

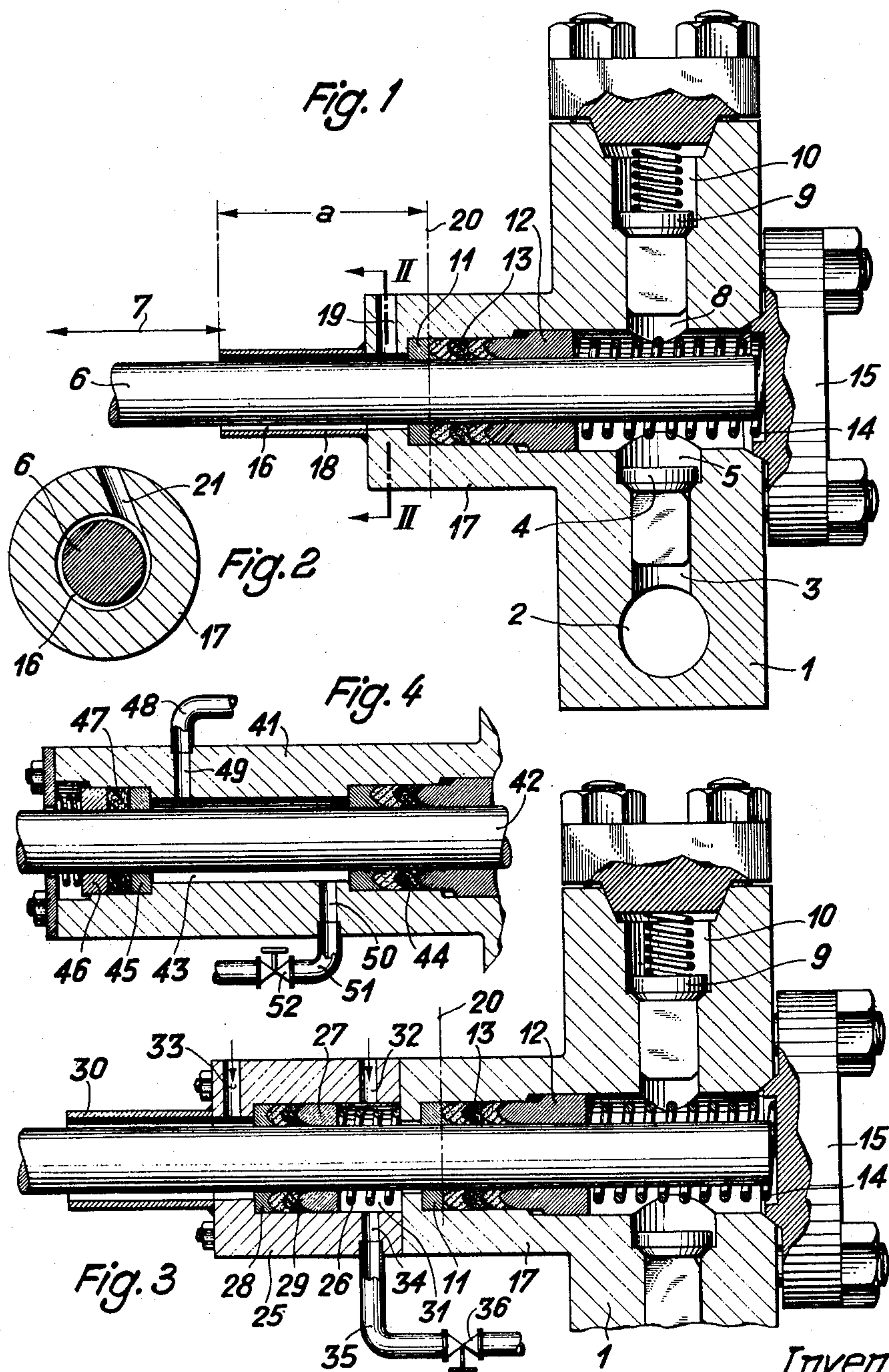
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STERILIZABLE HOMOGENIZING PUMP

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STERILIZABLE HOMOGENIZING PUMP

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6 Claims. (Cl. 103—153)

The present invention relates to a homogenizing pump, particularly for milk and liquids containing milk, which may be operated under sterile conditions.

Homogenizing pumps are usually in the form of a piston pump which raises the pressure of the liquid to be treated to between 200 and 500 kg./cm.² whereupon the liquid is expanded in a slotlike throttle orifice. In the case of milk the homogenizing effect consists in a substantial comminution of the fat particles. The plunger or piston rod of the pump extends through a stuffing-boxlike packing device.

Liquids may be sterilized by heating. It is known to sterilize milk and liquids containing milk by heating same momentarily by introducing steam into the liquid and condensing it therein and immediately thereafter evaporating the condensate and cooling the mixture by reducing the pressure thereof. The liquid may also be sterilized by indirectly heating it in a heat exchanger to the temperature necessary for destroying germs. Liquids treated in this manner may be filled into sterile containers and remain sterile if reinfection between heating of the liquid and closing of the containers is avoided.

Theoretically, sterilization by heating may be effected after the homogenization whereby the homogenizing pump need not operate under sterile conditions. It has been found, however, that homogenization must be done after sterilization by heating because, particularly in the case of milk, unfavorable changes take place if the milk is homogenized prior to heating.

It is an object of the present invention to provide a homogenization pump, particularly for milk and liquids containing milk, which can be operated under sterile conditions so that the milk can be sterilized prior to homogenization.

It is a further object of the invention to provide a homogenization pump with simple and inexpensive means affording operation of the pump under sterile conditions and avoiding reinfection of a sterilized liquid pumped by the pump. Conventional pumps can be provided with the aforesaid means without difficulty.

The pump according to the invention is provided with a space surrounding the piston rod or pump plunger outside of stuffing-boxlike packing means which separate the pump chamber from the outside of the pump. The space extends from the packing means in a direction opposite to the direction of the working stroke of the piston. Means are associated with the aforesaid space for conducting a sterilization agent into the space. In an embodiment of the invention the space is closed adjacent to the packing means and is open at the opposite end. In another embodiment the space is closed at both ends and means are associated therewith for removing the sterilizing agent from the space. In both cases the sterilizing agent, for example, steam, flows through the space alongside the piston and heats the latter to the sterilizing temperature. In the latter case a superatmospheric pressure of the sterilizing fluid may be maintained in the closed space.

Preferably, the space for receiving the sterilizing agent extends from the packing means through a distance at least equal to the length of the piston stroke. With this arrangement there is no surface portion of the plunger or

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piston rod which enters the pump chamber and has been in contact with contaminated air during the suction stroke.

In an embodiment of the invention two packing means are provided which are spaced from each other and the space characterizing the invention extends outside of the outermost of said packing means, i.e., extends from the packing means which is farthest away from the pump chamber. The pump casing or parts attached thereto extend between the two packing means and form an annular space around the pump plunger or piston rod between the packing means. This space may be supplied either with a sterilizing fluid or with a sterile coolant. Sterilizing fluid is supplied during initial sterilization of the pump prior to normal operation and sterile coolant is supplied during normal operation for cooling the plunger or piston rod and the packing means. Cooling may be desirable considering the heating effect of the sterilizing fluid flowing through the outermost space.

It is of advantage to arrange the means for supplying sterilizing fluid to the space or spaces surrounding the pump plunger or piston in such manner that the sterilizing fluid flows around the plunger or piston rod along helical lines. In this way equal cooling of the entire circumference of the plunger or piston rod and reliable blocking of the space against entry of contaminated air is obtained.

The novel features which are considered characteristic of the invention are set forth with particularity in the appended claims. The invention itself, however, and additional objects and advantages thereof will best be understood from the following description of embodiments thereof when read in connection with the accompanying drawing wherein:

FIG. 1 is a longitudinal sectional view of a homogenizing pump according to the invention.

FIG. 2 is a sectional view of the pump shown in FIG. 1 along line II—II of FIG. 1.

FIG. 3 is a longitudinal sectional view of a modified homogenizing pump according to the invention.

FIG. 4 is a longitudinal sectional view of a modified portion of a homogenizing pump according to the invention.

Like parts are designated by like numerals in FIGS. 1 to 3 of the drawing.

Referring more particularly to FIG. 1, numeral 1 designates a casing having a bore 2 through which the liquid to be pumped enters the pump. A suction channel 3 wherein a suction valve 4 is located receives the liquid from the bore 2 and supplies it to a pump chamber 5. A plunger 6 is reciprocated as indicated by arrows 7 by means of a crank drive, not shown. The liquid drawn in through the channel 3 leaves the pump chamber 5 at high pressure through a channel 8 containing a pressure valve 9 and through an outlet 10. A conventional homogenizing valve, not shown, is connected for liquid flow to the outlet 10. The pump plunger 6 is guided in a packing box including annular elements 11 and 12 and packings 13 placed therebetween. The parts 11, 12 and 13 are compressed by means of a coil spring 14 placed around the working end of the plunger 6. One end of the spring 14 rests on a cover 15 which closes the pump chamber 5. The second end of the spring presses against the annular element 12.

According to the invention the outer portion of the plunger 6 is surrounded by an annular space 16 which is formed by a protuberance 17 of the cylinder body 1 and a tube 18 welded to the protuberance 17.

A sterilizing agent, for example steam having a temperature of about 150° C., is introduced through a bore 19 into the space 16. The axial length of the tube 18 is such that the distance *a* between the outer end of the tube 18 and the packings 13 is at least equal to the stroke of the pump plunger 6.

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Before starting normal operation of the pump all passages and spaces through which the liquid to be treated flows during normal operation are initially sterilized. This may be done by introducing hot water or superheated steam of a temperature suitable for sterilization through the inlet bore 2 into the pump while the latter is running. At the same time sterilizing steam is introduced through the bore 19 into the space 16. By the initial sterilization of the pump chamber 5 the plunger 6 is also heated to sterilization temperature. If the initial sterilization is continued during a suitable period of time the stuffing box elements 11 to 13 and the outer parts of the plunger 6 are sufficiently heated for destroying germs thereat. Upon switching from feeding a hot fluid into the inlet 2 to feeding the cold liquid to be homogenized the entire pump would be cooled unless a hot fluid is introduced into the space 16. The outer parts of the pump plunger would come in contact with contaminated air whereby germs may be introduced into the pump beyond the dash-dot line 20 in FIG. 1 during each working stroke of the plunger.

The aforescribed reinfection of the pump and introduction of germs into the pump chamber 5 can be reliably avoided by the arrangement according to the invention. All parts which move to the right of the line 20 during the working stroke of the pump plunger are always in the space 16 and their temperature is maintained sufficiently high to destroy germs which may enter the space 16. The distance a of the outer end of the tube 18 from the line 20 is preferably somewhat greater than the stroke of the pump plunger.

FIG. 2 illustrates a particularly suitable arrangement of the bore for introducing the hot sterilizing agent into the space 16. The longitudinal axis of the bore 21 is approximately tangential of the circumference of the pump plunger 6. In this way the sterilizing fluid moves approximately on a helical line toward the open end of the tube 18 and the entire circumference of the plunger is equally heated.

In contradistinction to the arrangement shown in FIG. 1, in the embodiment of the invention shown in FIG. 3 the annular space which characterizes the present invention is not directly connected to the protuberance 17 of the pump casing 1. An additional housing portion 25 is connected to the protuberance 17 and contains an additional stuffing box including annular elements 27 and 28 and packings 29 therebetween. The elements 27 to 29 are compressed by a coil spring 26. A sleeve or tube 30 is connected to the housing 25. A bore 32 and a conduit, not shown, connects the space 31 surrounding the pump plunger and extending between the protuberance 17 and the packing 27 to 29 either with a source of heated sterilizing agent or with a source of coolant. The fluid introduced through the bore 32 into the space 31 leaves the latter through a bore 34 to which a conduit 35 containing a valve 36 is connected. As in the example shown in FIG. 1, a hot sterilizing agent, for example steam of a suitable temperature, is continuously introduced through a bore 33 into the space formed around the plunger 6 by the tube 30.

For initial sterilization a hot sterilizing agent is introduced through the bore 32 as well as through the bore 33. In this way the entire surface of the pump plunger which extends to the right of line 20 during the working stroke of the plunger is effectively sterilized. The sterilizing agent flowing through the space formed by the tube 30 to the outside prevents entry of germs from the surrounding atmosphere. After completion of the initial sterilization no further sterilizing agent need be introduced through the bore 32 and a coolant, for example, sterile water, may be introduced through the bore 32. The coolant flows around the pump plunger and is removed through the bore 34. This cooling arrangement considerably increases the life of the packings 11 to 13 and 27 to 29.

During initial sterilization as well as when introducing a

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sterile coolant into the space 31 a desirable pressure in said space may be obtained by the valve 36.

In the embodiment of the invention shown in FIG. 4 a housing portion 41 corresponding to the protuberance 17 in FIG. 1 forms a space 43 around a pump plunger 42. The latter corresponds to the plunger 6 in FIG. 1 and extends into a pump chamber, not shown, separated from the space 43 by a gland 44. In contradistinction to the arrangement shown in FIG. 1 the space 43 does not communicate with the atmosphere but is separated therefrom by a stuffing box formed by annular elements 45 and 46 and a packing 47 placed therebetween. The sterilizing fluid is supplied through a conduit 48 and a bore 49 to the space 43 and leaves the latter through a bore 50 and a conduit 51 containing a pressure-maintaining valve 52.

During normal operation the pump plunger 42 which is heated by the sterilizing agent, is cooled by the liquid pumped by the pump and by conduction and radiation to the surrounding air. In spite of the aforesaid cooling, by suitable choice of the temperature of a hot sterilizing agent the surface of the pump plunger moving through the gland 44 into the pump chamber can be maintained at such temperature that even heat-resistant germs are destroyed at each passage of the plunger surface through the space 43. With this arrangement it is not absolutely necessary to make the distance from the gland 44 to the outer end of the space 43 equal or greater than the pump stroke. The axial length of the space 43 may be made shorter than the pump stroke.

The invention is not limited to the described and illustrated examples. The invention is applicable to pumps having a piston and a piston rod in lieu of the illustrated pump plungers. Not only thermally acting sterilizing agents such as steam or hot water may be used, but also chemical sterilizing agents, for example a solution of hydrogen peroxide may be introduced into the space surrounding the piston rod or pump plunger according to the invention. The invention may be applied to pumps having a plurality of parallel acting plungers or pistons and having stuffing boxes or glands different from those shown in the drawing.

I claim:

1. A homogenizing pump, particularly for milk or liquids containing milk, comprising:
 - a casing,
 - a pump chamber in said casing,
 - a stuffing box means placed in said casing adjacent said pump chamber,
 - a reciprocating piston means extending from the outside of said casing through said stuffing box means into said pump chamber, and
 - means surrounding said piston means outside of said stuffing box means and forming an oblong space around said piston means, said space having two ends spaced longitudinally of said piston means, said means surrounding said piston means outside of said stuffing box means including an inlet substantially at one end of said space and an outlet substantially at the second end of said space,
 - said inlet including means for introducing the sterilizing fluid into said space in a plane normal to the longitudinal axis of said piston means and tangentially of said piston means for causing said sterilizing fluid to flow helically around said piston means through said space from said inlet to said outlet.
2. A homogenizing pump, particularly for milk or liquids containing milk, comprising:
 - a casing,
 - a pump chamber in said casing,
 - a stuffing box means placed in said casing adjacent said pump chamber,
 - a reciprocating plunger extending from the outside of said casing through said stuffing box means into said pump chamber,

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said casing having a portion surrounding said stuffing box means,
 a tubular element having a first end connected to said portion of said casing, said tubular element surrounding said plunger outside of said casing, 5
 said casing portion and said tubular element forming an annular space around said plunger, the longitudinal extension of said annular space being substantially equal to the stroke of said plunger, and
 inlet means placed adjacent the first end of said tubular element and communicating with said annular space 10
 for continuously conducting a sterilizing fluid into said annular space,
 said tubular element having an open second end for releasing the sterilizing fluid to the outside. 15
 3. A homogenizing pump as defined in claim 2 wherein said sterilizing fluid is steam.
 4. A homogenizing pump as defined in claim 2 wherein said sterilizing fluid is steam having a temperature of substantially 150° C. 20
 5. A homogenizing pump, particularly for milk or liquids containing milk, comprising:
 a casing,
 a pump chamber in said casing,
 a first stuffing box means placed in said casing adjacent 25
 said pump chamber,
 a second stuffing box means axially spaced from and placed coaxially and outside of said first stuffing box means,
 a reciprocating piston means extending from the out- 30
 side of said casing consecutively through said second

and first stuffing box means and into said pump chamber,
 first means surrounding said piston means outside of said second stuffing box means and forming a space around said piston means, the longitudinal extension of said space being substantially equal to the stroke of said piston means,
 said first means surrounding said piston means including an inlet and an outlet spaced longitudinally of said piston means for continuously admitting a sterilizing fluid into said space and releasing said sterilizing fluid from said space,
 second means surrounding said piston means between said first and second stuffing box means and forming a closed space around said piston means, and
 inlet means and outlet means connected to said second means surrounding said piston means for continuously admitting a sterilized cooling fluid to and releasing the sterilized cooling fluid from said closed space formed by said second means.
 6. A homogenizing pump as defined in claim 5 wherein said cooling fluid is water.

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