ABSTRACT

Covered containers are moved along guides, each cover being automatically elevated from its associated container body while being maintained in alignment with and directly over such body, enabling a suitable material to be dispensed into the open container body, whereupon simultaneous movement of the container body and cover along the guide continues with the cover descending back to its position closing the body, the cover being maintained in alignment with and directly over the body during its descent.

16 Claims, 6 Drawing Figures
APPARATUS FOR ASEPTICALLY FILLING INITIALLY COVERED CONTAINERS

The present invention relates to the filling of containers, and more particularly to methods and apparatus for opening and closing covered sterile containers which are filled with a suitable medium while open.

The preparation, sterilization and filling of containers with nutrient media for growth of organisms have generally been done by hand operations of laboratory technicians. Machines have been devised for performing the operations, but they are comparatively complex and costly. Difficulties are encountered in maintaining the container, such as a "Petri dish," in a sterile condition while its cover is being removed, a sterile liquified gel culture medium is aseptically dispensed into the uncovered container or dish, and the cover is replaced. Heretofore, contamination might occur due to "fall-in" of microorganisms into the uncovered container.

By virtue of the present invention, an apparatus has been provided for uncovering and re-covering containers while insuring their maintenance in a sterile condition, the apparatus being comparatively simple, economical to manufacture, and easy to operate.

Another object of the invention is to provide a method and apparatus for uncovering and re-covering containers, in which the covers are maintained in alignment with and above the bodies of the containers at all times to prevent "fall-in" of foreign matter thereinto.

A further object of the invention is the provision of an apparatus that conveys the containers along a predetermined path, automatically elevates the covers from the container bodies while maintaining them directly over and in alignment with the uncovered container bodies, and automatically lowers the covers back toward and into covered relation with the container bodies while the covers are being maintained directly over and in alignment with the container bodies. With each cover disposed above its associated container body, the desired medium is introduced or dispensed thereinto. The container body and its cover are maintained in vertically synchronized relation while being conveyed along the predetermined path, and while the cover is elevated and repositioned with respect to the container body therebelow.

This invention possesses many other advantages and has other objects which may be made more clearly apparent from a consideration of a form and method embodying the invention. This form and method are shown and described in the present specification and in the drawings accompanying and constituting a part thereof. They will now be described in detail, for the purpose of illustrating the general principles of the invention; but it is to be understood that such detailed description is not to be taken in a limiting sense.

Referring to the drawings:

FIG. 1 is a top plan view of an apparatus embodying the invention;

FIG. 2 is a vertical section taken along the line 2—2 on FIG. 1;

FIG. 3 is an enlarged section taken along the line 3—3 on FIG. 2, disclosing the relationship between the apparatus and a covered container body;

FIG. 4 is an enlarged vertical section taken along the line 4—4 on FIG. 2, disclosing the cover being elevated from the container body therebelow;

FIG. 5 is an enlarged vertical section taken along the line 5—5 on FIG. 2, disclosing the cover fully elevated above the container body, a suitable medium being dispensed into the open container body;

FIG. 6 is an enlarged vertical section taken along the line 6—6 on FIG. 1.

As disclosed in the drawings, a conveyor type of apparatus is provided for conveying closed containers C along a suitable path, automatically raising the covers 10 from the container bodies 11, replacing the covers onto the container bodies after they have been filled with a desired medium, the re-covered containers then being moved to a suitable point for removal from the apparatus.

As shown, a suitable support 12, such as a horizontal table, has a guide structure 13 of generally oval shape mounted thereon. Horizontal guide members or rails 14, 15 are supported by spaced vertical standards 16 on the table, these rails or guide members 14 being of generally right-angle cross-section and opposed to one another. The guides have horizontal flanges 16 and outer vertical flanges 17 extending upwardly therefrom, the bottoms 18 of the containers being adapted to slide along the horizontal flanges 16, the vertical flanges 17 restricting their lateral movement.

As specifically disclosed, each container C, such as a "Petri dish" which is relatively shallow, includes the container body 11, which has a flat bottom 18 and a cylindrical side wall 19, the cover 10 being adapted to fit across and over the container body and having a flat, upper closure portion 20 and a depending cylindrical skirt 21 integral therewith adapted to occupy a position extending downwardly over the upper portion of the body wall 19. The diameter of the cover is slightly greater than the diameter of the container body, the spacing between the vertical flanges 17, 17 being slightly greater than the diameter of the cover, so as to limit the extent of lateral movement of the covered containers C.

Empty containers C may be placed on the guides 14 at one side of the conveyor track, and filled containers removed from the guides at the same side of the track. The containers are moved along the track by an endless conveyor chain 22 which slides along a channel-shaped guide 23 mounted upon the horizontal support 12 below the guides and between the vertical supporting members 15. This chain meshes with a horizontally disposed sprocket 24 driven by a suitable prime mover and intervening transmission (not shown) at an appropriate speed. The chain guide 23 and the roller chain 22 itself are disposed to one side of a central vertical plane between the guides. At predetermined intervals along its length, the chain has upper and lower arms 24, 24 projecting in a lateral outward direction which receive vertical pins 25, these pins lying in the central vertical plane between the guides 14. The pins project upwardly to a substantial extent above the guides, the lower portions each having a larger diameter collar 26 secured thereto which extends upwardly to a location slightly above the horizontal plane of the guide or rail surfaces 16a, for a purpose described hereinbelow.
Each pin and collar 25, 26 is displaced from its adjacent pin and collar a distance slightly exceeding the diameter of the container cover 10. When the containers C are placed on the guides on rails 14 between the pins, each collar 26 will engage the container body 11 below its associated cover; whereas, the pin portion thereofabove will engage the periphery of the cover 10 itself. As the sprocket 24 rotates and moves the conveyor chain 22, the pins 25 and collars 26 will shift the container bodies 11 and covers 10 longitudinally of the guides 14 and around the oval track.

On the other side of the mechanism from the container loading and unloading stations L, U, a cover elevating and lowering mechanism is provided. As shown, opposed elevating bars or rails 30, 30 are secured to the guide bars 14, these bars being disposed in opposed relation to each other and having vertical flanges 31 spaced from one another the same distance as the vertical flanges 17 of the guide bars 14. Horizontal flanges 32 of the lifting bars face one another, but are of less width than the horizontal flanges 16 of the guide bars, the distance between them being slightly greater than the diameter of a container body 11, but less than the diameter of a cover 10. The lower ends 32a of the horizontal bars 32 overlap the vertical flanges 17 of the guide bars 14, terminating in a position below the lower end 21a of a cover skirt 21, so as to be engaged thereby (FIG. 3). The lifting bars 30 are parallel to one another and are inclined upwardly with respect to the direction of movement of the conveyor chain 22 therebelow and container C, such that the movement of a covered container C along the lifting bars 30 will cause the cover 10 to engage the horizontal flanges 32. As the vertical drive pin 25 moves the cover 10, and its collar 26 moves the container body 11 along the lifting bars 30 and the horizontal guide bars 14, the cover 10 is elevated from the container body 11 therebelow, such elevation continuing until the upper end or apex of the lifting bars 33 is reached, at which point the vertical lifting bars 30 merge into similar descending or downwardly inclined lowering bars 34 that terminate at the horizontal guide bars 14, with their horizontal flanges 32a lying alongside and within the vertical flanges 17 of the guide bars 14 and terminating below the cover 10 when fully disposed upon the container body 11.

Accordingly, it is evident that each collar 26 and its associated pin 25 push the covered container body 11 and cover 10 from the loading station L along the horizontal guide bars 14, the cover 10 engaging the inclined horizontal lifting flanges 32 of the lifting bars, which cause the cover to be elevated from the container body 11, whereupon continued movement of the container body 11 and cover 10 along the guide bars 14 and the downwardly inclined descent bars 34 will cause the cover to descend once more and replace itself by gravity in covered position over the container body 11. The conveyor then shifts the re-covered container C around the oval track back to the unloading station U.

In the operation of the apparatus, the containers C are placed on the horizontal guide bars or tracks 14, each collar 26 engaging a container body 11 below its cover 10, and the pin 25 engaging the periphery of the cover 10 itself. The radius of the pin 25 is less than the radius of the collar 26 by an amount that approximates the difference in radii between the cover periphery and the container body periphery, so that each collar 26 individually drives or pushes a container body 11 while the pin 25 drives or pushes the cover 10 thereabove, none of the pushing load being transmitted from the cover to the container body, or from the container body to the cover while such arts being are being pushed around the track. As described above, when the containers or "Petri dishes" are disposed at the lower end of the inclined ramp 30, the covers engage the lifting flanges 32. As the pin 25 and its associated collar 26 push the cover and the container body along the lifting bars 30 and guide bars 14, respectively, the cover is elevated to uncover the container body therebelow. When the upper portion 33 of the lifting bars is reached, a suitable medium 40 can be dispensed into the open container body 11 through a suitable tube 41 and filling spout 42. When the desired quantity of medium has been dispensed into the container body, filling is discontinued. The continued movement of the conveyor 22 pushes the filled container body 11 and its cover 10 thereabove along the guide bars 14 and the descent bars 34, respectively, the cover descending toward the container body, which is always maintained in vertical alignment therewith, until the cover 10 drops over the container body 11 into fully closed position thereover. The covered containers C with the culture medium, or other substance, therein are then conveyed by the pins 25 and collars 26 around the track to the unloading station U for removal.

The pins 25 are collars 26 simultaneously engage the container covers and bodies, maintaining them in vertical synchronization and position with one another at all times. Since the cover 10 is always maintained over the container body 11, "fall-in" of organisms or other foreign substances is prevented, so that a sterile container C remains in that condition, insuring that the sterile culture medium 40 introduced thereinto will be uncontaminated.

The apparatus can operate continuously, the medium being dispensed into the uncovered dish at the appropriate time, with a pump (not shown), or the like, synchronized with the conveyor 22, dispensing the desired amount of medium into the uncovered dish. The mechanism for accomplishing the filling of the containers forms no part of the present invention, and, for that reason, is not illustrated nor described in detail.

The apparatus is preferably operated under "clean bench" conditions by directing a sweep of sterile air, or other gas, continuously over the apparatus.

It is, accordingly, apparent that a relatively simple apparatus has been provided which insures the maintenance of the containers in a sterile condition during uncovering of the containers, their filling, and their recovering. The cover is maintained vertically aligned with the containers at all times.

I claim:

1. In apparatus for lifting and lowering container covers from and on container bodies of containers: means for supporting the containers with the covers on the upper ends of the container bodies; means engageable with both the container bodies and covers for moving the bodies and covers along said supporting means; means engaging opposite sides of said covers for lifting the covers completely from the container bodies while
the container bodies and covers are being moved along
the supporting means; and means engaging opposite
sides of said covers for enabling the covers to lower
into closed position over the container bodies while the
container bodies are being moved along the supporting
means.

2. In apparatus as defined in claim 1; and means for
maintaining the covers above and in vertical alignment
with the container bodies during lifting and lowering of
the covers from and toward closed position on the con-
tainer bodies.

3. In apparatus as defined in claim 1; and means for
dispensing a desired medium into the uncovered con-
tainer bodies.

4. In apparatus as defined in claim 1; means for
dispensing a desired medium into the uncovered con-
tainer bodies; and means for maintaining the covers in
alignment with the container bodies during removal of
the covers from the bodies, dispensing of the medium
into the uncovered bodies, and replacement of the
covers on the bodies.

5. In apparatus as defined in claim 1; said lifting
means comprising lifting bars inclined to said support-
ning means and engageable with opposite sides of the
covers; said lowering means comprising lowering bars
inclined to said supporting means and engageable with
opposite sides of the covers.

6. In apparatus as defined in claim 1; said lifting
means comprising spaced lifting bars inclined upwardly
from said supporting means in the direction of move-
ment of said bodies and covers and engageable with op-
posite portions of the covers; said lowering means com-
brising spaced lowering bars inclined downwardly from
the upper ends of said lifting bars in the direction of
movement of said bodies and covers and engageable with
opposite portions of the covers.

7. In apparatus as defined in claim 1; the covers each
having a skirt fitting over the upper wall portion of an
associated container body; said lifting means compris-
ing lifting bars inclined to said supporting means and
engageable with the lower edges of the skirts on op-
posite sides of the container bodies; said lowering
means comprising lowering bars inclined to said sup-
porting means and engageable with the lower edges of
the skirts on opposite sides of the container bodies.

8. In apparatus as defined in claim 1; the covers each
having a skirt fitting over the upper wall portion of an
associated container body; said lifting means compris-
ing spaced lifting bars inclined upwardly from said sup-
porting means in the direction of movement of said
bodies and covers and engageable with the lower edges
of the skirts on opposite sides of the container bodies;
said lowering means comprising lowering bars inclined
downwardly from the upper ends of said lifting bars in
the direction of movement of said bodies and covers and
engageable with the lower edges of the skirts on op-
posite sides of the container bodies.

9. In apparatus as defined in claim 1; said lifting
means comprising spaced lifting bars inclined upwardly
from said supporting means in the direction of move-
ment of said bodies and covers and engageable with op-
posite portions of the covers; said lowering means com-
brising spaced lowering bars inclined downwardly from
the upper ends of said lifting bars in the direction of
movement of said bodies and covers and engageable
with opposite portions of the covers; and means for
maintaining the covers above and in vertical alignment
with the container bodies during lifting and lowering of
the covers from and toward closed position on the con-
tainer bodies.

10. In apparatus as defined in claim 1; the covers
each having a skirt fitting over the upper wall portion of
an associated container body; said lifting means com-
brising spaced lifting bars inclined upwardly from said
supporting means in the direction of movement of said
bodies and covers and engageable with the lower edges
of the skirts on opposite sides of the container bodies;
said lowering means comprising lowering bars inclined
downwardly from the upper ends of said lifting bars in
the direction of movement of said bodies and covers and
engageable with the lower edges of the skirts on op-
posite sides of the container bodies; and means for
maintaining the covers above and in vertical alignment
with the container bodies during lifting and lowering of
the covers from and toward closed position on the con-
tainer bodies.

11. In apparatus for lifting and lowering container
covers from and on container bodies of containers, the
covers having skirt portions extending downwardly
along the exterior of the bodies: spaced guide members
on which the lower ends of the bodies rest; spaced lift-
ing members above and inclined upwardly from said
guide members; spaced lowering members above said
guide members and inclined downwardly from the
upper ends of said lifting members to said guide mem-
ers; said lifting and lowering members being engageable
with the lower edges of the skirt portions to lift and
lower the covers from and onto the container bodies as
the covers and container bodies are moved along the
guide members and lifting and lowering members; and
means engageable with the perimeters of said covers
and container bodies for simultaneously moving the
covers and container bodies along the guide members
and lifting and lowering members.

12. In apparatus for lifting and lowering container
covers from and on container bodies of containers, the
covers having skirt portions extending downwardly
along the exterior of the bodies: spaced guide members
on which the lower ends of the bodies rest; spaced lift-
ing members above and inclined upwardly from said
guide members; spaced lowering members above said
guide members and inclined downwardly from the
upper ends of said lifting members to said guide mem-
ers; said lifting and lowering members being engageable
with the lower edges of the skirt portions to lift and
lower the covers from and onto the container bodies as
the covers and container bodies are moved along the
guide members and lifting and lowering members; and
means for simultaneously moving the covers and con-
tainer bodies along the guide members and lifting and
lowering members; said simultaneously moving means
including generally vertically disposed members en-
gageable with the perimeters of the covers and bodies
to maintain the covers above and in vertical alignment
with the bodies during lifting and lowering of the covers
from and onto the bodies.

13. In apparatus as defined in claim 12; said verti-
cally disposed members comprising first portions en-
gaging the perimeters of the bodies only and second
portions engaging the perimeters of the covers only.
14. In apparatus for lifting and lowering container covers from and on container bodies of containers, the covers having skirt portions extending downwardly along the exterior of the bodies: spaced guide members on which the lower ends of the bodies rest; spaced lifting members above and inclined upwardly from said guide members; spaced lowering members above said guide members and inclined downwardly from the upper ends of said lifting members to said guide members; said lifting and lowering members being engageable with the lower edges of the skirt portions to lift and lower the covers from and onto the container bodies as the covers and container bodies are moved along the guide members and lifting and lowering members; and means for simultaneously moving the covers and container bodies along the guide members and lifting and lowering members; said simultaneously moving means including vertical pins extending between said guide members, lifting members and lower members and engageable with the perimeters of the covers only, and collars on said pins between said guide members and engageable with the perimeters of the bodies only.

15. In apparatus for lifting and lowering container covers from and on container bodies of containers, the covers having skirt portions extending downwardly along the exterior of the bodies: spaced guide members on which the lower ends of the bodies rest; spaced lifting members above and inclined upwardly from said guide members; spaced lowering members above said guide members and inclined downwardly from the upper ends of said lifting members to said guide members; said lifting and lowering members being engageable with the lower edges of the skirt portions to lift and lower the covers from and onto the container bodies as the covers and container bodies are moved along the guide members and lifting and lowering members; and means for simultaneously moving the covers and container bodies along the guide members and lifting and lowering members; said moving means including a conveyor member, vertical pins secured to said conveyor member and extending between said guide members, lifting members and lowering members and engageable with the perimeters of the covers only, and collars on said pins between said guide members and engageable with the perimeters of the bodies only.

16. In apparatus as defined in claim 15; and means for dispensing a desired medium into each container body when its associated cover is elevated above the body.