April 1, 1969 A. LODGE 3,436,170

METHOD OF STERILIZING UTILIZING STEAM

Filed Jan. 5, 1965

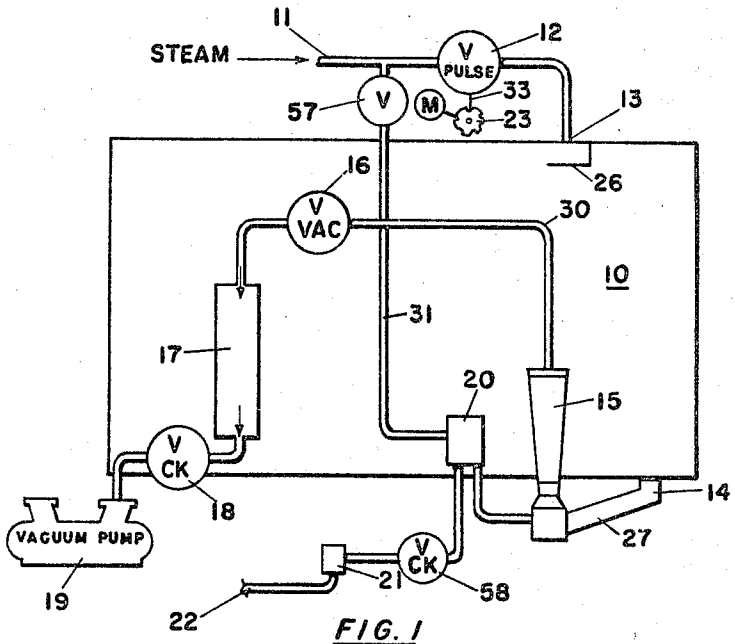


FIG. 1

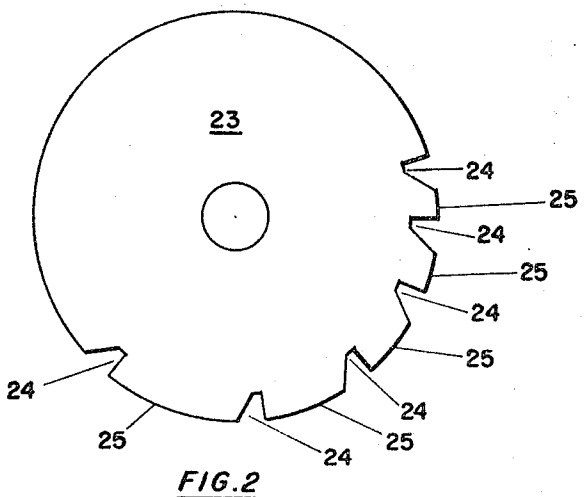


FIG. 2

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United States Patent Office 3,436,170
Patented Apr. 1, 1969

3,436,170

METHOD OF STERILIZING UTILIZING STEAM

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Filed Jan. 5, 1965, Ser. No. 423,446
Int. Cl. A61l 1/00
U.S. Cl. 21—56 1 Claim

ABSTRACT OF THE DISCLOSURE

A process of sterilizing with steam wherein air is removed from a closed chamber, while simultaneously and intermittently introducing steam to said chamber during said air removal in pulses for a predetermined time, the time between said pulses increasing during said predetermined time, and then introducing steam to said chamber continuously for sterilization for a time sufficient to effect sterilization of the article.

This invention relates to sterilization and, more particularly, to an improved cycle and apparatus for sterilization of articles.

There have been many methods advocated for promoting rapid steam sterilization of difficult types of loads. One form of a load which is difficult to sterilize thoroughly is a surgical pack of cotton fibers, cellulosic material, or the like, which may be wrapped in a form so dense that passage of steam into the pack or air out of the pack is hampered by the fibrous material.

Saturated steam at temperatures above the atmospheric boiling point is well known as a reliable sterilizing agent. The theory is that the elevated temperature destroys the viability of the bacteria and the moisture introduced by the condensing steam in the process of giving up its latent heat to heat the contaminated material softens or prepares the bacteria for the kill. To be effective, the steam must reach all parts of the load where sterilizing is required. The presence of air or other non-condensible gas excludes the steam and prevents proper sterilization. Air itself is used as a sterilizing medium but it has to be circulated to all parts of the load by powerful fans and the load must be loose and easily penetrated because air has no latent heat to give up at these temperatures and heat is carried by convection only. The absence of moisture makes the bacteria more difficult to kill so air sterilizers use very much higher temperatures.

Excessive temperature and excessive time are both detrimental to cellulosic material. The best sterilizing cycle is the one that subjects all parts of the load to optimum sterilizing conditions as nearly as possible at the same instant. This is because, for safety's sake, a delay must be provided in the control system to equal or exceed any lag that may be encountered in the heat-up of the most remote part of the densest pack. Since the more accessible parts will pick up heat rapidly, these parts will be subjected to high temperatures for a longer time and will be rapidly damaged.

Common methods for the removal of air and sterilization are the gravity displacement, prevacuum, pulsing system, and combinations and modifications thereof.

The present invention takes advantage of the desirable features of previous methods and, in addition, speeds up the process by providing an improved arrangement of piping, valves, and pumps which provide rapid removal of air from the load.

This sterilizer consists of a pressure chamber with a steam opening near the top baffled to reduce turbulence. A drain opening at the lowest point of large dimensions connects with a vacuum source. Means is provided to intermittently admit steam while the vacuum source is working.

The vacuum source may consist of a steam ejector connected by large piping directly to the chamber drain opening and having no valves between the chamber and the ejector. This makes it possible to use a smaller valve. There may be a valve and condenser in the discharge line of the ejector before discharging into the backup means which may be another ejector or a vacuum pumping system designed to handle air, water, and water vapor.

The steam line feeding the low pressure ejector may have a drip trap or water separator at its lowest point to insure dry steam to the ejector. This ejector may be disposed vertically with the steam line and nozzle at the lowest point so that the same drip trap will act as a chamber drain trap when there is pressure in the chamber and the ejector steam is shut off. The ejector steam valve must be located ahead of the drip trap.

Steam may be intermittently admitted to the chamber by the same steam valve which is used to admit sterilizing steam. A program of admission may be controlled by a cam having grooves representing open positions of the valve and lands representing closed positions of the valve. This cam can be revolved at constant speed during the vacuum cycle by a motor and the spacing of the grooves will determine the frequency of pulses while the width of the grooves will determine the duration of each steam admission.

A cam is shown having six pulses of equal duration but spaced to provide large amounts of steam (frequent pulses) early in the cycle and lesser amounts later in the cycle. This intermittent steam pulse provides a scrubbing action on the load in the sterilizer which helps remove air from the load while also diluting the air in the chamber. Cams of other land and groove proportions could be provided.

It is, accordingly, an object of the present invention to provide an improved sterilization cycle.

Another object of the invention is to provide a sterilization cycle which is simple, efficient, and effective.

Still another object of the invention is to provide a sterilizing apparatus wherein the use of an improved steam circuit makes it possible to eliminate certain parts of the apparatus, and, thereby, simplify the apparatus.

A further object of the invention is to provide an improved steam apparatus for sterilization of materials, wherein a notched cam actuates a mechanism which injects steam in spurts instead of in a steady stream as is frequently done.

Still a further object of the invention is to provide an improved programming apparatus for steam sterilization.

With the above and other objects in view, the invention comprises the processes set forth in the specification, drawing, and recited in the appended claim. The invention will be better understood from a reference to the drawing and detailed specification wherein:

FIG. 1 is a schematic view of a sterilizer having the improved apparatus attached thereto; and

FIG. 2 is an enlarged view of the cam shown in FIG. 1.

Now with more particular reference to the drawing, a sterilizing chamber **10** is shown with a steam opening **13** near the top, baffled at **26** to reduce turbulence in the steam entering the chamber. A drain opening **14** is provided at the lowest point of the sterilizer. The drain opening is of large dimensions and is connected to a source of vacuum which, in the example shown, is vacuum pump **19**. A means for intermittently admitting steam while the vacuum pump **19** is operating is shown. This means is made up of the valve **12**, cam **23**, and motor M for rotating the cam **23**.

The vacuum source may further consist of a steam ejector **15** connected by a large pipe **27** directly to the chamber drain opening **14**. It will be noted that no valves or other obstructions are necessary between the chamber

and the ejector. This makes it possible to use a smaller valve at **16** in the discharge end of the ejector because here the gas is compressed and is of smaller volume than in the suction line from the chamber to the ejector where such valves are normally located. One variation was made with the vacuum valve situated between the condenser and the pump in order to take advantage of further reduction in volume of effluent due to lowered temperature. This was abandoned because of fouling of the condenser by sterilizing temperature.

There may be a vacuum valve **18** and a condenser **17** in the discharge line **30** from the steam ejector **15** connected in the line before it discharges into the backup means which may be either another ejector connected in series with the ejector shown or the backup means could be vacuum pump **19**. Pump **19** is designed to handle both air and water or water vapor.

The steam line **31** feeding the low pressure ejector **15** may have a water separator **20** and drip trap **21** at its lowest point to insure dry steam to the ejector **15**. This ejector **15** may be disposed vertically in the suction line with the steam nozzle at the lower end directed upward and connected with the steam supply through separator **20** which, in turn, drains through trap **21**. A check valve **58** should be located in the drain line to prevent return of foreign matter to the chamber when the pressure differential might be reversed. The same drip trap **21** will act as a chamber drain trap when there is pressure in the chamber and the ejector steam is shut off in line **31**.

Steam may be intermittently admitted to the chamber through the same steam valve **12** which is used to admit sterilizing steam. A program of admission may be controlled by a cut cam **23** having grooves **24** representing open positions of the valve and lands **25** representing closed positions of the valve. This cam can be revolved at a constant speed during the vacuum cycle by motor M and the spacing of the grooves will determine the frequency of pulses while the width of the grooves will determine the duration of each steam admission.

The cam **23** shown has six grooves which are indicated at **24** and each time the actuating member **33** of the valve **12** drops into one of these grooves **24**, it turns on the steam in the chamber. This intermittent steam pulse provides a scrubbing action on the load in the sterilizer which helps remove air from the load while also diluting the air in the chamber. Thus, by injecting steam in spurts instead of a steady stream, a preset amount of steam is pulsed into the chamber at different intervals, depending on the particular cycle required. After the vacuum cycle described above, steam for sterilization may be admitted to the chamber continuously for a period sufficient to effect sterilization.

In the illustration shown in FIG. 2, the time between pulses increases with rotation of the cam since the grooves are further apart in the direction of rotation of the cam so that as the steam pressure and the temperature build up inside the chamber, the time between the pulses increases. Thus, the time between pulses can be readily determined by a simple arrangement which is difficult to carry out by other means such as by means of modulating valves. Also, it is possible to keep the vacuum pump on continuously and no bleed valves are necessary. Also, by use of the cam, it is not necessary to have additional steam valves for sterilizing steam and the like.

To summarize, the disclosure herein shows an improved cycle for sterilizing and also discloses a simplified piping system that eliminates certain parts that are required in other systems. In addition to the foregoing, no valves are necessary between the chamber and the ejector and, by virtue of this, a rapid draw down of the pressure without valves is possible. Also, smaller ejector valves are usable which is a substantial saving in apparatus cost. Further, the duration of time of the initial part of the cycle is reduced.

The foregoing specification sets forth the invention in its preferred practical forms but the process disclosed is capable of modification within a range of equivalents without departing from the invention which is to be understood is broadly novel as is commensurate with the appended claim.

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

1. A method for sterilizing an article in an enclosed chamber comprising

removing the air from said chamber at a continuous rate,

simultaneously and intermittently introducing steam to said chamber during said air removal in pulses for a first predetermined time,

the time between said pulses increasing during said predetermined time,

and introducing steam to said chamber continuously after said predetermined time for a period of time sufficient to effect sterilization of said article.

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U.S. Cl. X.R.

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