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(54) **PORTABLE HUMIDITY AND TEMPERATURE CONTROL AND MONITORING DEVICE AND SYSTEM**

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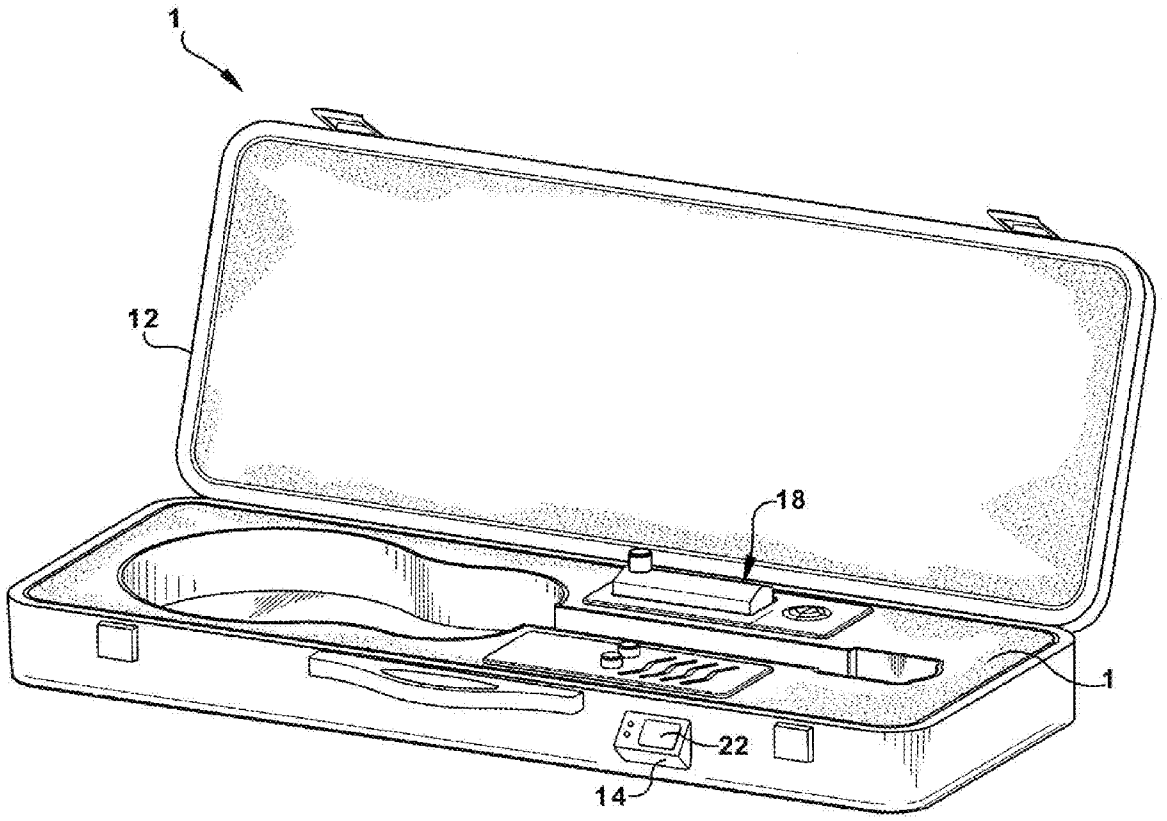
(57) **ABSTRACT**

The invention is related to a portable humidity and temperature monitoring control device and/or system for use with articles susceptible to damage by a lack or excess of either. More specifically, the invention relates to a humidity and temperature control device and monitoring system for wooden articles, particularly wooden musical instruments. In addition, the invention disclosed herein will find broad application for the maintenance of any article susceptible to damage caused by extremes in temperature and humidity, whether high or low.



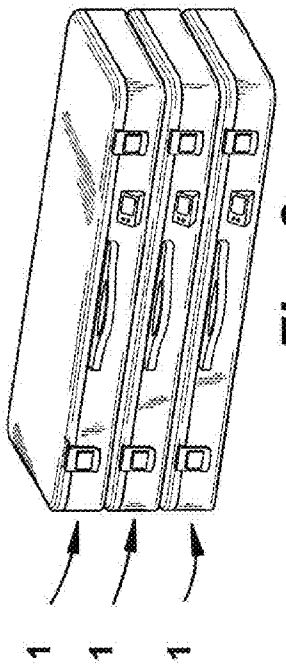


Fig 3

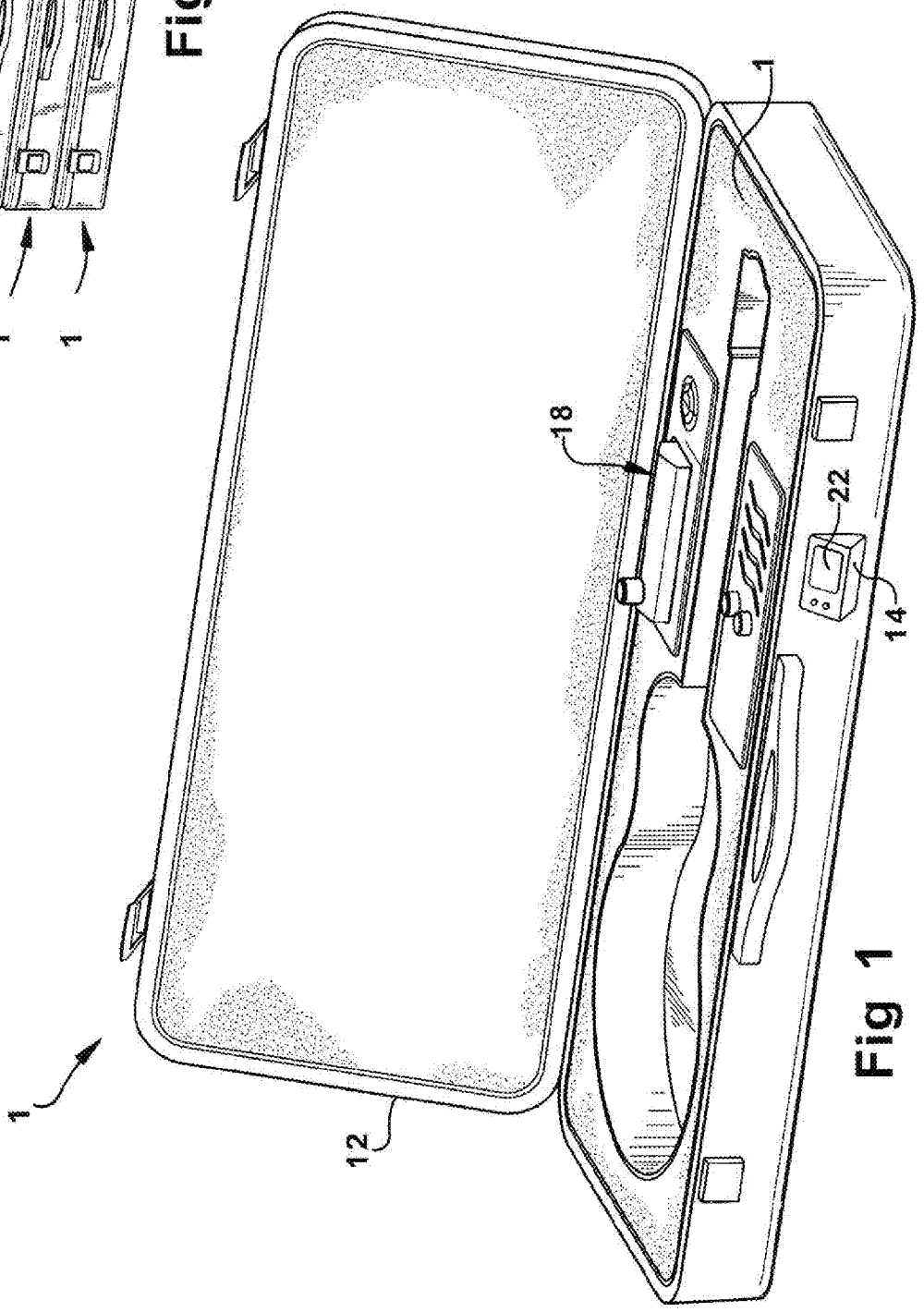


Fig 1

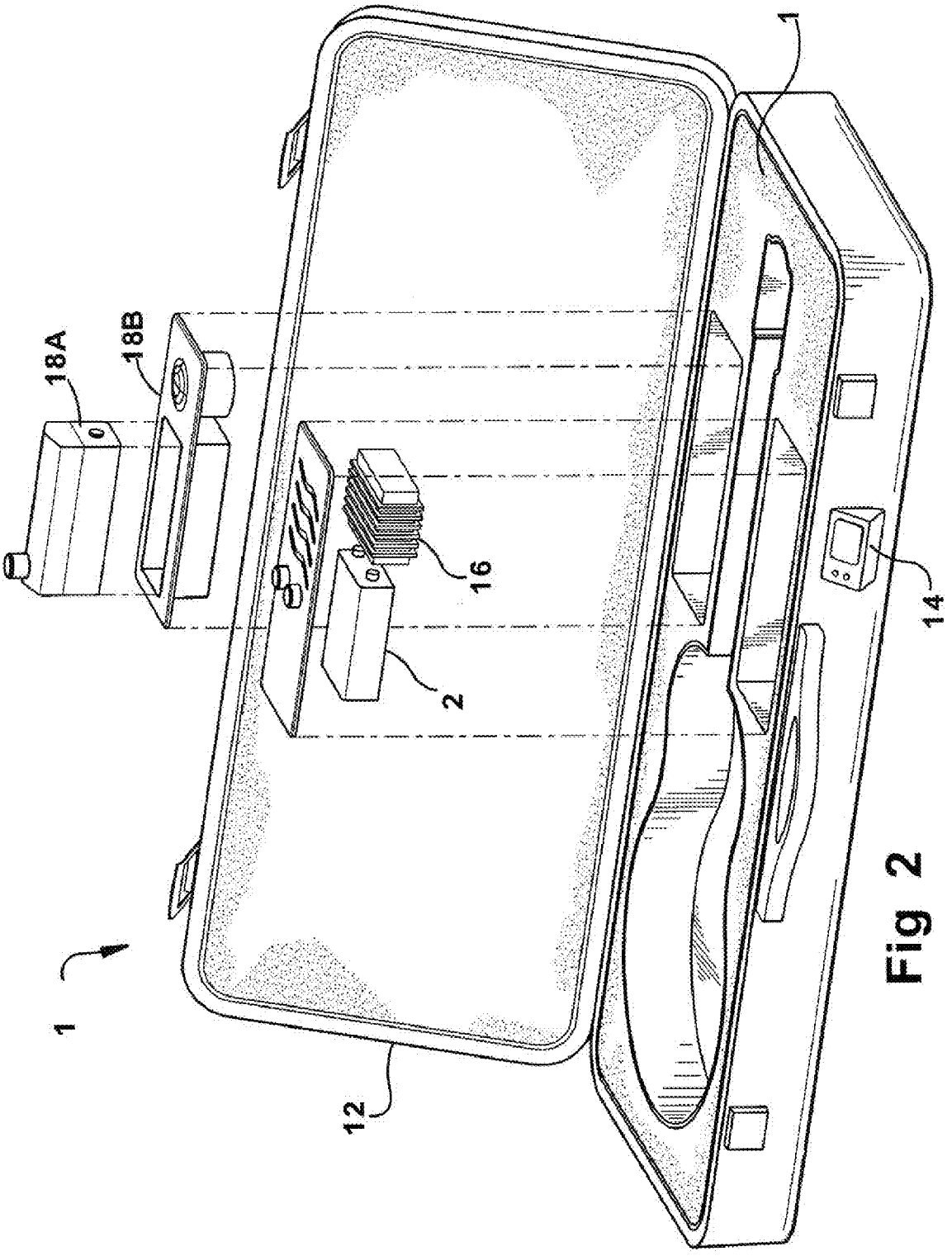


Fig 2

PORTABLE HUMIDITY AND TEMPERATURE CONTROL AND MONITORING DEVICE AND SYSTEM

RELATED APPLICATIONS

[0001] This application claims priority to Provisional Patent Application No. 61/081,113, filed Jul. 16, 2008.

FIELD OF THE INVENTION

[0002] The invention is related to a portable humidity and temperature monitoring control device and system to use with articles susceptible to damage by a lack or excess of either. More specifically, the invention relates to a humidity and temperature control device and monitoring system for various articles, particularly wooden musical instruments. In addition, the invention disclosed herein will find broad application for the maintenance of any article susceptible to damage caused by extremes in temperature and humidity, whether high or low.

BACKGROUND OF THE INVENTION

[0003] Many articles, and particularly those that are porous in nature, are susceptible to changes in temperature and humidity. Articles comprising cellulosic materials, such as articles made from fibers, textiles, or wood for example and particularly wooden, stringed musical instruments are affected by changes in temperature and humidity in the environment in which the articles are stored and/or used. While the application is drafted with reference particularly to wooden musical instruments, it is to be understood that the invention finds equal application to the preservation of all such articles that may experience deleterious affects due to temperature and humidity conditions. As such, particular reference to detail and use of the invention in connection with musical instruments is exemplary only. Other items that may benefit from the inventive system include, but are not limited to fabrics and textiles, such as clothing or furniture, heirlooms, antiques, documents, cigars, artwork, and many other such items.

[0004] The invention is hereafter described with reference to use of the same specifically for preserving wooden musical instruments. It is common for a musician to store an instrument in a carrying case. Cases for such instruments are generally not hermetically sealed and are, therefore, susceptible to changes in temperature and humidity, sometimes extreme and/or prolonged changes in temperature and humidity. Instruments constructed from wood may and typically do have glued joints. Temperature and humidity changes affect not only the wood itself, but also the glued joints. Over time, changes in temperature and humidity can cause an instrument to warp, bow and crack, resulting in damage to the wood or the integrity of the instrument's design, which could compromise and changes in the instrument's performance in terms of tone and resonance. It could also decrease the appraised value of any instrument, especially vintage and/or collector's edition instruments.

[0005] Guitars, banjos, mandolins, ukuleles, violins and other stringed wooden instruments require constant humidity, for example in the range of 45-55% humidity, and constant temperature, for example, in the range of 72-77° Fahrenheit, in order to prevent damage to the instrument. Such damage may occur in the form of cracking of the finish on the instrument, warping of the actual wood used to construct the instrument, and weakening conditions of glue joints. Extreme, prolonged and/or sudden changes in humidity and repetitious cycling of these conditions can destroy these types of musical instruments, many of which cost hundreds, thousands or even tens of thousands of dollars.

[0006] Means for adjusting humidity in instrument cases exist and are known. For example, it is known to provide a compartment within the interior of such a case to retain a desiccant pouch or other type material. That material may be and is generally a sponge or other porous type of stone. In some instances, the desiccant or porous material is retained within a perforated compartment to facilitate the flow of moisture throughout and within the case. It is also known, in combination with the foregoing, to use a fabric or flexible material case that is form-fitting with regard to the article being protected. This helps to reduce airflow around the instrument within the case. The flexible material may have a reflective outer surface to maintain a cooler temperature within the case. However, these existing solutions are arguably somewhat rudimentary, non-electronic, unreliable and don't allow the user to truly control and monitor the climate, like one would with an HVAC system in his or her home.

[0007] Even though means are known and available to identify and correct deficiency or excess with regard to humidity, there remains a need for a mechanism that allows the musician or other user to effectuate an almost immediate, continual and precise change in humidity and temperature within a closed instrument case or storage area. There also remains a need for a mechanism that is completely electronic and digital and that integrates all components for controlling and monitoring humidity, temperature and other aspects of protecting the instrument.

SUMMARY OF THE INVENTION

[0008] The present invention relates to a portable humidity and temperature control and monitoring device (hereinafter referred to as "the device") disposed within a housing that includes a controller, a humidifier, a heating and cooling element and a power source. The controller records and provides data received from at least one sensor for detecting humidity level and temperature level, and in response thereto provides signals to the humidifier and/or the heating/cooling element. The humidifier is in fluid communication with the interior of the housing, and in further electrical communication with the controller. The heating/cooling element is in electrical communication with the controller, such that the system operates as a whole to maintain a pre-set level of temperature and humidity within the housing.

DESCRIPTION OF THE DRAWINGS

[0009] FIG. **1** is a perspective view of one embodiment of the portable humidity and temperature control and monitoring device and system of the present invention and related disclosures.

[0010] FIG. **2** is an exploded view of the portable humidity and temperature control and monitoring device and system of FIG. **1**.

[0011] FIG. **3** is a perspective view of several portable humidity and temperature control and monitoring devices of FIG. **1** shown in a stacked or interlocking position.

DETAILED DESCRIPTION OF PREFERRED AND ALTERNATE EMBODIMENTS

[0012] The present invention and related disclosure is related to a portable humidity and temperature control and

monitoring mechanism for use with devices or articles susceptible to damage due to temperature and humidity conditions. More specifically, the invention relates to a humidity and temperature control device and monitoring system for musical instruments and other articles.

[0013] While the present invention may be discussed herein primarily with respect to wooden musical instruments, it is equally applicable to other porous items and articles that may need to be protected from changes in humidity and/or temperature. Such items or articles may include, but are not limited to: all types of musical instruments and accompanying components, such as for example, reeds, strings, bows and other accessories; furniture; antiques; art work; cigars; cloth items, including blankets, drapes, gowns, fur coats and many other items; heirlooms, memorabilia and keepsakes; and any other such item the value of which may be compromised by humidity or temperature damage. Given the foregoing, the following is to be read and understood to be adaptable to all such items and articles, and not just for use with musical instruments, though it is set forth with respect to the same for exemplary purposes.

[0014] Guitars, banjos, mandolins, ukuleles, violins and other stringed wooden instruments require constant humidity and temperature in order to be maintained in perfect playing condition and in order to retain their appraised values. For example, it is desirable to maintain an optimum, constant humidity of between about 45-55% and an optimum constant temperature of about 72-77° Fahrenheit with regard to wooden instruments. Of course, it is understood, that the basic design of the subject invention is applicable to other articles and devices susceptible to damage through humidity and temperature change, and while wooden musical instruments are referred to herein, such reference is meant to apply to all such articles and devices. As such, while musical instruments such as guitars, violins and other stringed instruments may require a constant humidity and temperature as defined hereinabove, these ranges are not restrictive of the subject invention, and may be determined to respond to other temperature and humidity conditions more relevant and more pertinent to the article or device being maintained. With regard to all such articles, extreme and sudden changes in humidity can destroy the articles or devices due to warping, cracking, mold and mildew, de-lamination and other deleterious effects caused by extreme changes in humidity and temperature.

[0015] The invention provides a device designed to control and monitor humidity and temperature within an enclosed, portable environment or housing for an article or device. As used herein, the term "housing" means any compartment or closed area, irrespective of size. The device can be used in a small case, such as, for example, that of a flute or instrument reeds. Conversely, the device may be capable of being adapted to be removable or retro-fitable for reapplication to controlling temperature and humidity in a larger housing, container or area, such as a closet, a room, a storage compartment, a tour bus, or any other such enclosure. Of course, the device is adaptable for use with all size compartments that fall between these examples, as well as smaller or larger housings. The power necessary to run the system may change due to size of the housing, though the basic principle of design and operation will remain. In addition, the device may be varied in size to control the environmental conditions in different size compartments or rooms. For example, a music studio may include a room, closet or compartment, where instruments can be stored, in which case the electronic humidification and temperature control and monitoring system may be designed to more optimally control the environment in this larger area. Alternatively, a smaller system, though not as small as that used with a single instrument case, may be needed in that instance where it is intended for use with, for example, a display case in a museum or in a home which houses one or more instruments. The system and apparatus are intended to be adaptable for use in a sealed enclosure or housing having a defined space, though such space may vary in size from a small instrument case to a larger room or space.

[0016] The device may be permanently affixed to a case, housing, compartment or any type of enclosure contemplated herein. Alternatively, the device may be removably attachable to a surface or portion of the case, housing, compartment or other enclosure. This requires precision engineering of the electronic components comprising the overall system such that the integrity of the performance thereof is not compromised by removal and/or replacement to and from one or more housings. The device may be affixed to a frame provided specifically for the device, may be retained within a compartment, may be adhesively attached, may be statically attached, or may be affixed by any known means for doing so. As such, the manner in which the device is affixed or installed to or within a housing is not critical to the use thereof.

[0017] In a preferred embodiment, shown in FIG. **1**, the invention herein, generally referred to as **100**, provides a case for a single instrument, indicated at **12**, whether that instrument is a guitar, a violin, a cello, a bass, a ukulele, a banjo, a mandolin or other stringed and/or wooden instrument, or any one or more components thereof. In this regard, the case is slightly larger than an instrument case of the generally known and used design. The slight increase in size allows for the inclusion of a device according to the invention capable of registering and detecting the ambient relative temperature and humidity immediately surrounding the instrument or article within the case as well as within the general vicinity of the exterior of the case. As shown in FIG. **1**, the device also contains a semi-customizable insert **10** designed to cradle the instrument, in this case a guitar, which thereby allows for the same, basic standard outer shell to be used with a variety of sizes and shapes of guitars and other instruments. In a preferred embodiment, the housing or case is made of polypropylene which allows for a hard, shock-resistant outer surface. However, the case or housing may be made of any durable material suitable for transporting and sufficiently protecting the inner contents of the case. Also, as shown in FIG. **3**, the case is designed to interlock with other cases of the same type. This feature provides for easy transport and storage of several cases and can provide the ability to electronically link the cases so that only one power source may be required to power the portable humidity and temperature control and monitoring devices located within each case.

[0018] Regardless of the type of instrument or the particular embodiment chosen to implement the invention, the basic components of the system remain the same. In its most basic sense, the system and apparatus of the present invention, shown in FIGS. **1** and **2**, include a housing **12**, a controller **14**, a heating and cooling mechanism **16**, a humidifier **18** and a power source **20**. Included within the controller **14** are an electronic thermostat, electronic hygrometer, digital controls, temperature and humidity sensors, a heating and cooling mechanism and a display panel, digital or analog, used to display humidity and temperature parameters within the

housing. A warning mechanism may also be included to alert the user of other than optimal conditions within the controlled housing **12**.

[0019] The controller **14** provides the user with an accurate, easily manipulated mechanism to select settings and monitor the maintenance thereof. The controller **14** contains a built-in digital thermometer to monitor the temperature and a built-in digital hygrometer to monitor the humidity within the housing. The controller **14** further includes sensors to detect temperature and humidity fluctuation. The sensors may monitor the temperature and humidity within the housing as often as several times a minute. The sensors may be external to or integrally connected to the control device **14**. Preferably, the sensor is fully calibrated. An optimum sensor may include exact dew point measurement. Systems employing such a sensor, for example are available commercially from Ientek Co., Ltd., and allow for immediate sensing of changes and quick response thereto in order to maintain substantially constant conditions within the housing. The sensors desirably consume very little power, exhibit long-term stability, and are very sensitive. The controller **14** may further include an LCD display **22** capable of providing such information as set and current humidity and temperature values and the current status of humidifier, i.e., humidifying or dehumidifying. Additionally, it may provide historical setting and read-out data correlated to venues, dates, etc. The display **22** may be placed on the exterior of the housing and display digitally or in analog form the humidity and temperature parameters within the housing **24**. A duplicate display may be placed on the interior of the housing **24**. Alternatively, a wireless signal may be sent to a remote device in the possession of the user, allowing the user to remotely monitor and control temperature and humidity changes at any time.

[0020] Suitable heating and cooling elements for use in conjunction with the electronically controlled thermostat are known, such as, for example, those available from Watlow Industries, including, but not limited to, various configurations of resistance wires and thermocouples. As shown in the FIG. **2**, the heating and cooling functions are performed by a thermoelectric assembly **16**. A thermoelectric assembly (TEA) is a device that operates as a heat pump. It contains one or more thermoelectric modules (TEM), a solid state that utilizes the Peltier effect to move heat, and at one or more heat sinks or other heat dissipating device. The Peltier effect refers to the transport of heat that occurs when electrical current passes through a thermoelectric material. Heat is either picket up where electrons enter the material and is deposited where electrons exit the material (as is the case in an N-type thermoelectric material), or heat is deposited where electrons enter the material and is picked up where electrons exit the material (as is the case in a P-type thermoelectric material). A TEM is usually constructed by connecting alternating N-type and P-type elements of thermoelectric material ("elements") electrically in series and mechanically fixing them between two circuit boards. The use of an alternating arrangement of N-type and P-type elements causes electricity to flow in one spacial direction in all N-type elements and in the opposite spatial direction in all P-type elements. As a result, when connected to a direct current power source, electrical current causes heat to move from one side of the TEM to the other (e.g., from one circuit board to the other circuit board, etc.). Naturally, this warms one side of the TEM and cools the other side. Reversing the direction of current flow also reverses the direction of heat pumping, allowing for cooling and heating. The amount of heat pumping is regulated by the amount of current, allowing for precise temperature control. The electronic humidifier **18** contains a reservoir for holding water and a wicking device for absorbing excess moisture. The humidifier **18** may additionally include a digital gauge providing for pin point accuracy with respect to achieving and maintaining a desired level of humidity, and further allows for immediate response and correction of changes in humidity within the enclosed housing. The electronic humidifier **18** includes a mechanism, for example, a fan, or suction/blower-type device within the housing. It also includes a reservoir **18**A and wicking device **18**B for maintaining the proper humidity within the housing. In addition, depending on the size of the housing or exterior environmental conditions, one or more additional mechanisms may be added to enhance the efficiency of the electronic thermostat and humidifier components.

[0021] The foregoing components may be powered from a number of sources. For example, in one embodiment, the subject invention includes an adapter for use with a wall outlet or other remote power source including but not limited to, for example, a vehicle power jack, such as that used for a cell phone charger adaptor or an MP3 player. In another embodiment, the invention includes a battery pack **20** including an AC/DC adapter, for portable use of the system when a remote power source is not available. The device may alternately contain an integrated power source to enable operation of the system within multiple cases from one AD/DC adapter or battery pack. The battery or battery pack suitable for use with the invention is not limited in any regard.

[0022] In another embodiment, the present invention includes a case for an instrument or article as defined above, and a second, outer case or component-filled "bag-type" sheath which encloses the first case. In this regard, the inner, instrument case would be used to control humidity within the interior of the inner case and immediately surrounding the actual article or instrument contained within the case. The outer case, enclosing the inner case, would function predominantly as a mechanism for controlling the temperature in the area within the outer case and immediately surrounding the exterior of the inner case, and consequently also the interior thereof. In part, this arrangement may provide a buffer which further enhances maintenance of the controlled conditions.

[0023] In yet another embodiment, the humidity and temperature control and monitoring device would be contained within a custom designed, hermetically sealed case. When closed, the case would become airtight and would secure the contents of the case against entry of microorganisms or other foreign bodies. To this end, the case would additionally include heavy-duty latches, hinges and gaskets to complete and secure the seal. The case may also contain one or more of the following features, such as: an ultra-durable, fire-safe outer shell made of a composite material to aid in insulation and temperature control; an outer shell made of a shock-resistant material and/or contain shock or G-force sensors; a lining made of foam or other suitable material to aid in insulation and/or shock resistance.

[0024] Additional features that may further define a humidity and temperature control and monitoring device of the present invention include, but are not limited to: inter-lockable phalanges or grooves and wheels on the outer shell to aid in stacking, storing and/or transporting multiple cases; a theft deterrent tracking device; a keypad or RFID locking system; a built-in stand or shelf located within the interior of the case

to aid in changing strings and performing other maintenance duties; an interior light; and data storage and/or historical parameters tracking with USB port capability in order to download a running history of climate changes.

[0025] The system contemplated herein may take any number of forms or configurations, so long as the ability to instantaneously detect and alter housing interior environmental conditions is maintained. Though the invention has been described herein with reference to certain embodiments, one skilled in the art will appreciate the applicability of the basic premise of the invention to applications for controlling and monitoring the temperature and humidity of housing for many articles that could potentially suffer degradation due to changes in the same. As such, all applications are intended to be covered by the claims appended hereto.

What is claimed is:

1. A portable humidity and temperature control and monitoring device disposed within a housing comprising:

a controller for recording and providing data received from at least one sensor detecting humidity level and temperature level, and in response thereto providing signals to a humidifier and a heating/cooling element such that each functions to acquire and maintain a pre-set level; and

a power source,

the humidifier in fluid communication with the interior of the housing and further in electrical communication with the controller; and

a heating/cooling element in electronic communication with the controller.

2. The portable humidity and temperature control and monitoring device of claim **1** further comprising a digital display on an external surface of the housing.

3. The portable humidity and temperature control and monitoring device of claim **1**, wherein system data is provided to a remote receiver.

4. The humidity and temperature control and monitoring device of claim **1**, wherein the housing further has disposed therein an article to be preserved.

5. The humidity and temperature control and monitoring device of claim **1**, wherein the system is self-contained.

6. The humidity and temperature control and monitoring device of claim **1**, wherein the housing is a guitar case.

7. The humidity and temperature control and monitoring device of claim **1**, wherein the housing is a permanent structure.

8. The humidity and temperature control and monitoring device of claim **1**, wherein the housing is portable.

9. The humidity and temperature control and monitoring device of claim **1** further including a warning mechanism designed to alert the user of temperature and humidity values outside pre-set ranges.

10. The humidity and temperature control and monitoring device of claim **1**, wherein the power source is an AC/DC adaptor.

11. A device operable to simultaneously control the humidity and temperature of the interior of a housing, the device comprising:

a controller comprising:

an electronic thermostat;

an electronic hygrometer;

at least two digital controls for setting the temperature and humidity parameters;

at least one sensor;

a heating and cooling mechanism;

a humidifier; and

a power source,

the humidifier and heating and cooling unity being in electronic communication with the controller, such that changes to humidity and temperature within the housing are sensed and altered to maintain the temperature and humidity within a pre-set range.

12. The device of claim **11** further comprising a digital display on an external surface of the housing.

13. The device of claim **11**, wherein system data is provided from the sensor to a remote receiver.

14. The humidity and temperature control and monitoring device of claim **11**, wherein the housing further has disposed therein an article to be preserved.

15. The humidity and temperature control and monitoring device of claim **11**, wherein the housing is a guitar case.

16. The humidity and temperature control and monitoring device of claim **11**, wherein the housing is portable.

17. The humidity and temperature control and monitoring device of claim **11** further including a warning mechanism designed to alert the user of temperature and humidity values outside pre-set ranges.

18. The humidity and temperature control and monitoring device of claim **11**, wherein the power source is an AC/DC adaptor.

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