Title: RADIO FREQUENCY IDENTIFICATION CONTROLLED HEATABLE OBJECTS, SYSTEMS AND SYSTEM COMPONENTS, AND METHODS OF MAKING THE SAME

Abstract: Radio frequency identification controlled heatable objects, systems and system components, and method of making radio frequency identification controlled heatable objects, systems and system components are provided.
RADIO FREQUENCY IDENTIFICATION CONTROLLED HEATABLE OBJECTS, SYSTEMS AND SYSTEM COMPONENTS, AND METHODS OF MAKING THE SAME

[0001] This application claims priority pursuant to 35 U.S.C. 119(e) to co-pending U.S. Provisional Patent Application Serial No. 60/756,536, filed January 5, 2006, the entire disclosure of which is incorporated herein by reference. This application is a continuation-in-part of U.S. Application Serial No. 10/833,356 filed April 28, 2004 and U.S. Application Serial No. 11/148,802, filed June 9, 2005, the disclosures of which are incorporated herein by reference in their entireties.

Field of the Invention

[0002] The present invention is broadly concerned with cookware and cooking appliances. More particularly, the invention is concerned with: temperature regulated cookware and servingware items, such as pots, pans, buffet serving pans, serving dishes, platters, and the like; cooking systems utilizing temperature regulated cookware and servingware items; and methods of making temperature regulated cookware items, systems and system components.

Background of the Invention

[0003] Cooking is often referred to as an art, not only because of the combination of ingredients that go into a particular recipe, but also due to the skill necessary for proper application and infusion of varying levels of heat over a given period of time throughout the different phases of the food preparation process. Traditional cookware appliances, such as ovens (microwave ovens being an exception), grills, heat lamps and stoves, all utilize the thermodynamic process of conduction to transfer heat from the outer surface of the food item to its interior. This is generally true regardless of the type of heat source used to heat the surface of the food, be it a radiation heat source (i.e. a heat lamp), conduction heat source (i.e. a stovetop),
or a convection heat source (i.e. a convection oven or a food dehydrator).

[0004] The use of thermometers or other temperature sensors to monitor and control the cooking process is well known. A common thermometer used to monitor and control the cooking process is a probe-type or contact thermometer which is inserted directly into the food item to obtain a temperature of the interior of the food item. Such thermometers are undesirable for use with cookware/servingware objects that have a lid as the use of a probe-type thermometer requires removal of the lid each time a temperature reading is taken. A number of cookware-associated non-contact thermometers have been developed that are attached to, or incorporated into, cookware objects such as pots and pans. For example, the invention disclosed in U.S. Patent Application Serial No. 10/833,356, which is incorporated herein by reference in its entirety, provides a means of obtaining consistent and accurate measurement and control of the temperature of a cookware object, such as a pot or pan, by embedding a temperature sensor within a heatable portion of an object, such as within a tunnel through the base of the pot or pan. The temperature sensor is connected to an RFID tag located apart from the heatable portion of the pot or pan. The RFID tag acts as a transmitter (and sometimes as receiver) to communicate with a reader/writer located in a cook-top for heating the object, providing temperature information and other information regarding the object (such as heating characteristics) to the cook-top. The temperature information and the heating information are used by the cook-top to control the temperature of the object.

[0005] The prior invention in which the temperature sensor is embedded within a tunnel in the base, as disclosed in U.S. Patent Application Serial No. 10/833,356, and in U.S. Application Serial Nos. 11/148,802 filed June 9, 2005 and 11/266,148 filed November 3, 2005 (the disclosures of which are incorporated herein in their entireties), provides a highly effective
way of regulating temperature during cooking. This allows a selected cooking temperature to be maintained while cooking on a stovetop. The cooking temperature can be programmed into the stovetop in the manner described in U.S. Patent No. 6,953,919 (the entire disclosure of which is incorporated herein by reference), or the temperature can be selected manually (as is also disclosed in U.S. Patent No. 6,953,919, or alternatively, in the manner disclosed in U.S. Application No. 60/738,259 which is incorporated herein by reference in its entirety).

[0006] As is disclosed in U.S. Patent No. 6,953,919, an entire recipe may be programmed into the stovetop (and/or into the cookware/servingware item being used) by associating an RFID tag on which the recipe is preprogrammed with the RFID reader/writer of the stovetop. The RFID reader will read the recipe information from the RFID recipe tag and then that information will be used to control the cookware according to the recipe instructions. For example, if the recipe is for cooking rice, the user might be instructed to place water in the pan; then the pan will be heated by the stovetop until the water is boiling; the user might then be instructed by the stovetop (through an audible or visual signal) to add the rice to the water; the stovetop then might reduce the temperature to simmer for a period of time until the rice is ready; the stovetop then signals the user that the rice is ready to serve.

Summary of the Inventions

[0007] The present inventions relate to improvements to the temperature regulated cookware/servingware systems such as those disclosed in U.S. Patent No. 6,953,919, and U.S. Application Nos. 10/833,356, 11/148,802, 11/266,148 and 60/738,259 (the entire disclosures of which are incorporated herein by reference), including improvements to temperature regulated cookware/servingware items, such as pots, pans, buffet serving pans, serving dishes, platters, and the like; new and improved methods of making temperature regulated cookware/servingware
items; improvements to the RFID reader/writer; improvements to the RFID receipe tags; and
new and improved methods of making RFID recipe tags.

[0008] The foregoing and other objects are intended to be illustrative of the invention and
are not meant in a limiting sense. Many possible embodiments of the invention may be made
and will be readily evident upon a study of the following specification and accompanying
drawings comprising a part thereof. Various features and subcombinations of invention may be
employed without reference to other features and subcombinations. Other objects and
advantages of this invention will become apparent from the following description taken in
connection with the accompanying drawings, wherein is set forth by way of illustration and
example, an embodiment of this invention and various features thereof.
Brief Description of the Drawings

[0009] A preferred embodiment of the invention, illustrative of the best mode in which the applicant has contemplated applying the principles, is set forth in the following description and is shown in the drawings and is particularly and distinctly pointed out and set forth in the appended claims.

[0010] Fig. 1a is a front view a recipe card of the instant invention.

[0011] Fig. 1b is a back view a recipe card of the instant invention.

[0012] Fig. 2 is an exploded view of a recipe card of the instant invention.

[0013] Fig. 3 is a perspective view of a pan tag assembly of the instant invention.

[0014] Figures 4 and 5 are bottom and top views, respectively of an overmolding shell of the instant invention.

[0015] Fig. 6 is a bottom view of an RFID tag and a capacitor of the tag.

[0016] Fig. 7 is a bottom view of an RFID tag and an accumulator of the tag.

[0017] Figures 8 through 12 show several embodiments of RFID controlled cookware having imbedded temperature sensors.

[0018] Figures 13 through 22 show the design schematics for various dies and draws of the instant invention for several cookware objects.
Detailed Description of a Preferred Embodiment

[0019] As required, a detailed embodiment of the present inventions is disclosed herein; however, it is to be understood that the disclosed embodiment is merely exemplary of the principles of the invention, which may be embodied in various forms. Therefore, specific structural and functional details disclosed herein are not to be interpreted as limiting, but merely as a basis for the claims and as a representative basis for teaching one skilled in the art to variously employ the present invention in virtually any appropriately detailed structure.

RFID Recipe Tags

[0020] Referring to Figs. 1a, 1b and 2 the RFID recipe tags of the instant invention are shown and described. The RFID recipe tag of the instant invention is in the form of a recipe card, 10, in which the RFID tag (in which the recipe is stored) is imbedded. Fig. 1a shows a front view of fully-assembled and laminated recipe card 10, and Fig. 1b shows a rear view of recipe card 10. The front of recipe card 10 is made of a piece of cardstock, 12, on which information regarding the recipe is printed, such as the name of the recipe, ingredients, nutrition and serving information (number of servings, serving size, etc.), as well as a picture of the item to be cooked. Also included on front cardstock 12 is embossed label 16, which identifies the location of the RFID tag in card 10. Label 16 may include written instructions to the user informing the user to place the label portion of card 10 in the scanning area (marked on the cooktop) of the RFID reader located on the cooktop. The back of recipe card 10 is made of a second piece of cardstock, 14, on which additional recipe information is printed, such as the necessary ingredients and written recipe steps/instructions for cooking, as well as photographs of the various steps as they are performed to aid the user as they are cooking.

[0021] In a preferred embodiment, traditional stovetop recipes which require continuous
monitoring by the user, such as to add in ingredients at different times, and/or to stir the food, are modified so as to become 1-step recipes. In this embodiment, the temperatures are controlled to appropriate levels to prevent scorching and the cooking takes place primarily with a lid on the cookware item to seal in moisture during cooking. The temperatures are controlled and scorching is prevented by modifying the duty cycle of the cooktop to switch on and off the power at a rate that allows the food to heat without overheating at the bottom and create convection within the sealed cookware item.

[0022] Referring to Fig. 2, the method of manufacturing recipe card 10 is described. Figure 2 shows and exploded view of the components of card 10 (excluding the laminate portions). RFID tag 20 is connected (such as by glue) to the back (non-printed) side of cardstock 14 in embossed area 17 which is located to align with embossed label 16 of cardstock 12 when recipe card 10 is fully assembled. RFID tag 20 includes antenna 22 which slightly protrudes from tag 20. To protect RFID tag 20 and its antenna 22 from the heat and pressure incurred during lamination of card 10, card 10 includes a cardboard insert or buffer, 13, located between cardstocks 12 and 14. Cardboard insert 13 includes hole 18 cut out of insert 13 to provide a recess for locating antenna 22. Insert 13 is sized slightly smaller than each of cardstocks 12 and 14 to provide a clean fit when all three 12, 13, and 14 are fitted together (sandwiched) to form card 10. Card 10 is completed by lamination on both sides of the assembled pieces 12, 13, and 14. Once laminated, holes are cut or punched along one edge of card 10 to allow card 10 to be placed in a binder for storage and then easy removal during use.

[0023] By sandwiching the RFID tag by the paper and laminate the tag is protected from moisture and heat that is often part of the environment in which cooking takes place.

[0024] The RFID tag is programmed with suitable information of both the sequences and
recipe steps to control both the cookware and the IH stove in order to make the perfect recipe in
which no stirring is required and in which no scorching occurs.

[0025] The printed information on recipe card 10 shows the user photos of the
preparation of the cooking and recipe steps coordinated with the instructions that the RFID tag
transmits to the stovetop. The user is then informed of the preparation steps by an audible beep
and or voice simulation. For example, by reviewing the recipe card photos and textual
information, the user may know that a first beep of the stovetop means that the user is to add
water to the cookware item, as second beep would mean to add other specified ingredients and so
forth. The sequence of the audible signals that are to be provided are stored in the RFID tag and
transmitted to the stovetop when the stovetop is programmed by the recipe card.

[0026] Each recipe uses different type of duty cycles to create many different types of
convections in order to make the perfect automatic cooking recipes without the need to stir and
without scorching. The information is programmed into the RFID tag.

[0027] An exemplary manufacturing process/requirements and quality control process for
manufacturing card 10 is further described below:

[0028] LAMINATION:

1. Card size: 4 5/8” x 7 3/8” (total dimensions of fully laminated card 10).
2. 10 mil laminate on both sides.
4. 0.22 mm cardboard insert.
5. Rounded corners to be die cut even and smooth, with no sharp edges.
6. Cards stock folded evenly so that colored borders are even all around the card, no noticeable
   white edges showing (cardstocks 12 and 14 are made up of a single piece of cardstock that is
folded in half around cardboard insert/buffer 13).

7. Laminated card to be free of defects, dirt, debris, threads, hair. Any cards found with debris within lamination to be scrapped and have the tag carefully removed for later use.

8. Recipe cards uploaded with correct data supplied by manufacturer.

9. Laminate to be free of scratches, mars.

10. Laminate edges should be free of hanging plastic shavings.

11. Plastic circles from holes removed.

12. Holes 2.75” center to center, spaced evenly from both edges. ¼” diameter hole.

[0029] FULFILLMENT:

1. Ringed binders (for holding multiple cards together) to be clean, free of fingerprints, marks, mars, bends. Unacceptable binders to be set aside for return to vendor. Unacceptable binders include:
   - Clear vinyl from spine not trimmed.
   - Noticable bends in binder covers.
   - Faint lines in vinyl, where the vinyl may have been folded.
   - Mars or imperfections in logo or company name front and back.
   - Marks or smudges that cannot be removed.

2. White paper insert in spine, 1/8” above the clear plastic for easy removal by consumer.

3. All cards collated according to order provided by customer.

4. All cards placed in 3 rings of binder unless specified otherwise for shrink wrapping in groups.

5. Correct data on cards according to photo-matched data and bar codes provided by customer/manufacturer. Recipe data to be checked to verify correct data on card, dead tag, or
RFID TAG ASSEMBLY

[0030] The invention disclosed in U.S. Application No. 11/148,802 relates primarily to an RFID pan tag assembly that includes among other components, a protective shell or overmolding for the RFID tag. Referring to Fig. 3, the overmolding for RFID tag 60 includes overmolding shell 160 (as is shown separately in Figs. 4 and 5) and an epoxy-based material. Shell 160 includes base 162 and generally circumferential wall 164. Shell 160 is shaped slightly larger than the RFID tag so that the RFID tag may be placed within wall 164 of shell 160 laying flat on base 162. The RFID tag includes two pads on its surface, to which two conductors of mineral insulated cable 62 are connected. Base 162 of shell 160 includes trough 168 to accommodate cable 62 in shell 160. The conductors of cable 62 are embedded within a highly compressed magnesium oxide covering and are covered with a stainless steel sheath in a manner similar to how conductors are embedded within fiberglass insulation in cables of the prior art. The stainless steel sheath houses or supports the magnesium oxide, which is a generally powdery substance, so that the conductors remain embedded within the magnesium oxide. The ends of the conductors are exposed (i.e. the magnesium oxide and stainless steel sheath are removed from the ends of the conductors, or the ends of the conductors are otherwise made devoid of any insulation), and the conductors are sonic welded to the terminal pads of the RFID tag. A bead of epoxy material is applied to the conductors to provide an additional seal with the insulation (i.e. the magnesium oxide and the stainless steel sheath). The exposed portion of the conductors of cable 62 is ultimately maintained within the epoxy-based material which is surrounded by shell 160. A layer of the epoxy-based material is placed in shell 160 and RFID tag 60 is then placed in the shell such that cable 62 extends through opening 166 in wall 164. Then the epoxy-based
material is placed over the RFID tag and allowed to harden and fully encase tag 60. This provides a tight seal to be formed around the insulated portion of cable 62 and shell 160 such that the RFID tag and the conductors will not be exposed to moisture during operation and/or cleaning of cookware.

[0031] While the overmolding discussed above provides protection for the RFID tag, there are still issues in providing sufficient power to the tag during operation. The RFID reader operates at 12~15 Volts power with 4AMP ~6 AMP for RFID communication. And the RFID tag is totally passive-meaning that it has no power source of its own. The RFID tag receives its power from RF energy transmitted by the reader.

[0032] Referring to the preferred embodiments discussed in connection with U.S. Application Serial #10/833,356 and #11/148,802, the RFID tag captures the RF energy in the 13.56Mhz RF waves transmitted by the reader by 1Watt power with its RFID antenna and capacitor circuit (resonant circuit). The RFID tag uses this energy to run its circuit and take the temperature measurement, and then sends the remaining energy back in the form of a return RF wave back to the reader installed into the heating object. A 1,000 Ohm RTD is used to take the temperature measurement using up as little of this captured energy as possible within the RTD during the temperature measurement.

[0033] As the RFID tag does not have any power source, it is necessary to use the power of the reader to run the system and RFID tag in the manner discussed above.

[0034] The purpose of the instant invention is to solve the problem of this limited power source for the RFID tag. The basic principles of the instant invention are described at an atomic and/or molecular level. The substances used to make shell 160 are each made up of atoms or molecules. Each molecule includes one atom by itself or multiple atoms held together by
chemical bonds. Each atom includes both negative and positive subatomic particles (electrons and protons, respectively), as well as neutral particles (neutrons).

[0035] The atomic nucleus, which is a positive proton is surrounded by the negative electrons. The negative electrons may be transferred to other nearby atoms or shared between atoms.

[0036] It is possible for objects to be atomically constructed to have either negative or positive array of electricity. If the balance may be collapsed, such as by friction, we have a condition of the electrification or electric charge. This can be positive or negative.

[0037] In this condition, if the object which has a condition of the positive electrification touches or has frictions with the object which has a condition of the negative electrification, the above negative electrons which are surrounding a positive proton jump out (i.e. are transferred to or shared with the other object). We call this phenomenon “electric discharge”.

[0038] This condition of the electrification occurs not only by touching or having friction between both negative and positive electrification objects, but is also possible by the touching of these objects with air.

[0039] It has been found in connection with the instant invention that PTFE (Fluorine resin) has negative friction in the air easily and Mica (Muscovite) has positive friction in the air easily.

[0040] In the instant invention, the epoxy resin shell 160 (shown and described with respect to Figs. 4 and 5) is made to protect pan tag from the heat and moisture by two pieces of shells (top and bottom, can be made in the manner described above with respect to Figs. 4 and 5, in which shell portion 160 is one piece, and the resin to fill and encase the RFID tag is the second portion). Mica powder is mixed with the epoxy resin of one of the portions of the shell
(i.e. shell portion 160) and PTFE powder is mixed with the resin of the other shell (or resin that files shell 160 to encase the RFID tag). The RFID tag is then covered by two different shells. The shell including PTFE powder becomes negatively charged and the shell included Mica powder becomes positively charged. Mica is very safe as opposed to alternatives such as asbestos. The epoxy resin is very robust against electricity.

[0041] The percentage of powder of each PTFE and Mica in each portion of the shell of the preferred embodiment is roughly 50%.

[0042] In the preferred embodiment, the RFID tag generates 1.5kV power in humidity of 65%–90% and 35kV power in humidity of 10%–20%. A very small accumulator (220, shown in Fig. 7) which is located in the RFID tag generates the power once and transmits data to the reader by the RF waves. The accumulator in the reader keeps the power for the communication with the RFID tag. Once the reader provides the power to the pan tag in the very beginning, no additional power is needed to run the RFID tag, which (in the preferred embodiment) is located into the handle of the cookware object.

[0043] The RFID tag captures the RF energy from the 13.56Mhz RF waves transmitted by the reader (located in the cooktop) by 1 Watt power. This energy is captured by the RFID tag’s antenna and capacitor circuit (resonant circuit). The RFID tag in the cookware object then uses this energy to run its circuit and take the temperature measurement, and then sends the remaining energy back in the form of return RF wave back to the reader.

[0044] This increase in energy is not enough, by itself, to provide the temperature measurement necessary to cook perfectly without scorching and/or stirring. As the RFID tag of the instant invention itself can generate the energy from the air, the RFID tag has the ability to communicate with the reader in the stovetop many times in a second to provide to the stovetop
real time cooking information through the RTD in the cookware object (connected to the RFID tag). This is necessary because the cooking condition is changing every moment. The increase in energy provided by the instant allows the RFID tag to measure the temperature multiple times and send a new temperature reading to the reader in the stovetop 16 times in a second.

[0045] It will be appreciated that this invention may be applied in many ways in addition to RFID cookware, such as cellular phone or portable computer, eliminating the need to recharge batteries.

[0046] This invention is further discussed with respect to the following:

[0047] Relation between E and q:

[0048] When we have Electrical Charge (q), we have an Electric Field at the region surrounding (q).

\[ q = \text{Electrical Charge}, \quad V = \text{Electric Potential}, \quad R = \text{Distance}, \quad P = \Omega \cdot \text{m}(\text{Electric} \]
Conduction Rate), $E=\text{Electric Field}$.

[0050] i.e. $E=(1/4\pi\varepsilon)(q/r^2)(r/r^2)$

Capture the power:

[0051] In a preferred embodiment, one of the important factors to create power is to make the surface of the negative friction shell that is made in part out of PTFE powder (Fluorine resin) such that it has a rough and matted finish.

[0052] Next, the preferred embodiment includes a “Charge Controller”, “Supper-dielectrics Capacitor”, “Diode” and “High frequency Inverter”. The Circuit diagram for these components is as follows:
[0053] Coulomb’s law tells us:

\[ F = k \frac{|q_1 q_2|}{r^2} = \frac{|q_1 q_2|}{4\pi \varepsilon_0 r^2} \]
[0054] F=size of force, q=size of electrical charge, r=distance of two objects, k=invariable proportion

[0055] This k shows $\varepsilon_0$

[0056] This is called permittivity of vacuum and $\varepsilon_0 = 8.854 \times 10^{-12} \text{F/m}$.  

**Definition of Maxwell and Gauss**

$$\nabla \cdot \mathbf{E} = \frac{\rho}{\varepsilon_0}$$

[0057] Negative electrons moves to positive electrons. Prior to the instant invention it was believed that static electricity could not be utilized as a power source. Nevertheless, the instant invention enables the use of this static electricity.

[0058] The direct current which is caused by the negative electron and positive electron goes to the “Charge Controller” and then goes to “Supper-dielectrics Capacitor” and then goes to “High frequency Inverter” and becomes alternating current in order to be used for the communication between the reader and the RFID tag at 15 volts 16 times in a second.

[0059] This power is transmitted to the larger capacitor in the reader of the stovetop by RF waves immediately.

[0060] A capacitor is added to the RFID tag to help to eliminate noise and interference during operation. As is shown in Fig. 6, the capacitor, 200, is attached to the solder pad on the back of the RFID tag (210) to act as a noise filter. In the preferred embodiment shown in Fig. 6, a 100nF capacitor is used with a Tagsys RFID tag.

**COOKWARE OBJECTS**

[0061] Figures 8 through 12 show several embodiments of RFID controlled cookware in
which temperature sensors (RTD’s) are imbedded in the cookware and connected to RFID tags in the same or similar manner to that disclosed in U.S. Application No. 10/833,356.

[0062] Figure 8 shows a pan (800) in which one temperature sensor (810) is imbedded in the bottom of the pan, and a second sensor (820) is attached to the side of the pan towards the top. The second sensor provides temperature information of the contents of the pan towards the top. Both sensors are connected by wires to RFID tag 830. This is useful for automated cooking, particularly when the amount of ingredients will vary. For example, if the amount of water is unknown or varies from the recipe, the temperature at the bottom of the pan will not provide accurate data for the system to know that the water is boiling. If the water level is higher than instructed in the recipe, the temperature level at the bottom may reach a level that would have boiled the instructed amount of water, but that has not yet boiled the higher amount of water. The second sensor at the top of the pan provides the temperature of the water at the top so that the system will know if the water is boiling or not regardless of the amount of water placed in the pan.

[0063] Figures 9a and 9b show pan 900 having a grid of sensors (or sensor net), 910, made up of coated (temperature insulated coating - also protects from pressure during cladding) titanium wire. The entire wire or net is a temperature sensor and is connected to RFID tag 930. The coating is cut away at points, such as at crossing 915, in which it is desired to measure a temperature point. The grid is clad between layers of the cookware, using processes known for cladding. Alternatively, the grid may be attached to or made as part of a slab bottom that is connected to the base of the pan in a manner known in the art in which slab bottoms are used. When the grid is clad into a pan, it allows the thickness of pan layers to be reduced verses the embedded RTD’s disclosed in U.S. Application No. 10/833,356. Once the layers are clad
together, it is merely necessary to dig a hole into the side of the pan to expose the wire and connect it to RFID tag 930, rather than drilling through the bottom to locate the sensor.

[0064] Figure 10 shows a pan, 1000, utilizing two RFID tags, 1030 and 1035, and two RTD's, 1010 and 1015, one at each side of the pan. The RTD's are located in slots/notches 1040 and 1045 cut into each side of the pan in the manner described in U.S. Application No. 10/833,356.

[0065] Figures 11a, 11b and 12 show several embodiments of cast pans in which a channel is cast into the pan for placement of the RTD. Referring to Fig. 11a, channel 1105 is cast into pan 1100. RTD 1110 is placed in the channel and connected to RFID tag 1130 which is located in an opening 1150 (shown in Fig. 11b) that is cast into the handle of pan 1100. Handle caps 1155 are connected together by mating tabs 1156 and 1157 to cover and protect RFID tag 1130. Referring to Fig. 12, channel 1205 is cast into pan 1200. RTD 1210 is placed in the channel and connected to RFID tag 1230 which is located in pan handle 1260 which is attached to the side of the pan (i.e. not a cast piece of the pan). Handle 1260 may be made and attached in any manner known or developed, such as the manner discussed in U.S. Application No. 10/833,356.

RFID READER

[0066] All readers for the RFID systems of the prior art provide data only one time in a second. This is not enough to make recipes work easily by automatic cooking, because the condition of the food/ingredients or circumstances are different always.

[0067] Below is a diagram of the RFID system describing an improved reader that obtains temperature data 16 times per second:
Diagram for the RFID Automatic Cooking System

[0068] The reader of the instant inventions obtains 18 data points (i.e. temperature measurements) in a second repeatedly during the cooking process and transmits the information from the RFID tag to the RFID reader. The reader takes out the max and min values and adds up the rest of the 16 data points; send it to the Micom (microcomputer) of the Induction Stove to control the cooking process. In this manner it is possible to obtain improved data of the heating objects all the time to make perfect recipes automatically (i.e. without stirring and without scorching).

[0069] The IH micro determines the best power and duty cycle to provide to the IH by using the continuous information that is obtained during cooking.
Drawing Methods for Radio Frequency Identification Controlled Heatable Objects

[0070] Embedding an RTD sensor within an object, as is discussed in U.S. Application Nos. 10/833,356, 11/148,802, 11/266,148 and 60/738,259 requires the use of relatively thick materials, which can create difficulties in the drawing process and which require special tooling, as is discussed below in more detail.

[0071] Thick clad material which is clad with stainless steel and aluminum is utilized in connection with the preferred embodiments of RFID cookware in which temperature sensors are to be imbedded. The total thickness of the material for the heatable objects should be around 4mm in order to drill a hole into the center of the objects to place the RTD sensor at the center of the objects.

[0072] In preferred embodiments, this clad material is over 3-ply and one of the most preferred combinations utilizes over 0.5mm thickness magnetic 430 series stainless steel outside (outer layer of the pan) for being heating by induction and the inside (inner layer or cooking surface of the pan) is 304 stainless steel of same thickness as the outside 430 series stainless steel. By using these different types of materials inside of the cookware objects and outside, rusting is reduced. The inside material is resistant to rust that may be caused by the harsh cooking environment and food deposits; while the outside magnetic stainless steel works very good for induction. These two different type of stainless steel layers (outside and inside layers) sandwich aluminum or an aluminum alloy sheet. In the preferred embodiment the aluminum alloy sheet has at least 7 different plies/layers.

[0073] This multi-ply clad material describe above creates fantastic absorption, conduction and equal distribution of the heat from the Induction Heater to the pan and conducts the heat to the side wall of the heating object very quickly and evenly. This phenomenon is
made by the cladding of different characteristic materials like aluminum and stainless steel or copper and stainless steel and aluminum. These combinations of the clad materials provide a result similar the phenomenon of refraction of light in water. The heat is transferred to bottom of the pan into the magnetic stainless steel of 430 series. The heat is conducted, bent and expanded to the next aluminum sheet or sheets until the heat is conducted to the 304 stainless steel which is inside the cookware object. The bending and expansion results in the heat spot that starts at the out side of 430 stainless steel layer that receives energy from the Induction Stove to be much wider once the heat reaches to the inside 304 stainless steel. In addition heat is conducted to the side wall of the object in the same manner. This provides a much improved amount of conduction over alternative materials for the cladding such as stainless steel and a carbon core sheet or iron sheet are utilized. In addition, the materials of the preferred embodiment result in a reduced weight than could be obtained with alternative materials.

[0074] Use of the RFID cooking system described in connection with the instant invention allows a user to bake deep cakes easily by the heating a cookware object very nicely and evenly and without the need to stir due to the very good convection which results from the above-described materials for making cookware objects combined with the control of the duty cycle of the Induction Stove, which is controlled by the sequences programmed into the recipe card.

[0075] Manufacturing cookware using the type of materials discussed above requires the use of a very heavy press machine. In the preferred embodiment a press of over 700 tons power is used to draw the objects. The speed of the drawing becomes very important due to the thickness of the materials, it should be slow, roughly one drawing in three seconds.

[0076] The draw tooling utilized for making cookware using the clad materials described
above is created by using known laws/rules used in the forming of clad material and manipulating these laws to provide the desired shape based upon the thickness of the material (i.e. 0.160" or 4mm material in the preferred embodiments).

[0077] Manipulation of the draw rules primarily is contained in the application of respective radii keeping the depth of draw always in sight. By applying techniques that match draw die and draw punch radii it is possible to successfully form the desired part.

[0078] Set down tooling uses a traditional set down form. A modification to allow the success with 0.160" material consists of tight tolerance punch nose configurations and in some instances employing draft.

[0079] All tooling is made from traditional materials. The forming section of the first draw dies and blank holders are made from aluminized bronze. The first draw punches are created from D2 and hardened. All set down tools are made from D2 and hardened.

[0080] First draw operations are accomplished in a double action hydraulic press. General application of pressure equates to 200-250 tons for blank holder and punch pressures are controlled by the press allowing only pressures required to complete the draw.

[0081] Typical punch speeds utilized are 0.90-1.00 in/sec.

[0082] Second draw operations are performed in a double action mechanical press, which cycles at 8-1/2 strokes per minute. The second draw operation requires 100 tons pressure on the outer ram and 100 tons pressure on the inner ram. Failure to meet the pressure requirements will result in unacceptable set down shapes.

[0083] Figures 13 through 22, as labeled, show the design schematics for various dies and draws of the instant invention for several cookware objects.
Method of Tunneling

[0084] U.S. Patent Application No. 10/833,356 discloses methods of making cookware/servingware items and other heatable objects in which a tunnel is formed in the bottom of the object for placement of a temperature sensor. In one embodiment, a hole is bored into the bottom of the object. In a preferred embodiment of the instant invention, the hole is bored in the object using a gun drill. In yet another preferred embodiment, the hole is bored into the bottom of the object while a clamping force is applied to the object to push out the panel. This is useful for cookware manufactured to include a concave bottom surface that is designed to flatten out as the object is heated so that the bottom of the object will lie flat on the surface of the cooktop during cooking.

[0085] In the foregoing description, certain terms have been used for brevity, clearness and understanding; but no unnecessary limitations are to be implied therefrom beyond the requirements of the prior art, because such terms are used for descriptive purposes and are intended to be broadly construed. Moreover, the description and illustration of the inventions is by way of example, and the scope of the inventions is not limited to the exact details shown or described.

[0086] Although the foregoing detailed description of the present invention has been described by reference to an exemplary embodiment, and the best mode contemplated for carrying out the present invention has been shown and described, it will be understood that certain changes, modification or variations may be made in embodying the above invention, and in the construction thereof, other than those specifically set forth herein, may be achieved by those skilled in the art without departing from the spirit and scope of the invention, and that such changes, modification or variations are to be considered as being within the overall scope of the
present invention. Therefore, it is contemplated to cover the present invention and any and all changes, modifications, variations, or equivalents that fall within the true spirit and scope of the underlying principles disclosed and claimed herein. Consequently, the scope of the present invention is intended to be limited only by the attached claims, all matter contained in the above description and shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

[0087] Having now described the features, discoveries and principles of the invention, the manner in which the invention is constructed and used, the characteristics of the construction, and advantageous, new and useful results obtained; the new and useful structures, devices, elements, arrangements, parts and combinations, are set forth in the appended claims.

[0088] It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.
CLAIMS

What is claimed is:

1. An RFID recipe card comprising:
   an RFID tag sandwiched between a front layer and a back layer;
   a buffer layer between an antenna of said RFID tag and one of said front and back layers.

2. The RFID recipe card as claimed in claim 1 wherein said buffer layer comprises a cardboard insert.

3. The RFID recipe card as claimed in claim 2 wherein said insert includes a hole to provide a recess for said antenna.

4. The RFID recipe card as claimed in claim 1 wherein said front and back layer are made of a cardstock material.

5. The RFID recipe card as claimed in claim 1 further comprising a lamination surrounding said front and back layers, said RFID tag and said buffer layer.

6. The RFID recipe card as claimed in claim 5 further comprising holes punched in said lamination.
7. A component for radio frequency identification controlled object comprising:
   a temperature sensor;
   a radio frequency identification tag associated with said temperature sensor, said tag
   being operable to communicate temperature information obtained by said temperature sensor with a heating device; and
   a shell at least partially surrounding said tag;
   wherein said shell comprises a first portion including PTFE and a second portion
   including mica.

8. The component as claimed in claim 7 wherein said PTFE and said mica are mixed into an epoxy-based material.

9. The component as claimed in claim 7 further comprising a mineral insulated cabling connecting said tag to said temperature sensor.

10. A component for radio frequency identification controlled object comprising:
    a radio frequency identification tag; and
    a shell at least partially surrounding said tag;
    wherein said shell comprises a first portion including PTFE and a second portion
    including mica.

11. The component as claimed in claim 10 wherein said tag receives power from an RFID reader.
Fig. 13
Fig. 14
Fig. 16
Fig. 17
Fig. 22