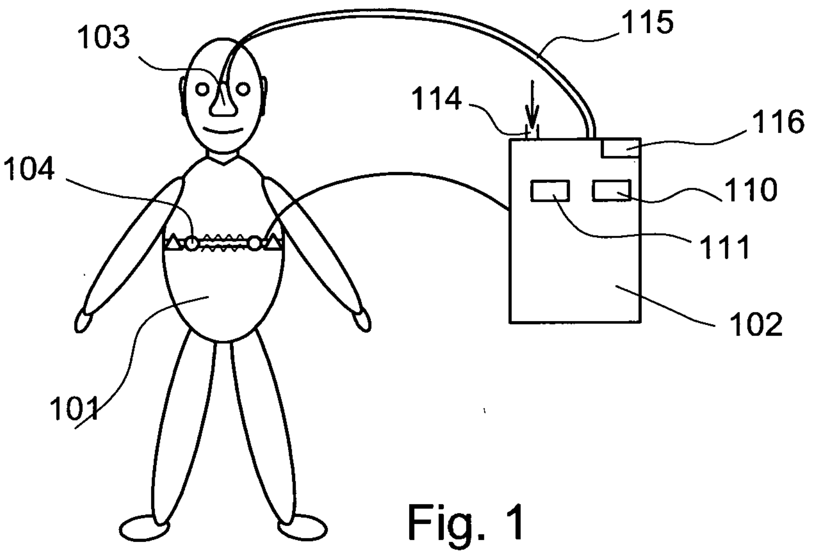
103
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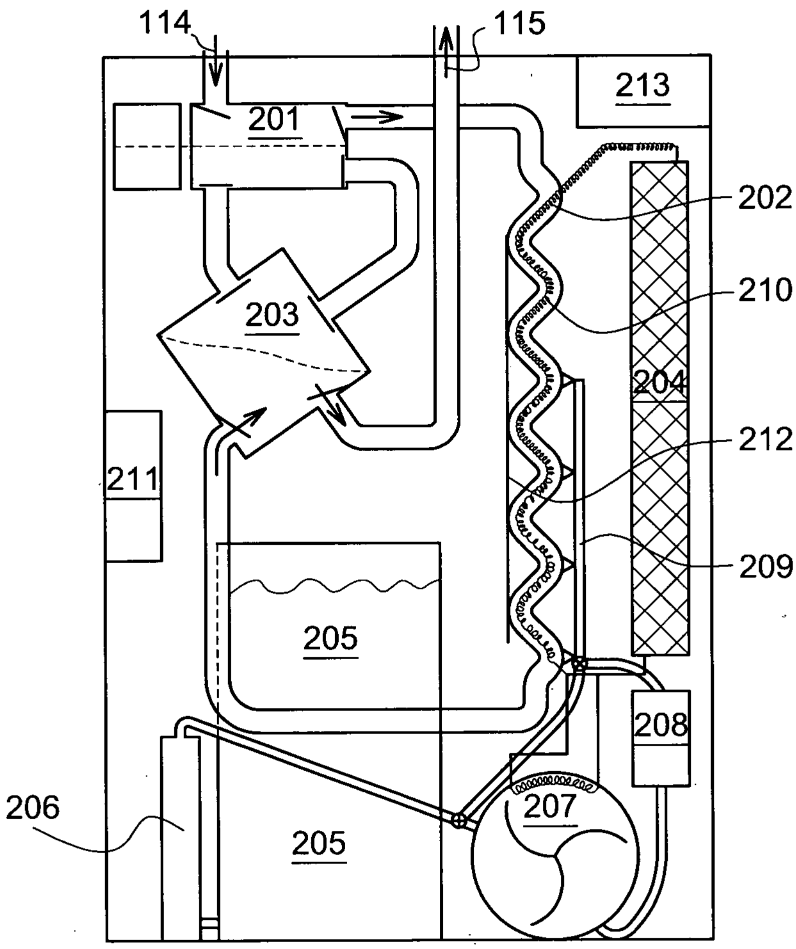
Fig. 1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205

Fig. 2

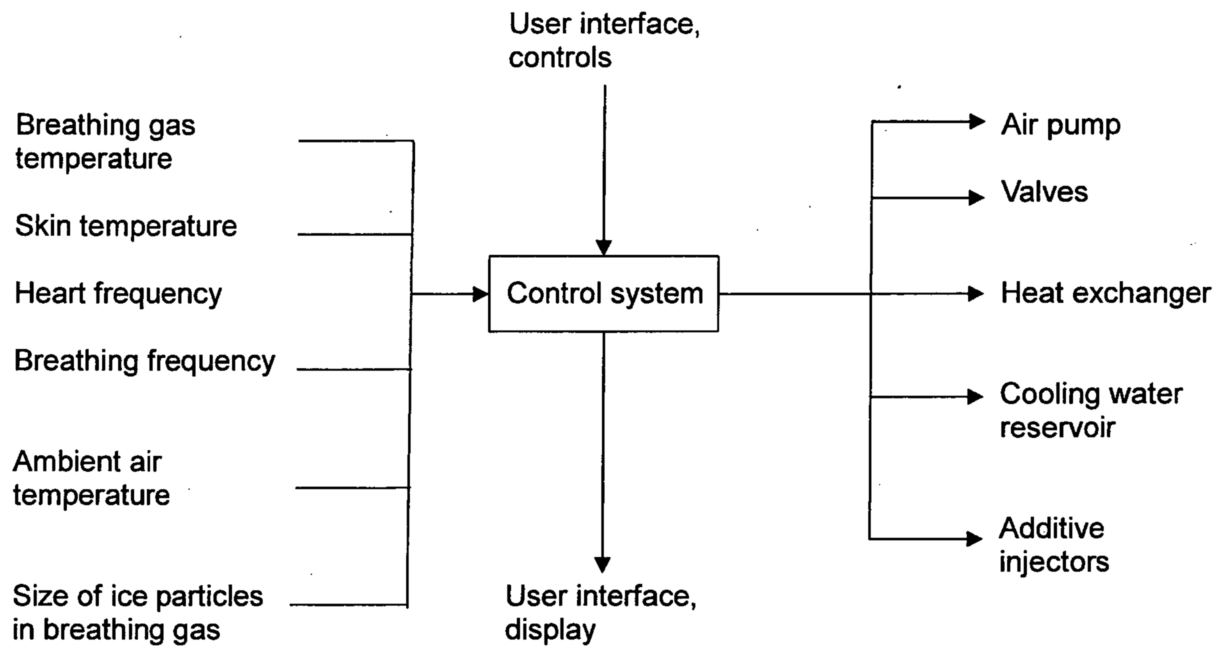
User interface, controls
Breathing gas temperature
Skin temperature
Heart frequency
Breathing frequency
Ambient air temperature
Size of ice particles in breathing gas
Control system
User interface, display
Air pump
Valves
Heat exchanger
Cooling water reservoir
Additive injectors

Fig. 3

INTERNATIONAL SEARCH REPORT

International application No
PCT/NL2009/000027

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61M16/10 A63B22/00 A63B24/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A61M A63B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2005/070035 A2 (BELSON AMIR [US]) 4 August 2005 (2005-08-04) the whole document	1-23
E	WO 2009/022902 A1 (VERVOORT MARINUS JACOBUS [NL]) 19 February 2009 (2009-02-19) the whole document	1-2,20
A	WO 2005/113046 A2 (BRIGHAM & WOMENS HOSPITAL [US]; JIANG YANDONG [US]; FERRIGNO MASSIMO [) 1 December 2005 (2005-12-01) abstract; figures	1

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
2 November 2009	10/11/2009

Name and mailing address of the ISA/	Authorized officer
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INTERNATIONAL SEARCH REPORT

International application No
PCT/NL2009/000027

Patent document cited in search report		Publication date	Patent family member(s)			Publication date
WO 2005070035	A2	04-08-2005	CA	2559403	A1	04-08-2005
			EP	1718256	A2	08-11-2006
			JP	2007518544	T	12-07-2007
			US	2009107491	A1	30-04-2009
			US	2008262377	A1	23-10-2008
WO 2009022902	A1	19-02-2009	NONE			
WO 2005113046	A2	01-12-2005	NONE			