

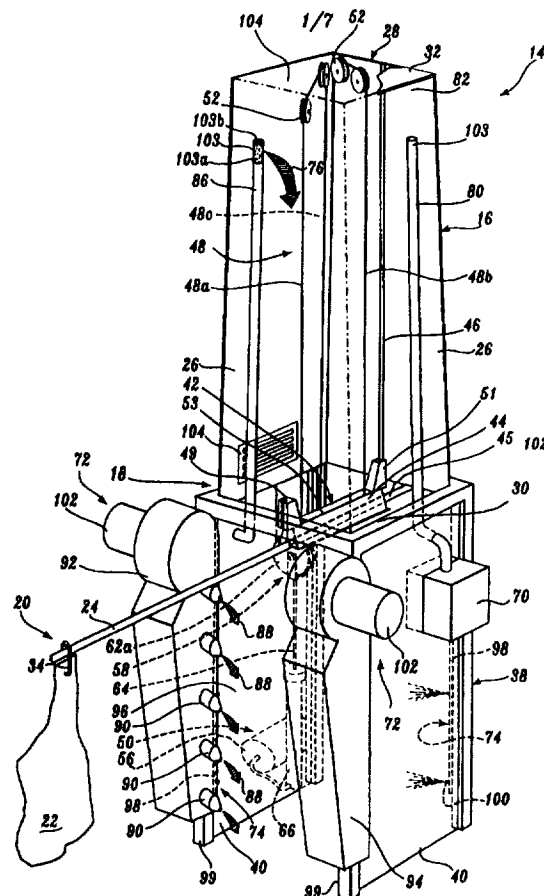


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(21) International Application Number: PCT/US97/16457 (22) International Filing Date: 16 September 1997 (16.09.97) (30) Priority Data: 08/710,348 16 September 1996 (16.09.96) US (71) Applicant: FRIGOSCANDIA INC. [US/US]; P.O. Box 3984, Bellevue, WA 98009 (US). (72) Inventors: WILJANEN, Kenneth, John; 5615 S. Willow, Seattle, WA 98118 (US). HOCKER, Jon, Almon; 20024 99th Court N.E., Bothell, WA 98011 (US). (74) Agent: NAGAE, Jerald, E.; Christensen O'Connor Johnson & Kindness, Suite 2800, 1420 Fifth Avenue, Seattle, WA 98101 (US).	(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, UZ, VN, YU, ZW, ARIPO patent (GH, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG). Published <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>	

(54) Title: LOW VOLUME STEAM PASTEURIZATION APPARATUS AND METHOD**(57) Abstract**

An apparatus and method for pasteurizing meat units (22) includes a generally upright enclosure (16) supported by a support frame (38), the enclosure having a lower end opening (30) and a translation arrangement (42) for raising and lowering the meat unit into the enclosure. The translation arrangement (42) includes a movable support (44), a power source (50), guides (52), a tension member (48), and guide rails (46). A steam supply (70) releases steam (76) into the enclosure to rapidly heat the meat surface. A gas supply (72) having an array of water-removing air nozzles (90) is located near the front exterior of the enclosure (16) near the lower end opening (30). The gas supply for directing gas (88) at the meat unit to remove excess surface water as the meat unit moves into the enclosure and onto the translation arrangement (42). A cooling system (74) for cooling the meat unit as it descends from the enclosure includes a plurality of cold water spray nozzles (100) attached to a water conduit (98). The enclosure is located above either a main rail (24) or a spur rail (36) of a conveyor system (20) along which the meat units are traveling on rolling hooks (34). A method of pasteurizing the meat units includes: filling the enclosure with steam or a steam-air mixture; directing high velocity gas at the meat unit to remove surface water as the meat passes onto a translation arrangement; lifting the meat unit into the enclosure; rapidly heating the meat surface in the enclosure using the steam or steam-air mixture; and lowering the meat unit from the enclosure while applying a cooling medium to the meat unit surface.



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LOW VOLUME STEAM PASTEURIZATION APPARATUS AND METHOD

Field of the Invention

The present invention relates to methods and apparatus for treating raw meat units, and more particularly, to methods and apparatus utilizing steam to destroy meat
5 surface pathogens.

Background of the Invention

Concerns over pathogens on meat have been elevated in recent years due to *E-coli* related illnesses and deaths. *E-coli*, other coliform bacteria, and many other pathogens reside on the surface of meat beginning with the meat carcass processing
10 step. The pathogens originate from fecal matter and other contaminants on the surface of the meat. Without adequately destroying these pathogens, the meat is processed, packed, and shipped to the distributor, retailer, or consumer. It is then left to the consumer or preparer of the meat to address a problem that by then can be even worse. The bacteria may have further grown or may reside throughout the meat.
15 This is the case, for example, with ground meat, since during meat processing, the surface pathogens are distributed throughout the meat.

The only precaution commonly taken by meat processors is to spray the carcasses with water having a temperature of 120-140°F. This measure is not necessarily effective or efficient at destroying the surface pathogens. Not all
20 pathogens are killed at these temperatures and large volumes of water are required, along with a large amount of energy to heat the water, since the water cannot easily be recirculated if contaminants are to be avoided.

In response, certain U.S. federal regulations have been imposed on food preparers and recommendations have been made to increase the likelihood that

pathogens are killed. For example, restaurants must cook hamburger at 160°F throughout for at least five seconds. Additionally, private meat processors have created new and improved methods and devices for processing meats in order to reduce pathogens such as *E-coli*. One such method is described in U.S. Application
5 Serial No. 08/335,437 which includes the steps of removing surface water from the meat, passing the meat through a steam heating chamber having a positive pressure relative to the outside of the steam chamber to quickly heat the exterior of the meat, then rapidly chilling the surface of the meat. A meat conveyor is provided that extends through a dewatering chamber, a steam chamber, and a chilled water
10 chamber. The meat conveyor supports the meat and transfers it from chamber to chamber.

The above described general method and apparatus are appropriate for processors that have a large through-put of pasteurized meat or that have sufficient plant floor space within which to house such a potentially large apparatus. For
15 smaller processors, there are few known systems capable of processing a small number of meat units efficiently, regardless of what pasteurization method is used. Likewise, there are not many systems small enough to occupy only a small amount of plant space. In addition, the inventor knows of no meat surface pasteurization system that is specifically adapted to smaller sized units of meat and poultry, e.g., a half
20 carcass, a single leg, a single poultry carcass, etc.

The process and apparatus of the present invention were developed to effectively and efficiently kill surface pathogens on meat and poultry products of varying sizes, where the products are processed by low volume processing operators, i.e., those having a smaller overall through-put or a smaller building space. The term
25 "low volume" as used herein may also refer to smaller units of meat as well. Therefore, the present invention helps to reduce the risk of contaminated meat reaching the end user, regardless of the space and processing limitations of smaller operations or the size of the meat unit.

Summary of the Invention

30 The invention provides an apparatus and method for pasteurizing meat units, regardless of the space and processing limitations of smaller operations or the size of the meat unit. In accordance with aspects of the present invention, the apparatus includes a generally upright enclosure having a lower end opening leading into the enclosure and a translation arrangement for raising and lowering the meat unit into the
35 enclosure through the lower end opening.

In accordance with further aspects of the invention, the apparatus further includes a steam supply located at the enclosure for releasing steam or a steam-air mixture into the enclosure; a gas supply located in front of the enclosure near the lower end opening, the gas supply for directing gas at the meat unit in order to
5 remove excess surface water from the meat unit as the meat unit is moved into place on the translation arrangement; and a cooling system attached to the enclosure near the lower end opening for cooling the meat unit as the meat unit descends from the enclosure via operation of the vertical translation arrangement. The apparatus may optionally include an air injection fan attached to the enclosure for releasing air into
10 the enclosure during steam pasteurization.

In accordance with other aspects of the invention, the steam supply includes a steam conduit, or steam pipe, having a steam outlet located within the enclosure, the steam pipe releasing steam at about or above atmospheric pressure. The gas supply includes a plurality of air jets pneumatically interconnected via a manifold. Gas is
15 released at a velocity in the range of about 5,000 to 10,000 feet per minute. The cooling system includes a plurality of cold water spray nozzles attached to a water conduit, or water pipe, that is connected to the support frame. The support frame preferably includes sidewalls to inhibit particles from projecting from the enclosure and support frame areas.

In accordance with still further aspects of the invention, the translation arrangement includes a movable support from which the meat unit is hung, a power source for providing powered movement of the movable support, one or more guides (e.g., sheaves) attached to the enclosure, and a tension member connected at one end to the movable support member and connected at the other end to the power source,
20 the tension member being guided and supported by the guides. Additional linear upright rail guides may be attached to opposed inside surfaces of the enclosure to vertically guide the movable support.

In accordance with still other aspects of the invention, the enclosure is located above a conveyor system along which the meat unit travels on rolling hooks. In one
30 embodiment, the enclosure is located directly above a main rail of the conveyor system. In an alternative embodiment, the enclosure is located away from the main rail and is linked to the main rail via a spur rail stemming from the main rail.

In accordance with yet further aspects of the invention, a method of pasteurizing the meat units is provided that includes directing high velocity gas at the
35 meat unit to remove surface water from the meat unit while moving the meat units

onto the movable support; lifting the meat unit into the enclosure; rapidly heating the meat surface in the enclosure by exposing the meat to a steam or steam-air mixture in the enclosure; and lowering the meat unit from the enclosure while simultaneously applying a cooling medium (e.g., water) to the meat unit as it exits the enclosure opening.

Brief Description of the Drawings

The foregoing aspects and many of the attendant advantages of this invention will become more readily appreciated as the same becomes better understood by reference to the following detailed description, when taken in conjunction with the accompanying drawings, wherein:

FIGURE 1 is a perspective view of a steam pasteurization apparatus formed in accordance with the present invention;

FIGURE 2A is a front view of the apparatus of FIGURE 1;

FIGURE 2B is a perspective detail view looking upward at a portion of the apparatus of FIGURE 1;

FIGURE 3 is a side view of a portion of the apparatus of FIGURE 1;

FIGURE 4 is a top down cut-away view of the apparatus of FIGURE 1;

FIGURE 5 is a perspective view of an alternative conveying system formed in accordance with the present invention; and

FIGURE 6 is a flow chart detailing a preferred pasteurization method in accordance with the present invention.

Detailed Description of the Preferred Embodiment

In the following description, the term "meat unit" is to be understood to be a piece of meat or poultry of a size that is generally smaller than a whole beef carcass, e.g., a half or quarter carcass, a limb or rib section, a whole fowl, etc. The present invention is envisioned for meat units sized smaller than about 10½ feet long by 2½ feet wide. Larger pieces may be used, if the entire apparatus is enlarged appropriately. Likewise, multiple meat pieces may be combined to form a single meat unit so long as the pasteurization method is capable of effectively pasteurizing the surfaces of each piece. The preferred method of pasteurization is believed to be most effective when only a single meat piece is pasteurized at any one time.

Referring to FIGURE 1, a perspective view of a steam pasteurization apparatus 14 formed in accordance with the present invention is shown. In general, an upright enclosure 16 having a lower end 18 is positioned above a conveying system 20. Meat units 22 traveling on a conveyor main rail 24 are raised into the

-5-

enclosure 16 where pasteurization components sterilize the surface of the meat unit 22. The meat unit is then lowered from the enclosure and passed to the next phase of processing, such as cutting, packaging, freezing, etc.

In more detail, the enclosure 16 is a vertically elongated rectangular structure formed of a temperature, moisture, and corrosion resistant material. Example materials include stainless steel and aluminum. As shown in FIGURES 2 and 3, the enclosure 16 includes a number of substantially upright sidewalls 26 located between the lower open end 18 and an upper closed end 28. The lower end 18 includes an opening 30 to allow passage of the meat unit 22 up into and down out of the enclosure 16. The upper end 28 is closed by an upper end wall 32. It is important for the enclosure 16 not to contain too many holes or other passages out of the enclosure 16 (other than the lower end opening 30), as any such holes will interfere with the capture and retention of steam during the pasteurization process. The overall size of the enclosure 16 will depend on the size of the meat units 22 to be pasteurized. It is preferable that the inner surfaces 34 of the sidewalls 26 be as near to the meat unit 22 as possible without actually touching the meat unit 22 or interfering with the meat unit's vertical translation.

The placement of the enclosure 16 relative to the conveying system 20 will depend upon the attributes of a particular conveying system. In a conventional conveying system, the main rail 24 is provided for translating meat units 22 hung from meat hooks 34. It is typical for the main rail 24 to extend the length of the process plant, so that the meat units 22 may be mechanically transferred between processing stations. The meat hook 34 is held to the main rail 24 using any one of a number of trolley-type arrangements. The meat unit is then manually rolled or translated between processing stations. In more sophisticated systems, the meat unit is transferred by an automated system.

As shown in the perspective view of FIGURE 1, the pasteurization apparatus 14 is located so that the enclosure opening 30 is directly above the main rail 24 of the conveyor system. As the hook trolley travels along the main rail 24, it passes through the pasteurization apparatus 14 where translation components are therein provided for raising and lowering the meat unit. This aspect is discussed in detail below. In the alternative arrangement shown of FIGURE 5, the pasteurization apparatus 14 may be located to one side of the main rail 24, with a spur rail 36 providing a path between the main rail 24 and the enclosure 16. Multiple spur rails and pasteurization apparatus may be extended from a single main rail. In use, a meat

hook 34 having a meat unit 22 is translated from the main rail 24 onto the spur rail 36 and lead to the enclosure 16. This configuration may be particularly useful for some processors who have widely varying processing needs. For example, meat units 22 not requiring surface pasteurization may be moved along the main rail 24 without
5 having to wait for other meat units to be pasteurized.

In either rail arrangement, the enclosure 16 is mounted on a support frame 38. The frame 38 preferably includes sidewalls 40 about those sides of the support frame 38 that are generally parallel to the main rail 24. The sidewalls may be rigid structures permanently secured to the support frame 38 or flexible flaps detachably
10 hung from the support frame 38. The sidewalls 40 help to contain any fluids or particles flung from the pasteurization apparatus 14 or the meat unit 22 during use.

Regardless of the conveying system used, the present invention pasteurization apparatus 14 further includes a translation arrangement 42 for raising and lowering meat units into the enclosure 16 through the lower end opening 30. Shown in
15 FIGURES 2-4, the preferred translation arrangement 42 includes a movable support 44 having a short elevator rail section 45 that replaces a portion of the main rail, the short elevator rail section 45 being separable from the main rail. The short elevator rail section 45 is positioned within the envelope of the enclosure 16 and is aligned with the main rail. The hook trolley is directly transferred from the main rail
20 onto the short elevator rail section 45. In a like manner, the main rail may be the spur rail 36 discussed above, where the short elevator rail section 45 replaces a portion of the spur rail.

Referring to FIGURES 2 and 2B, the movable support 44 preferably includes a structural stiffener 43 extending lengthwise of the rail section 45 to provide added
25 rigidity to the rail section 45. The stiffener 43 may be formed of any one of a number of known materials, e.g., metal, and is attached to the rail section 45 using conventional methods, e.g., welding.

Referring to FIGURES 2, 2B, and 4, the movable support 44 further includes a formed cover 47 extending lengthwise of the rail section 45 on the opposite side
30 thereof to the stiffener 43. The cover 47 prevents condensation from dripping down onto the trolley and onto the short elevator rail section 45. The cover 47 shown in FIGURE 2A and 2B extends substantially between opposed enclosure sidewalls and has a generally L-shaped cross-section with a lower serif 41 that is positionable adjacent the rail section 45. The upper edge 53 of the cover 47 is positioned parallel
35 to the short elevator rail section 45 and is rotatable about an axis extending between a

pair of guide blocks 49, 51 mounted on the ends of the movable support 44. The stiffener 43 is preferably attached to the guide blocks 49, 51 for providing added strength to the movable support 44.

5 The movable support 44 is sized to extend between a pair of upright guide rails 46. The guide rails 46 are fixedly attached in a generally vertical orientation to opposed inner sidewall surfaces of the enclosure 16. The guide rails 46 are located to position the hanging meat unit 22 centrally relative to the enclosure walls. The guide rails 46 extend substantially the entire vertical length of the enclosure. The guide blocks 49, 51 slidably engage with the guide rails 46. For example, in FIGURE 1,
10 guide blocks are preferably formed of a low-friction material, such as slidable plastic. Other arrangements may be used, e.g., rotatable bearings, a wheel arrangement, etc. The guide blocks 49, 51 are formed to be structurally capable of withstanding the intended meat unit load and of being reliable for use over an extended number of cycles.

15 During use, the cover 47 is rotatable between an open (to receive and remove the hook trolley) from rail section 45) position and a closed (during the pasteurization) position about axis 63. The cover is preferably automatically and mechanically opened and closed. One technique for accomplishing this is shown in FIGURE 2B. Small wheels 65 are attached to the ends of the cover near the lower
20 section of the cover. The wheels are oriented with their axis generally parallel to the rail section and are configured to engage horizontal guide members 67 extending approximately inward from the inside surfaces of the enclosure near the lower end, a distance approximately equal to approximately one-half the thickness of the small wheels 65. The short guide members 67 are continuously attached to the enclosure
25 inside surfaces in horizontal orientation.

When the movable support is located at its lowermost position as shown in FIGURE 2B, the small wheels 65 are engaged with the guide members 67 causing the cover to be rotated about axis 63 to its open position. As the movable support 44 moves upward, gravity causes the small wheels 65 to continue communication with
30 the guide members 67, also causing the cover 47 to rotate about axis 63 to its closed position. Eventually the small wheels 65 lift upwardly off the guide members 67. When the movable support 44 is being lowered, the wheels 65 encounter and engage the guide members 67 as the movable support continues to its lowermost position, the small wheels 65 rolling outward along the guide members 67 to cause the cover 47 to

rotate about axis 63 to its open position. The guide members 67 also serves as gutters to collect condensate.

By opening the cover 47, the hook trolley may be rolled onto the short elevator rail. A notch 55 (see FIGURES 2B and 3) is preferably provided at an upper
5 central location in the rail 45 so as to encourage the trolley to stay in one place during translation as well as provide an audible check for the worker indicating that the trolley is in place. Once upward translation begins, the cover 47 rotates to a closed position. A small cutout 57 (see FIGURE 4) formed in the lower section of the cover
10 allows the hook to extend from its trolley without interfering with the cover. The small cutout 57 also captures the hook and trolley to prevent them from traveling laterally on the short elevator rail during vertical translations, thus helping to maintain the meat unit at the approximate center of the enclosure. Other methods or mechanisms may be used to stabilize the meat relative to the movable support 44.
15 When the movable support is near the end of its descent, the cover automatically rotates open, and the trolley is then available to exit the enclosure and continue along the conveying system.

One or more tension members 48, such as chains or wire ropes, are interconnected between the movable support 44 and a power source 50. Supporting the tension members 48 are multiple guides 52, such as sprockets, wheels, rollers,
20 sheaves, etc. The guides 52 are preferably attached to the inner surface of the enclosure 16 with at least one guide for each tension member being located at the upper end wall 32 directly above the connection of the tension member to the movable support. This location causes the forces on the tension member 48 to be most efficiently transmitted to the movable support 44. Shown in FIGURE 1 are two
25 tension members 48a and 48b, one end of each being attached to an end of the movable support. The other ends of tension members 48a and 48b are connected to each other and to tension member 48c, such that motion of 48c will cause identical motion in 48a and 48b.

The power source 50 supplies power to translate the tension members, thereby
30 causing the movable support 44 with the meat unit 22 to move vertically into and out of the enclosure 16. Any one of a number of available conventional power sources may be used. Shown in FIGURES 2-4, a preferred power source is a standard hydraulic power unit 56 and cylinder 66.

In order to efficiently translate the tension members 48 shown in FIGURE 1
35 and to coordinate their movement, a sheave or sprocket arrangement 58 may be

employed. One such example sheave arrangement is shown in FIGURE 2A. Other efficiency mechanisms may be employed. In FIGURE 2A, the tension member 48c is wound about a first lower sheave 62a, then about an upper sheave 60, and back down around a second lower sheave 62b. The tension member 48c is then routed upward
5 and mounted to the support frame 38 as described above. The lower sheaves 62a, 62b are attached to a translating rod 64 of the hydraulic cylinder 66 that is supplied hydraulic power from the power unit 56.

Contraction of the cylinder 66 pulls the lower sheaves 62a, 62b downward to increase the relative distance between the upper and lower sheaves 60, 62a, 62b. This
10 causes tension member 48c to feed into the sheave arrangement 58 at a ratio of 4:1 to the increase in the relative distance between the upper sheave 60 and the lower sheaves 62a and 62b, thereby causing the movable support 44 to move upward at four times the rate that the cylinder is contracting. This ratio is preferred, although other ratios may be more desirable for a particular application. Extension of the cylinder 66
15 decreases the distance between the upper and lower sheaves 60, 62a, 62b, whereby the weight of the movable support 44 and meat unit 22 maintains tension in the tension members 48 and results in the lowering of the meat unit.

As described fully in U.S. Application Serial No 08/335,437, the preferred pasteurization method includes the steps of first removing surface water from the meat unit, then passing the meat unit through a steam heating chamber to quickly heat
20 the exterior of the meat unit, and then rapidly chilling the surface of the meat unit to ensure that the meat unit is not cooked in any way. In order to accomplish this preferred method of pasteurization, the present invention pasteurization apparatus 14 further includes a steam supply 70, a gas supply 72, and a cooling system 74.

The steam supply 70 maintains a body of steam 76 in the enclosure 16 at all times. Shown in FIGURE 2A, a steam generator 78 located outside of the enclosure 16, provides a supply of steam 76 through a portion of a steam conduit or pipe 80 positioned within the enclosure 16. The steam pipe 80 preferably extends the entire vertical distance of the enclosure 16 and includes an opening 82 near its
25 uppermost end. The steam pipe 80 is shown in FIGURE 4 to be located in a corner formed by adjacent sidewalls 26. The steam 76 is preferably released at about atmospheric pressure at about 212°F, from the opening 82 in the steam pipe 80.
30

The present invention pasteurization apparatus 14 encompasses the use of other steam supply 70 arrangements. For example, a manifold may be located within
35 the enclosure 16 to direct steam to a plurality of steam outlets. Or, the steam

supply 70 may include an exterior manifold connected to a series of outlets that extend directly into the enclosure 16 through individual passages in the sidewalls 26. Likewise, various steam supply 70 sources may be used, e.g., a boiler, in conjunction with an appropriate control system.

5 It has been found useful in some pasteurization instances to mix a quantity of air with the steam during pasteurization. For such circumstances, an air injection fan 84 that is attached to the outside of the enclosure 16 feeds air to an air injection conduit or pipe 86 extending substantially the entire inner vertical length of the enclosure 16. A perforated end cap 103 is mounted on top of the pipe 86 to
10 efficiently distribute the air with the steam in the enclosure. The end cap has a perforated tubular section 103a and a perforated end plate 103b. These perforations help distribute the air discharged from pipe 86. The air injection pipe 86 is preferably located generally opposite the steam pipe 80. Ambient air is an acceptable medium. The mixture of air with steam slows down the heat transfer from the steam to the
15 meat unit, so as not to cause cooking of the interior of the meat unit. Rather, only the exterior surface of the meat unit is heated, which is sufficient to kill the bacteria thereon.

Shown best in FIGURE 1, the gas supply 72 is located near the front side of the enclosure lower end opening 30. The gas supply 72 is provided to direct gas 88 at
20 the meat unit 22 in order to quickly remove excess surface water from the meat unit 22. The gas supply 72 includes an array of water-removal air nozzles 90 attached along a pair of upright air passage structures, or manifolds 92, 94. The structures 92, 94 are secured to the exterior of the support frame 38 along opposed frame supporting legs 99. Each structure extends a vertical distance below the
25 enclosure corresponding in the height to the length of the intended meat unit. Each structure may include a fan or blower 102 for creating pressurized gas or may simply act as a distributor of gas that is pressurized at a distant location. In FIGURES 1, 2A, 3, and 4, water removal fans 102 provide a constant supply of pressurized air.

The nozzles 90 are located at roughly equal distances along the heights
30 structures 92, 94 and are positioned to direct gas toward the opposite structure. The gas 88 should be released at a velocity in the range of about 5,000 to 10,000 feet per minute. In FIGURE 2A, there are twelve water-removal air nozzles 90 illustrated: six attached to structure 92 and six attached to structure 94. The exact number and orientation of the nozzles will vary according to a particular application, but in
35 general, they should be sufficient in capacity and location to quickly remove excess

surface water from all sides of the meat unit 22. For example, using six nozzles 90 expelling gas at a velocity of 5,000 to 10,000 feet per minute takes roughly 1 to 10 seconds to remove most surface moisture from a typically-sized side of beef. Also, the nozzles preferably are pointed slightly downward and forward, i.e., toward the meat unit 22 approaching the enclosure 16. In this orientation, the nozzles blow the moisture from the meat unit 22 away from the housing 16, thereby reducing the likelihood that the moisture removed from the meat unit will have a detrimental effect on the rapid and efficient heating of the meat unit outer surface. The preferred gas is air, although other gases may be used that are suitable for a given application.

Shown best in FIGURE 1, the cooling system 74 is located near the enclosure opening 30 and is provided for projecting a cooling medium 96 onto the meat unit surface. The preferred medium is water. As such, four water pipes 98 are provided. Shown in FIGURES 1-3, each water pipe 98 extends a vertical distance below the enclosure corresponding to the height of the intended meat unit 22. The water pipes are preferably secured to the interior of the support frame 38 along the frame's supporting legs 99. Each water pipe has a plurality of cold water spray nozzles 100 attached along its length at roughly equal distances.

A cold water tank (not shown) supplies cold water to a water pump (not shown) which feeds the chilled pressurized water to the water pipes 98. The release pressure is preferably in the range of about 40 to 50 psig. The cooling medium 96 should be at a temperature in the range of about 35 to 40 °F (1 to 5 °C). The cooling medium 96 is necessary to stop any potential cooking of the meat unit 22. After washing down the sides of the meat unit 22, the cooling medium 96 drains away and should not be used again without being thoroughly sterilized.

Referring to FIGURE 6, the preferred method of pasteurizing meat units to reduce the population of surface pathogens on the meat in the present invention low volume apparatus includes moving the meat units 22 from a conveying rail 24 through the water-removal nozzles 90. The gas supply fans 102 are activated initially and kept running. This is more efficient than starting and stopping the fans for each passing meat unit, although that may be done instead. The nozzles 90 thus direct water-removing gas at the surface of the meat unit 22 as it passes by the structures 92, 94. Since the structures 92, 94 are preferably positioned on opposite sides of the meat unit 22, the nozzles 90 can remove substantially all excess surface water from the meat unit 22.

The now water-removed meat unit passes beyond the air nozzles 90 and onto the movable support 44. At this point, the meat unit 22 is surrounded by the support frame 38 and its attached cooling system 74. The cooling system 74 is not activated. Therefore, no cooling medium 96 is being directed at the meat unit 22 initially. Once
5 in place on the movable support, the translation arrangement 42 is activated to cause the movable support 44 to translate upward along the upright rail guides 46. This causes corresponding vertical movement of the meat unit 22 into the enclosure 16, as shown in FIGURE 2A.

Prior to the upward translation of the meat unit 22, the steam pipe 80 and
10 (optionally) the air injection fan 84 are activated and preferably kept activated to create a continuous steam or steam-air mixture at a desirable temperature and pressure within the enclosure 16 at all times. The steam-air mixture is preferably composed of about 50-90% steam, with a preferred steam-air mixture being 70 % steam and 30 % air. The pasteurization temperature is between roughly 180-210 °F,
15 a preferred temperature being 200 °F. For these values, the meat unit 22 is maintained within the enclosure for a period of 1 to 10 seconds.

After pasteurization of the meat unit has been accomplished by the steam or steam-air mixture in the enclosure 16, the translation arrangement 42 causes the movable support 44 to move downward along the upright rail guides 46. This causes
20 corresponding downward vertical movement of the meat unit 22 out of the enclosure opening, as shown in FIGURE 3. During the entire downward translation, the cooling system 74 is activated to direct the cooling medium 96 onto the outer surface of the meat unit 22 as it is being lowered. The support frame sidewalls 40 form a loose enclosure 16 that prevents the cooling medium 96 from spraying outward onto
25 people or other conveyor line products.

In order to increase the speed at which the above process is accomplished, the steam supply 70 is constantly activated so that the enclosure 16 continuously encloses a proper amount and temperature of steam 76. Should an excess amount of steam or steam-air mixture accumulate, a ventilation system, such as a vent fan 104 as shown in
30 FIGURES 1-3, may be selectively activated to draw the excess from the enclosure. It is preferred to incorporate a ventilation system regardless, since it may be used to dispose of used steam. The gas supply 72 is activated initially and kept running throughout the process. The cooling system 74 is operated only when the translating arrangement 42 is activated to lower a meat unit 22 from the enclosure.

While preferred embodiments of the invention have been illustrated and described, it will be appreciated that various changes can be made therein without departing from the spirit and scope of the invention. For example, conventional mechanisms such as control components (e.g., a pressure sensor, a temperature gauge, a timing device, etc.) may be added for use in controlling various pasteurization parameters.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. An apparatus for steam pasteurization of one or more meat units at a time, the apparatus comprising:

(a) a generally upright enclosure having a lower end opening leading into the enclosure, the enclosure being supported by a support frame;

(b) a translation arrangement for raising and lowering the meat unit into the enclosure through the lower end opening thereof;

(c) a steam supply for releasing steam into the enclosure;

(d) a gas supply located near the lower end opening of the enclosure for directing gas at the meat unit in order to remove excess surface water from the meat unit prior to the meat unit ascending into the enclosure via operation of the translation arrangement; and

(e) a cooling system located either near the lower end opening of the enclosure or on the support frame, the cooling system for cooling the meat unit as the meat unit descends from the enclosure via operation of the translation arrangement.

2. A steam pasteurization apparatus according to Claim 1, further including an air injection fan attached to the enclosure for releasing air into the enclosure.

3. A steam pasteurization apparatus according to Claim 1, further including a ventilation system in communication with the enclosure for removing gases within the enclosure.

4. A steam pasteurization apparatus according to Claim 1, wherein the steam enclosure is sized to accommodate a single meat unit at any one time.

5. A steam pasteurization apparatus according to Claim 1, wherein the enclosure is located substantially above a rail of a conveyor system along which the meat unit travels.

6. A steam pasteurization apparatus according to Claim 1, wherein the enclosure is located substantially above a spur rail of a conveyor system along which the meat unit travels.

7. A steam pasteurization apparatus according to Claim 1, wherein the translation arrangement includes:

- (a) a movable support from which the meat unit is hung;
- (b) a power source for providing powered movement of the movable support;
- (c) one or more guides attached to the enclosure; and
- (d) at least one tension member connected at one end to the movable support and connected at the other end to the power source, the at least one tension member being guided by the guides during translation.

8. A steam pasteurization apparatus according to Claim 7, wherein the one or more guides includes one or more sheaves attached to the enclosure.

9. A steam pasteurization apparatus according to Claim 7, further including at least one guide rail attached to an inside surface of the enclosure, the guide rail for vertically guiding the movable support.

10. A steam pasteurization apparatus according to Claim 9, wherein the at least one guide rail includes two guide rails attached to opposed inside surfaces of the enclosure in a generally upright orientation, the movable support including a short rail section engaged between the at least two guide rails during upward and downward translation of the movable support within the enclosure.

11. A steam pasteurization apparatus according to Claim 10, wherein the movable support further includes a cover for shielding the guide rail during use.

12. A steam pasteurization apparatus according to Claim 1, wherein the steam supply includes a steam conduit having a steam outlet, the steam outlet being located within the enclosure.

13. A steam pasteurization apparatus according to Claim 12, wherein the steam conduit releases steam at about atmospheric pressure.

14. A steam pasteurization apparatus according to Claim 1, wherein the gas supply includes an array of air nozzles through which pressurized air is released.

15. A steam pasteurization apparatus according to Claim 14, wherein the gas supply further includes air passage structures attached to the support frame near the enclosure lower end opening; the array of nozzles being in pneumatic communication with the air passage structures.

16. A steam pasteurization apparatus according to Claim 1, wherein the cooling system comprises a plurality of cold water spray nozzles.

17. A steam pasteurization apparatus according to Claim 16, wherein the cooling system further includes at least one water conduit to which the one or more cold water spray nozzles are attached, the at least one water conduit being attached to the support frame.

18. A steam pasteurization apparatus according to Claim 1, wherein the support frame underlies the upright enclosure.

19. A steam pasteurization apparatus according to Claim 18, wherein the support frame includes at least one sidewall for inhibiting outward projection of matter from the apparatus.

20. A steam pasteurization apparatus for destroying surface pathogens on units of meat, the apparatus comprising:

- (a) a main rail supporting a plurality of meat hooks from which the meat units are hung, the main rail disposed in a generally horizontal orientation;
- (b) a movable support in communication with the main rail and capable of engaging a meat hook from which the unit of meat is hung; and
- (c) an upright steam enclosure located above the movable support, the enclosure including a lower end opening through which the meat unit may be raised and lowered within the enclosure.

21. The steam pasteurization apparatus according to Claim 20, further including a spur rail in communication with the main rail, wherein the movable support is engaged with the spur rail.

22. The steam pasteurization apparatus according to Claim 20, wherein the enclosure further includes a closed upper end; the pasteurization apparatus further including a translation arrangement for raising and lowering the meat unit into the enclosure through the lower end opening thereof, the translation arrangement comprising:

(a) a power source for providing powered movement of the movable support;

(b) at least one guide attached to the enclosure closed upper end; and

(c) at least one tension member connected at one end to the movable support member and in communication with the power source at the other end, the at least one tension member being guided by the at least one guide.

23. The steam pasteurization apparatus according to Claim 22, further including a sheave arrangement comprising:

(a) first and second lower sheaves and an upper sheave, the tension member being wound between the upper and lower sheaves, the tension member being attached to one of the support frame, the first lower sheave, and the second lower sheave; and

(b) a hydraulic cylinder having a translating rod attached to the lower sheaves; whereby contraction of the cylinder increases the relative distance between the upper and lower sheaves to cause the movable support to move upward and extension of the cylinder decreases the relative distance between the upper and lower sheaves to cause the movable support to move downward.

24. The steam pasteurization apparatus according to Claim 22, wherein the sheave arrangement has a ratio of at least 4:1, thereby causing the movable support to move a distance four times the distance moved by the hydraulic cylinder.

25. A method of pasteurizing units of meat to reduce the population of surface pathogens on the meat, the method comprising:

(a) removing surface water from the meat unit by directing a gas at the meat surface as the meat unit passes through an array of water-removing air nozzles positioned near a generally upright enclosure;

(b) moving the meat units onto a movable support in the generally upright enclosure; and

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(c) lifting the units of meat into the enclosure by vertically translating the movable support upward;

(d) rapidly heating the surface of the meat unit within the enclosure by providing a supply of steam into the enclosure; and

(e) lowering the unit of meat from the enclosure by vertically translating the movable support downward, and simultaneously rapidly cooling the meat unit by applying a cool medium to the meat surface as the meat unit is being lowered from the enclosure.

26. A method of pasteurization according to Claim 25, wherein the step of rapidly heating the surface of the meat unit further includes the step of releasing air into the enclosure.

27. A method of pasteurization according to Claim 25, wherein the step of providing a supply of steam to a chamber includes providing a supply of steam at a pressure about at or above atmospheric pressure.

28. A method of pasteurization according to Claim 25, wherein the step of directing a gas at the meat surface includes directing gas at a high velocity.

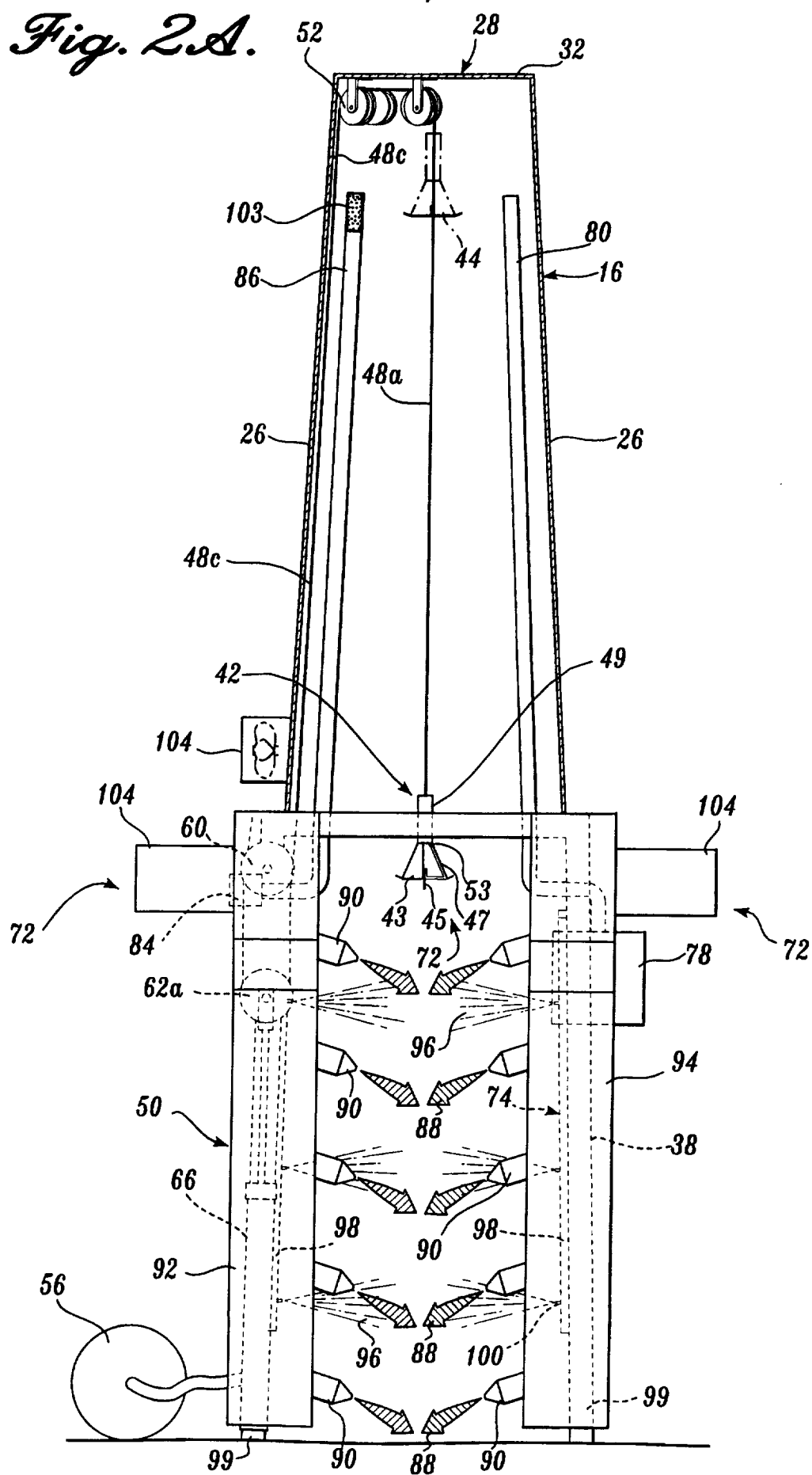
29. A method of pasteurization according to Claim 25, wherein the step of cooling the meat unit includes applying cold water to the meat surface.

30. A method of pasteurization according to Claim 25, wherein the upright steam enclosure is sized to accommodate a single meat unit at any one time.

31. A method of pasteurization according to Claim 30, wherein the movable support is formed from a main rail of a conveyor system.

32. A method of pasteurization according to Claim 30, wherein the movable support is formed of a spur rail of a conveyor system.

Fig. 2A.



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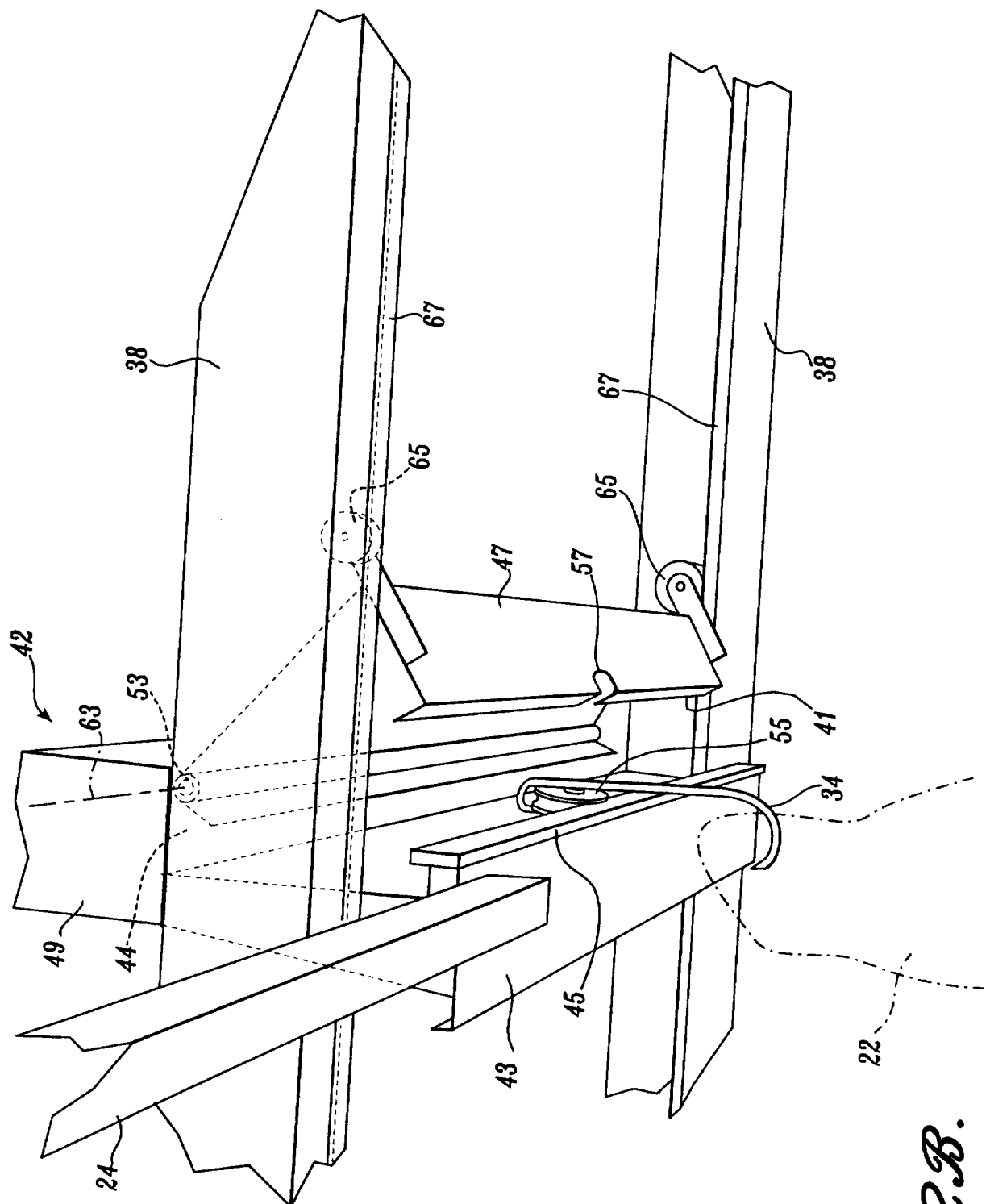
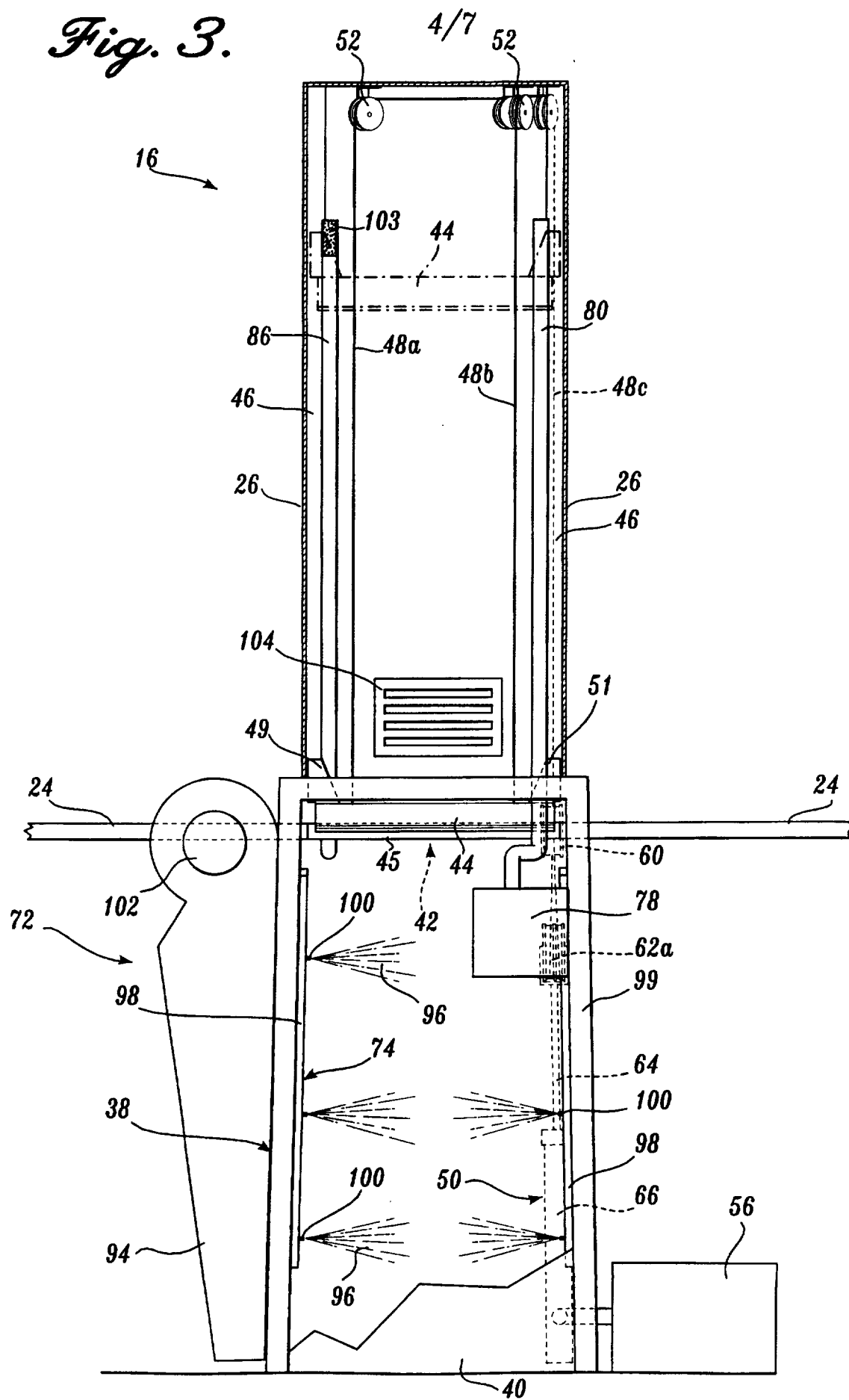
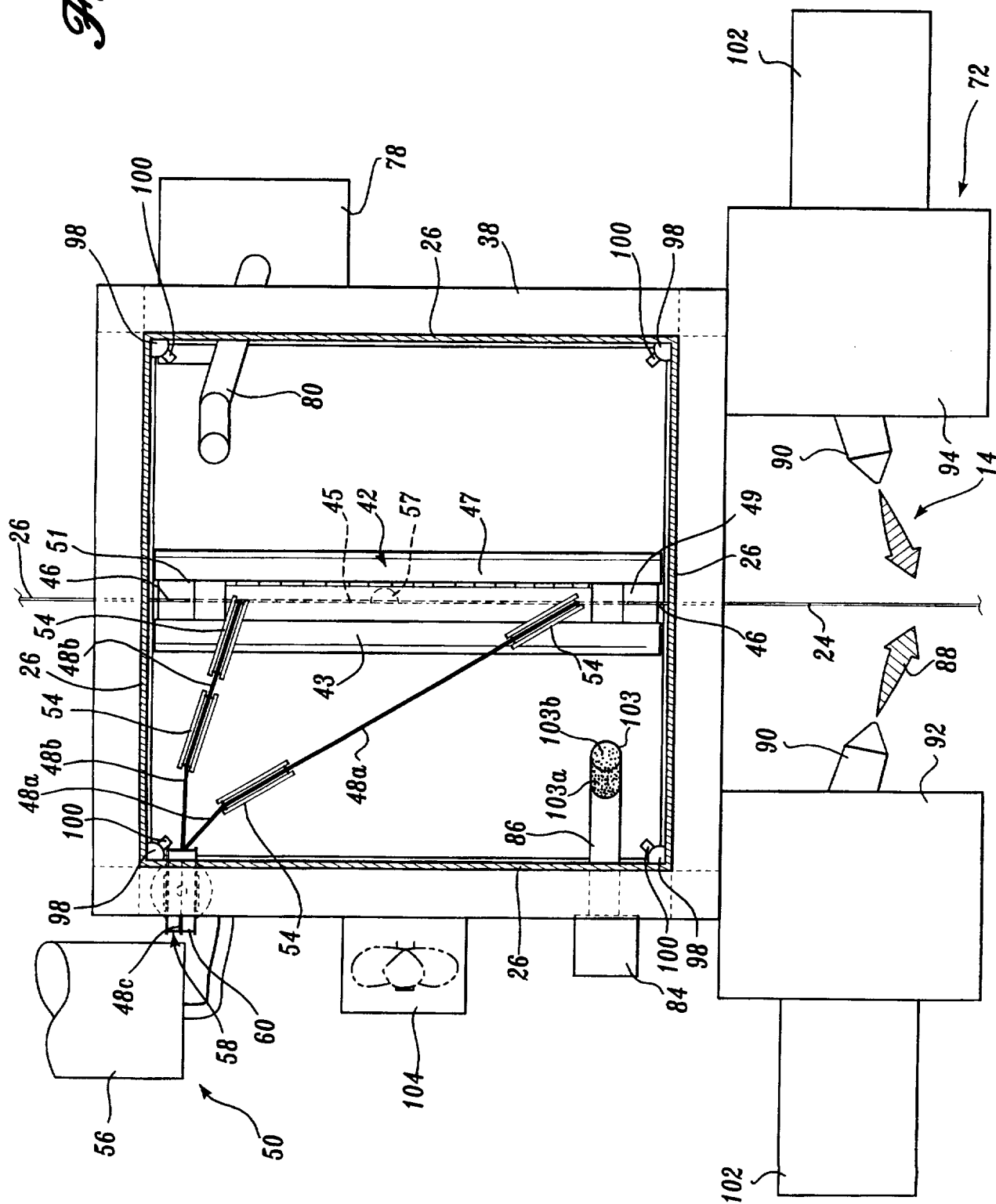


Fig. 2B.

Fig. 3.

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Fig. 4.



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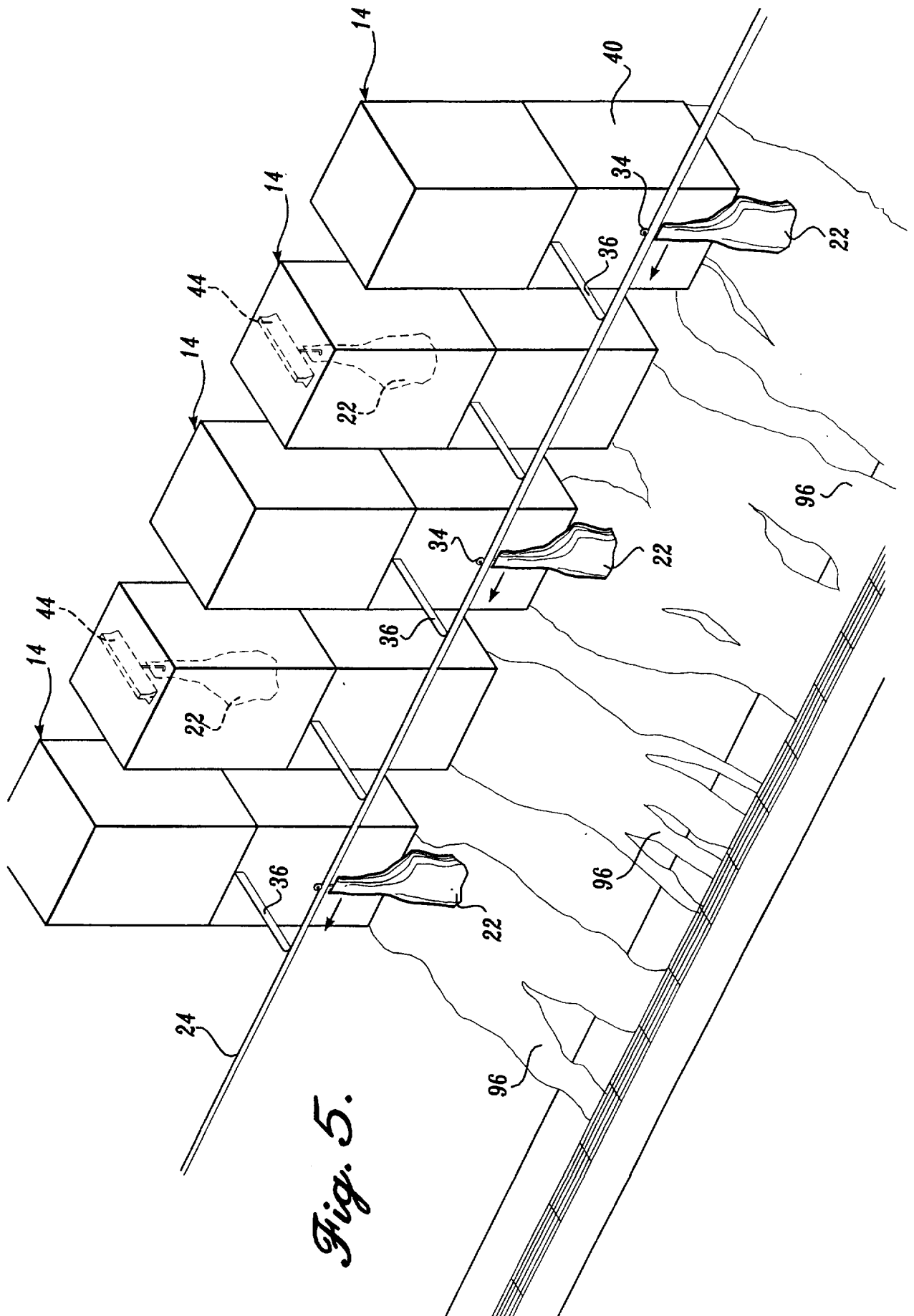
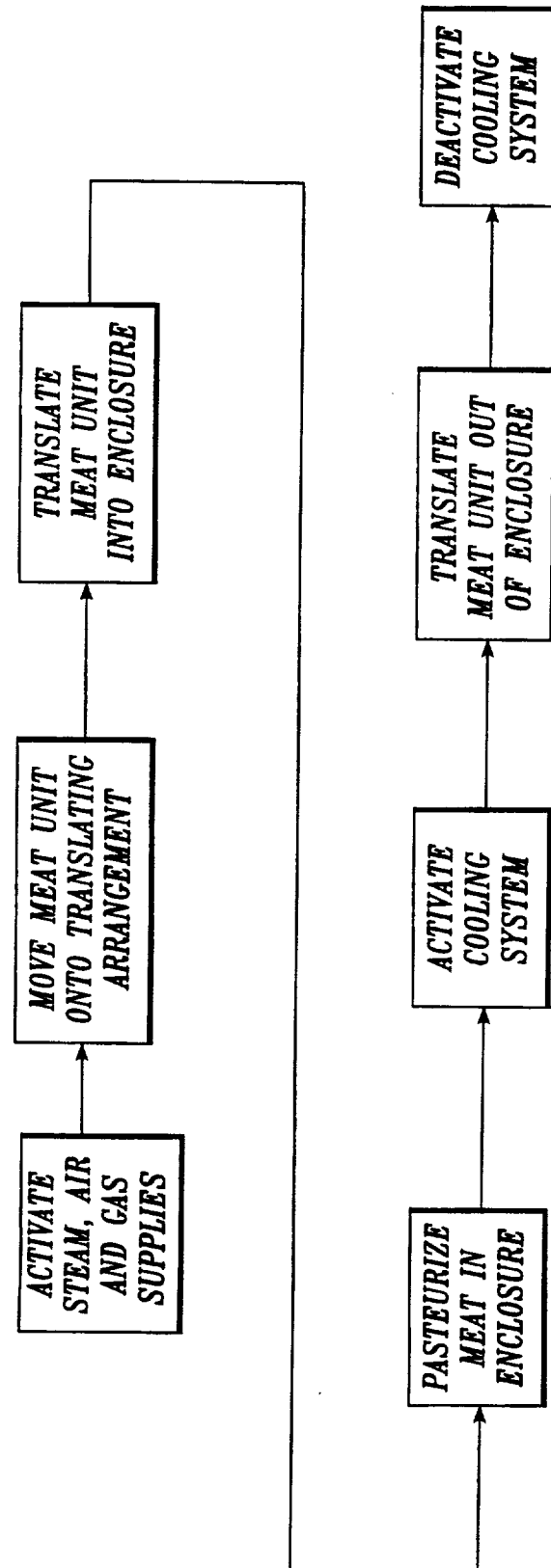


Fig. 5.

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*Fig. 6.*

INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 97/16457

A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 A23B4/005

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)

IPC 6 A23B

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)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 018 438 A (R. GRANDI) 28 May 1991	1-9, 12, 13,
Y	see the whole document ---	18-20, 22 14-17, 25-31
Y	WO 96 13983 A (FRIGOSCANDIA) 17 May 1996	14-17, 25-31
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A	US 5 439 694 A (W. F. MORRIS) 8 August 1995	1-32
	see the whole document ---	
A	US 3 705 813 A (MEAT TECHNOLOGY) 12 December 1972	25-32
	see the whole document ---	
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Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

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Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 97/16457

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