Sept. 24, 1957 L. J. PIRCON 2,807,698

THERMATRONIC PROCESSING AND CONTAINER-CELL COMBINATION

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Fig. 1

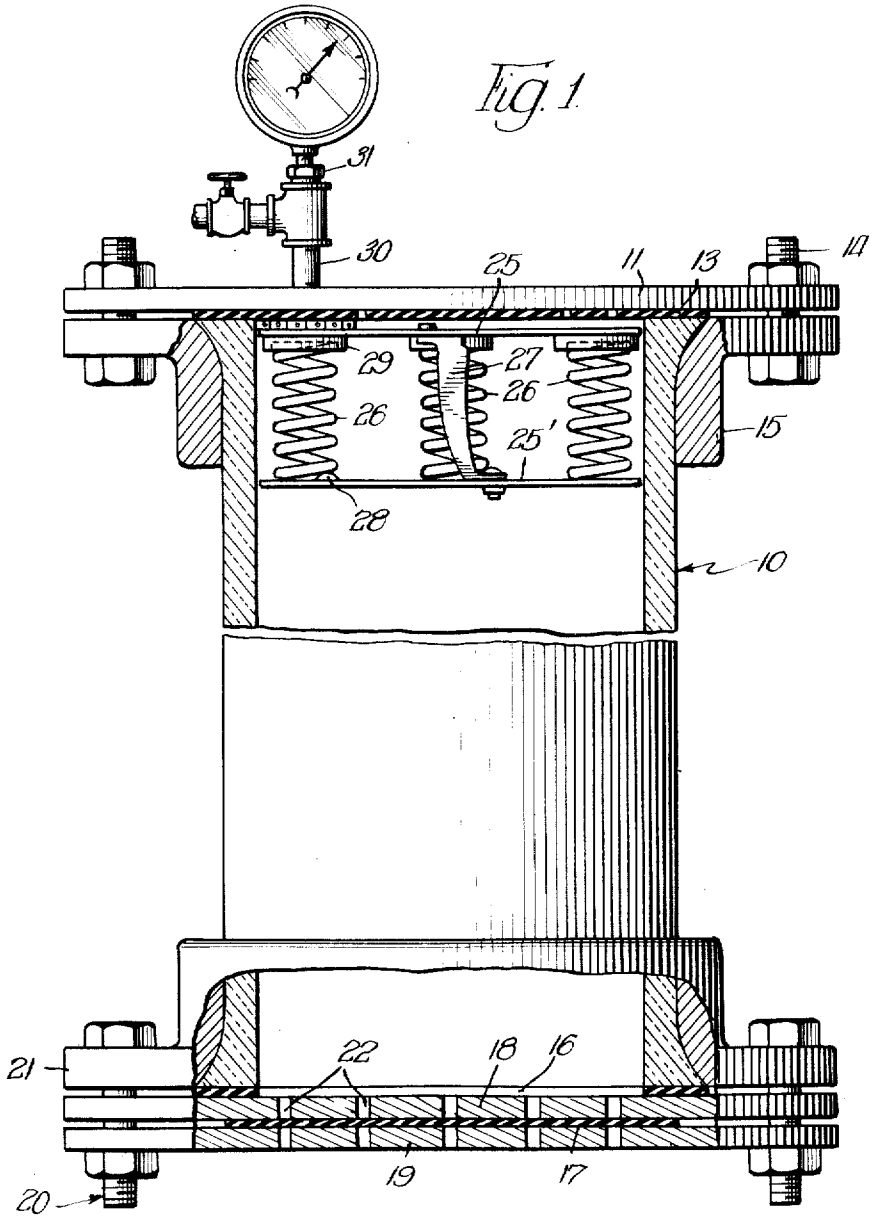

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Fig. 2

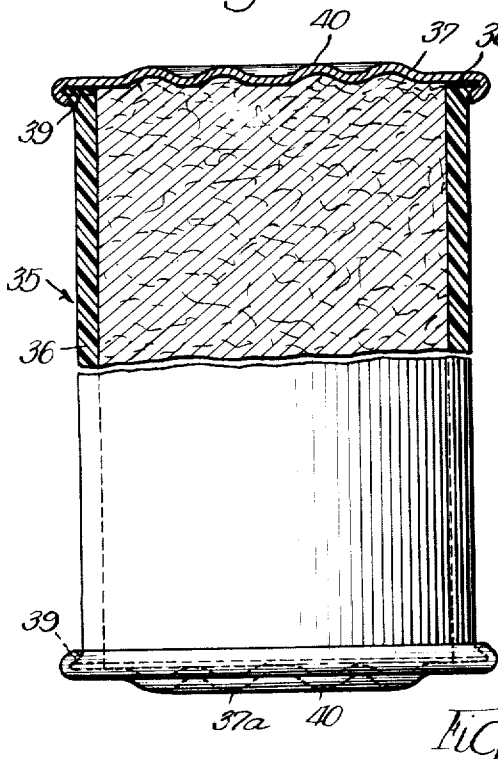


Fig. 4

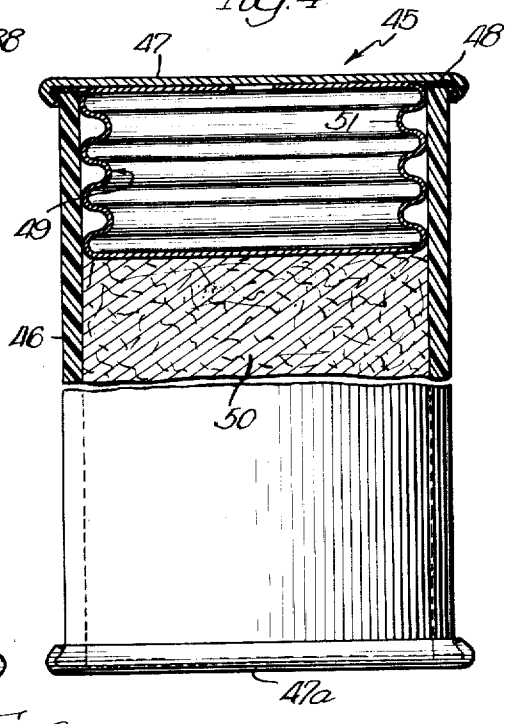
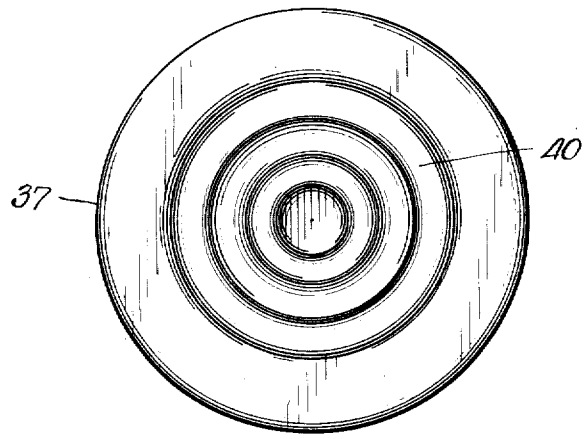


Fig. 3



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THERMATRONIC PROCESSING AND CONTAINER-CELL COMBINATION

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Application September 14, 1954, Serial No. 455,946

4 Claims. (Cl. 219—10.57)

My present invention relates generally to the art of processing food stuffs and the like through the application of a high-frequency electrical energy. More specifically, the invention herein of subject relates to improved equipment for employing high-frequency electrical energy to meat to accomplish the processing thereof.

High-frequency heating depends largely upon energy conversion rather than heat transfer, and has been mostly used to date for increasing thermal energy of plastics and wood bonding cements, but has yet to find successful commercial application for processing food products. Certain methods have been perfected for employing the principles of high-frequency heating to blanching vegetables and to the processing of canned meat products. I have found, however, that in the processing of current-conducting organic materials, such as meat—and particularly ground meat such as pork, luncheon meat, etc.—the known methods and apparatus are not applicable.

Briefly, when such material is placed between two parallel plate electrodes and low-frequency current is applied in the manner of conventional resistance heating technique, an extremely uneven type of heating results because of the capacitive reactance of the mass, and particularly because of the variance of this reaction value between different points of the mass. Moreover, with the use of known dielectric techniques wherein high-frequency currents are applied to the material, a severe burning and even a direct short-circuiting of the energizing source were experienced as a result of the current conducting characteristics of the mass. Accordingly, there has been no successful use prior to this invention, of dielectric or resistance heating equipment to effect heating of current-conducting organic materials, such as meat.

I have discovered that the thermal energy level of current-conductive organic materials can be uniformly raised throughout a mass by concurrently effecting both ionic and molecular motions in the mass, and I have termed this phenomenon "thermatronic" heating. This method of processing a meat product constitutes a means for increasing thermal energy without the need for temperature differential. Stated in other words, a product such as meat is capable of having its thermal energy increased homogeneously, or, that is, without a temperature difference between any two points in the meat. The details of this arrangement have been set forth in detail in my copending application which was filed September 14, 1954 and received Serial No. 455,945.

The phenomenon based on the above principles obviously lend themselves readily to the processing of meat, since the same provides a means for processing meat at substantially uniform and homogeneous temperatures while avoiding the heretofore troublesome contrary results encountered in attempting to employ induction heating or dielectric heating in the processing of meats.

Of further particular impact in the processing of meat, is the problem of accommodating rapid expansion in an enclosed container which accompanies the processing of meat having high solid and liquid volume expansion with temperature increase. This difficulty has particular significance in the application of the "thermatronic" principles referred to hereinabove, since it is necessary in the practice of that concept to contact the meat with parallel electrode plates. To this end, I have invented several processing cells or containers which are designed and constructed to permit the application of electrical energy to meat stored therewithin while accommodating the attending expansion without injury to the cell or disruption of the processing cycle.

Bearing the above principles and concepts in mind, the main object of this invention is to provide a new and improved means for raising the thermal energy level in meat and like products in such a manner that the meat may be uniformly and homogeneously processed.

Another object of this invention is to provide a new and improved processing cell for the thermatronic heating of meat and like food products.

Another important object of this invention is to provide a new and improved processing cell and container in which meat and like products may be processed through the application of thermatronic techniques.

A still further important object of this invention is to provide a new and improved processing cell for the application of thermatronic techniques to meats and the like, and which will accommodate expansion encountered in processing meats having high solid and liquid volume expansion rates.

A still further important object of this invention is to provide a new and improved closed container cell which will accommodate expansion encountered in processing meats and like products.

The above and further objects, features and advantages of this invention will be recognized by those familiar with the art from the following detailed description of its concepts and principles and especially as related to its application and association with the processing and container cells illustrated in the accompanying drawings.

In the drawings:

Figure 1 is a schematic elevational representation of a cell capable of processing meat according to the above briefly outlined concepts of thermatronic heating;

Figure 2 is a cross-sectional showing of a first modified form of container cell for use in thermatronic heating of meats and embodying means for accommodating the expansion of meat being processed therein;

Figure 3 is a top plan view of the container illustrated in Figure 2; and

Figure 4 is a partial cross-sectional view of a second modified form of container cell for the processing of meat.

Turning first to the features of the processing cell illustrated in Figure 1 of the drawings, it will be recognized that the same may be used in conjunction with a high-frequency electrical circuit and means of the order described in my copending application having Serial No. 455,945 which was filed September 14, 1954. Meat processed in such a cell is thereafter transferred to a can for commercial distribution. Briefly, the cell comprises a container into which raw meat is packed and sealed and which is then subjected to thermatronic heating to process the meat. Means are embodied in the cell for accommodating the expansion which accompanies the processing of the meat, caused by its high solid and liquid volume expansion characteristics. Such expansion characteristics are especially prominent in meat products such as boned ham, for example. As the description of the cell of Figure 1 unfolds hereinafter, it will be seen that the same demonstrates certain characteristics of construction which are peculiar in this field. The latter observation is likewise true as applied to the container cells illustrated in Figures 2 through 4 of the drawings, which in themselves constitute a processing and shipping means for the

processed product as opposed to the cooking vessel characteristic of the processing cell illustrated in Figure 1.

With particular regard to the processing cell of Figure 1, it will be recognized that the same constitutes a cylindrical container **10** made of Pyrex glass or like insulating material which is open ended. The upper end of the container **10** is enclosed by a steel plate **11** placed over a rubber gasket **13**, the latter of which contacts the immediate upper edges of the glass container **10**. Plate **11** and gasket **13** are held securely in position by means of a plurality of tie-bolts **14** which pass through plate **11** and are held to an aluminum flange or collar member **15** mounted to grip the upper end of the glass container. The lower end of container **10** is sealed over by means of an annular ring gasket **16** and a circular disc gasket **17** which are separated by an intervening aluminum or stainless steel cover plate **18** which is substantially coextensive with gasket **17**. A second cover plate **19** is disposed beneath the lower gasket **17** and the assembly of the two cover plates and two gasket members is held securely by bolt means **20** to a lower aluminum collar flange **21**, similar to the construction employed at the upper end of the container **10**.

For purposes of inserting a thermocouple probe so as to test the internal temperature of meat placed within the processing cell, a plurality of openings **22**, **22** are formed vertically through the two lower cover plates **18** and **19**. By this means a hypodermic needle-type thermocouple probe may be inserted through the gasket member **17** and into the interior of the container to test the internal temperature at various points in the meat being processed. When such a thermocouple probe is withdrawn from openings **22**, **22** the openings thus made in the rubber gasket **17** seal themselves to maintain the closed integrity of the cell.

Mounted within the upper end of the container **10** are a pair of parallel-spaced aluminum electrode plates **25**, **25'** which constitute a collapsible electrode assembly comprising the two metal plates **25**, **25'** and separating spring members **26**, **26**. The plates **25**, **25'** are interconnected electrically by means of flexible metal conductor ribbons **27** or like means.

It will be noted that when the cell of Figure 1 is packed with meat to be processed by thermatronic concepts, the lower plate **25'** of the collapsible electrode engages the upper end of the meat and as heat is applied to the meat to cause the same to expand, the flexible or collapsible nature of the electrode assembly readily accommodates such expansion due to the presence of the coil spring members **26**, **26**.

With regard to the collapsible electrode assembly, it is also worthwhile mentioning that the springs **26**, **26** are rigidly connected to the lower plate **25'** as by screw means **28** while the upper ends thereof are separated from plate **25** by intervening plastic spring cushions **29**. If desired, a means for mounting a pressure gauge comprising a suitable pipe **30**, with a coupling packing gland connector **31** may be mounted through the upper cover plate **11** so that a record of the pressures existing within the processing cell may be observed during the cooking operation.

When utilizing the cell of Figure 1, the upper plate **11** is connected directed to a high-frequency circuit as described in my application Serial No. 455,945 of reference, and the lower metallic head comprising the lower plates **18** and **19** etc. is connected to ground to cause the application of high-frequency cooking currents to the meat packed within the cell. When the final stage of cooking has been reached in the cell of Figure 1, the upper cover is removed from the insulating container **10** and the meat so processed removed for storage in a shipping container or the like. Such a processing cell is particularly adaptable and designed for use in a "batch" cooking process as opposed to a continuous process and is especially usable for the processing of canned hams and the like.

With particular reference to Figures 2 and 3 of the drawings, it will be appreciated from the showing therein that a container cell **35** comprises a cylindrical container portion **36** made of a suitable plastic or like insulating material which is capped off at its upper and lower ends by a corrugated metal container cover **37** and a similar bottom cover **37*a***, respectively. Each cover is sealed with the end of the container by means of a ring type gasket **38** or like sealing means. A container of this class is designed for accommodating the processing of meat or like food stuffs packed therein according to the thermatronic processes and concepts discussed hereinbefore and also is to be used as a shipping container for the processed products. It will be observed, therefore, that the upper and lower ends of the container **36** are provided with flanged overextensions or turned-out portions **39** forming a rim over which the edges of the cover members **37** and **37*a*** may be suitably turned to effect in conjunction with gaskets **38** an air-tight seal with the plastic-walled container **36**. Of particular importance in the construction of this device **35** is the provision of the multiple concentric corrugations or offset ribs in the top and bottom cover walls **37** and **37*a*** as indicated generally by numeral **40**. The corrugated portions of the cover and bottom walls provide a convenient means for accommodating expansion of the meat when the same is being heated during the cooking process.

In processing thermatronically with a container cell such as cell **35** illustrated, the upper and lower metal plates or walls **37** and **37*a*** are clamped securely between two metal electrodes connected to a high-frequency generator and to ground, respectively. As the cooking proceeds, the meat swells a substantial amount and the required room for expansion is provided by stretching the corrugations in the upper wall **37** and similarly formed lower expansion wall **37*a***. It is obvious, of course, that in certain instances only one such corrugated wall need be provided if the corrugations are of sufficient dimensions to accommodate the swelling of the meat product being processed.

An alternative container cell **45** is illustrated in Figure 4 of the drawings. Cell **45** is of the same general category or class as cell **35** shown in Figures 2 and 3, in that is provides not only a chamber for processing the meat, but likewise a container for shipping or commercially distributing the sterilized product. In accordance with the illustrated details of cell **45**, the same again embodies a plastic container **46** forming the side walls for the cell. The container is suitably capped over at its upper and lower ends by metal wall members **47** and **47*a***, respectively, which cooperate with seal rings **48**, **48**, as in the previously described embodiment. Between the upper metal cap or wall **47** and the meat to be processed, is located a collapsible spacer member **49** made out of aluminum or stainless steel foil. It will be appreciated that the spacer is in constant contact with the metal of upper wall **47** and likewise in contact with the meat **50** disposed in the cell. Such aluminum spacer, in essence, forms a collapsible electrode connection which, while it keeps good contact with the meat, permits the meat to expand without injury to the container **46**. Of particular note as regards the spacer member **49** is the bellows-like formation preferred for the side walls **51**, **51** thereof. Forming such side walls **51** with bellows-type corrugations illustrated, permits an even collapse of the spacer when the meat **50** expands during the application of the heat accompanying the process. This uniform collapse insures good electrical contact between the upper metal cap **47** and the meat **50** being treated.

Again, to operate a cell of the order illustrated at **45** in Figure 4, the metal ends **47** and **47*a*** thereof are pressed firmly between a pair of spaced electrode plates and current is applied through the upper cap **47**, the lower cap

47*a* being connected to ground to permit the passages of the high-frequency current into the meat of the container. With regard to the application of such current, it will be realized that the aluminum spacer member 49 provides an intermediate collapsible electrode or connection means between the plate means 47 and the meat 50.

From the foregoing it will be appreciated that I have herein described the features and concepts of improved means and devices for processing meats and related food stuffs. Further, I have illustrated and described the features of an improved bath-type processing cell and first and second modified forms of combined processing and container cells especially suited for the thermatronic processing of meat. While I appreciate that numerous changes, modifications and substitutions of equivalent materials and designs may be resorted to in practicing my invention, it is nevertheless thought that such variations will not necessarily depart from the spirit and scope of the invention involved. As a consequence, it is not my intention that I be limited to the particular features, forms and embodiments illustrated and described, except as may appear in the following appended claims.

I claim:

1. A cell for the processing of material according to thermatronic principles comprising, an open-ended container having side walls of insulating matter, a metal electrode plate means inclosing one end of said container, a second metal electrode plate means enclosing the other end of said container to thereby form an enclosed container, and collapsible means disposed within said enclosed container in an expanded condition intermediate the second electrode plate means and the surface of the material to be processed.

2. A container cell for the thermatronic heating of meat, comprising, a cylindrical open-ended container forming the side walls of the cell and made of suitable insulating material, a metal electrode sealing over one of said container, a second electrode sealing over the opposite end of said container, and a collapsible electrode connector means connecting said second electrode to the meat within said container, said electrode connector

means being located within said container for accomodating the expansion of said meat during the processing thereof.

3. A cell for the thermatronic processing of meat, comprising in combination, an open-ended container member made of suitable dielectric material, an electrode plate sealing over one end of said container, a second electrode plate sealing over the other end of said container, and corrugated means formed in at least one of said electrodes to accommodate the expansion of meat within the cell during the processing thereof to thereby avoid injury to the cell and to maintain circuit connection with said meat.

4. A cell for the processing of meat according to thermatronic heating principles, comprising, a substantially cylindrical open-ended container forming the side walls of the cell and made of suitable dielectric material, electrode plate means mounted over one end of said container and serving to seal over that end of the container, a cover plate means sealing over the other end of said container, a pair of electrode plates mounted in spaced parallelism within said container and having electrical connection with said cover plate, spring means separating said two electrode plates, and electrical conductive means interconnecting said two electrode plates, said spring means accommodating the movement of one of said electrode plates which is in contact with meat stored within said container relative to the other of said electrode plates thereby to permit the expansion of said meat during the process to thus avoid injury to the cell.

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