

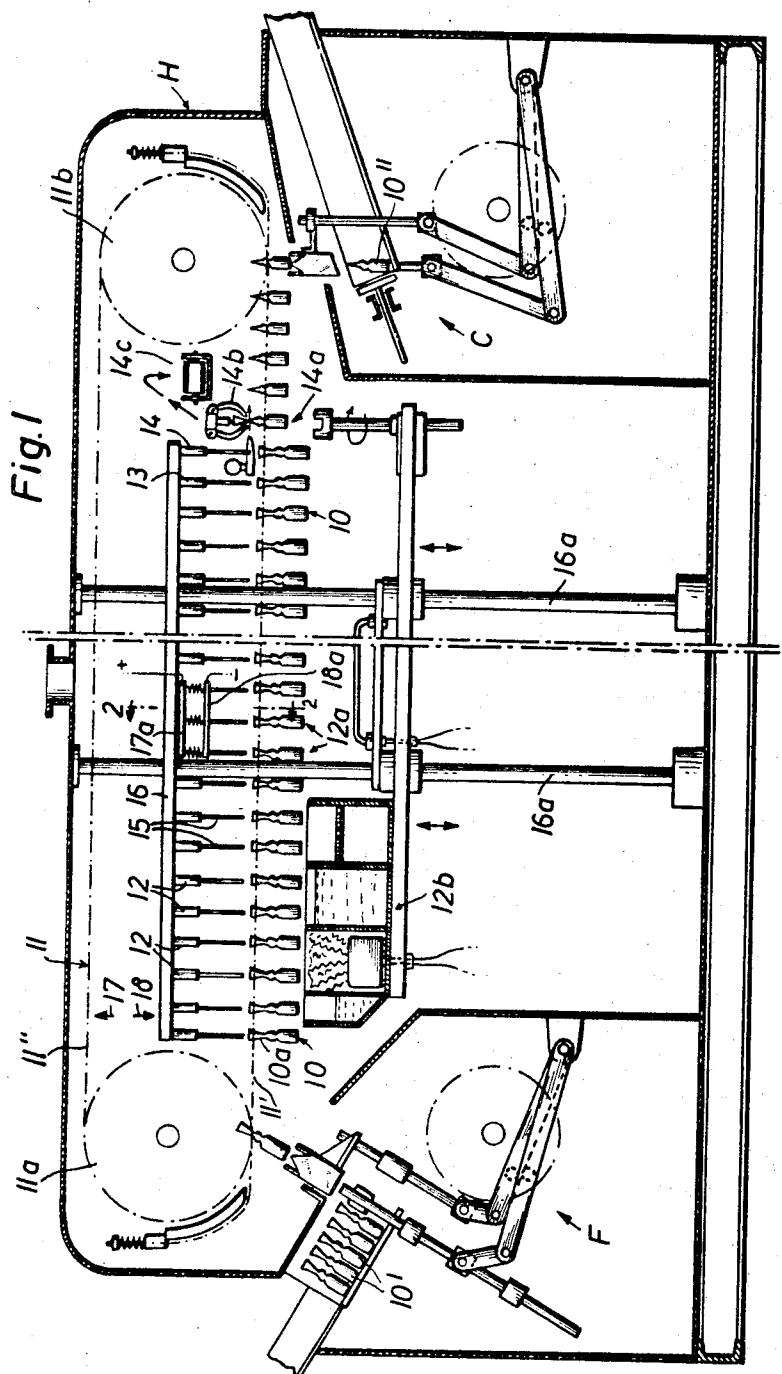
Jan. 14, 1969

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PROCESS AND APPARATUS FOR TREATING AMPOULES
AND SIMILAR CONTAINERS

3,421,840

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Sheet 1 of 3



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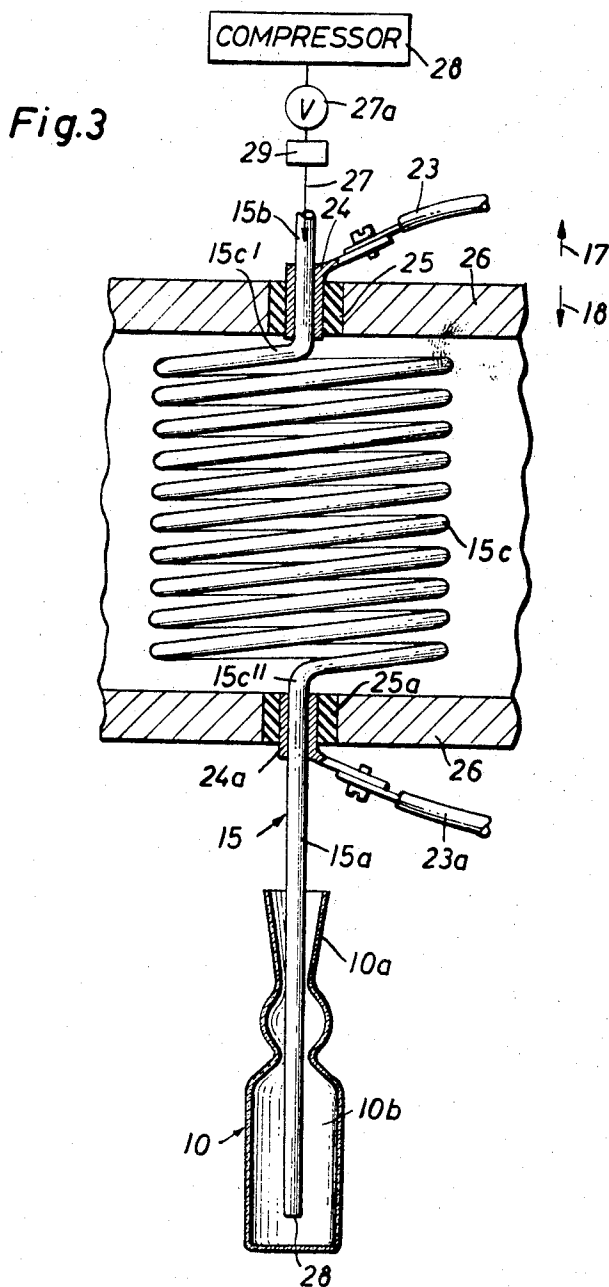
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PROCESS AND APPARATUS FOR TREATING AMPOULES AND SIMILAR CONTAINERS

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5 Claims

The present invention relates to treatment of ampoules and similar containers, and more particularly to a process and apparatus for treating with hot fluids the interior of open-ended ampoules, bottles and other types of containers which consist of vitreous, metallic or synthetic plastic material.

It is an important object of the present invention to provide a process for cleaning, and particularly for sterilizing, of ampoules and similar containers with a hot fluid according to which the fluid is heated and conveyed into the interior of containers in such a way that the possibility of contamination of hot fluid by contact with atmospheric air or with spent cleaning fluids is avoided in a very simple and efficient manner.

Another object of the invention is to provide a process of the just outlined characteristics which is especially suited for treatment of ampoules and similar containers in pharmaceutical plants, in bottling plants, and in other mass-manufacturing establishments wherein large quantities of containers must be processed within short periods of time.

A further object of the invention is to provide an apparatus which may be utilized for the practice of my method and which is constructed and assembled in such a way that an exceptionally large number of similar or different treating stations may be accommodated in a small area.

An additional object of my invention is to provide an improved fluid-conveying tube which may be utilized in an apparatus of the just outlined characteristics and which enables such apparatus to operate satisfactorily even though the apparatus comprises a smaller number of component parts than certain conventional apparatus for treatment of ampoules and similar containers of which I have knowledge at this time.

A concomitant object of the invention is to provide an apparatus of the above outlined characteristics wherein streams or jets of fluid used at one or more treating stations are heated in a fully automatic manner on their way into the respective containers and by prevention of contact with atmospheric air.

Still another object of the invention is to provide an apparatus for cleaning of ampoules wherein hot fluid used to clean and to sterilize or to dry the ampoules is prevented from exchanging heat with air or with the component parts of the apparatus subsequent to its heating and while it flows into the respective containers.

With the above objects in view, one feature of my invention resides in the provision of a process for cleaning the interior of open-ended ampoules and similar containers with a fluid, preferably with compressed air or another gas, comprising the steps of conveying the fluid in an elongated path which is sealed from the atmosphere and which extends through the open end of and discharges the fluid at a point in the interior of a container, and heating the fluid (preferably to sterilization temperature) while the fluid flows in a portion of the path which is closely adjacent to the point of discharge. In accordance with a more specific feature of the invention, the path for the fluid is defined by an elongated fluid-conveying tube at least a portion of which consists of current-conducting

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material and which is heated in response to flow of electric current therethrough. Such portion of the tube then constitutes a heating coil which automatically heats the fluid while the fluid flows from the intake end of the tube which is connected to a suitable source of fluid (such as an air compressor) and toward and through the discharge end of the tube which latter is adapted to extend through the open end and to discharge the fluid in the interior of an ampoule or another container which must be cleaned (e.g., sterilized) by contact with a hot fluid. If the coil is heated to about 400° C. and if the length of a suitable convoluted coil is about 2 m., air flowing through such coil may be heated to a temperature of about 300° C. which is normally sufficient to insure satisfactory sterilization of an ampoule even if the air is not caused to pass through one or more microfilters such as are used to separate bacteria from the body of a moving fluid.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The apparatus itself, however, both as to its construction and its method of operation, together with additional features and advantages thereof, will be best understood from the following detailed description of certain specific embodiments with reference to the accompanying drawings, in which:

FIG. 1 is a schematic side elevational view of an apparatus which embodies the invention, the housing of the apparatus and certain other parts being shown in vertical section;

FIG. 2 is an enlarged transverse vertical section as seen in the direction of arrows from the line II—II of FIG. 1; and

FIG. 3 is an elevational view of a portion of a different apparatus whose carrier for one or more fluid-conveying tubes is shown in vertical section.

Referring now in greater detail to the drawings, and first to FIG. 1, there is shown an apparatus serving as a means for cleaning (including sterilizing), filling and sealing of ampoules 10 or similar containers which are intermittently advanced in an elongated horizontal path by the lower run 11' of an endless conveyor 11. The ampoules 10 are arranged in a series of longitudinally and transversely aligned parallel rows, one such longitudinal row having been shown in FIG. 1, and their open ends 10a (also called spears) extend upwardly and through the interstices of the conveyor 11. The exact construction of this conveyor forms no part of my invention. It suffices to say that the conveyor 11 is trained around a pair of spaced wheels 11a, 11b at least one of which is driven to intermittently advance the lower run 11' in a direction from the left to the right, as viewed in FIG. 1, and that the conveyor comprises a series of longitudinally and transversely extending wire-like flexible elements defining longitudinally and transversely aligned rows of interstices each of which may receive and retain the spear 10a of an ampoule 10. Rows of open-ended ampoules 10' are fed into the lower run 11' of the conveyor 11 by a suitable feeding device F which is located at one end of the conveyor, and a collecting device C receives rows of sealed ampoules 10'' at the other end of this conveyor. The entire apparatus is accommodated in a housing H which is substantially sealed from the atmosphere so that all cleaning, filling and sealing operations may be carried out at pressures higher than atmospheric pressure.

Intermediate the ends of the conveyor 11, there is provided a series of treating stations including a plurality of washing stations 12, a plurality of sterilizing stations 12a, at least one filling station 13, a heat-sealing station 14 which is located immediately downstream of the filling station, as seen in the direction of movement of the lower run 11', and tip collecting station 14a whose tip collect-

ing and transferring elements or grippers 14b transfer portions of spears 10a onto an evacuating conveyor or chute 14c. Such tips are separated from the sealed spears 10a by the grippers 14b subsequent to the heat-sealing step. It will be noted that the heretofore described treating stations are located between the upper and lower runs 11', 11'' of the endless conveyor 11. Additional treating stations 12b which also serve to clean the ampoules and/or to collect the cleaning media are located at a level below the lower run 11'.

Each of the treating stations 12, 12a, 13, 14 comprises one or more rows of vertical tubes or needles 15 which are suspended on a common reciprocating means here shown as a carrier 16, and this carrier is reciprocable along a plurality of spaced vertical uprights 16a to move the needles 15 downwardly (arrow 18) and into the interior of the respective ampoules 10 or upwardly (arrow 17) so as to withdraw the discharge ends (i.e., the lower ends) of the needles from the respective ampoules. The arrangement is such that each longitudinal and each transverse row of needles 15 is aligned with an ampoule 10 between each pair of consecutive intermittent movements of the lower run 11'. In FIG. 1, the carrier 16 is shown in its upper end position whereby the discharge ends of the needles 15 are lifted above and away from the respective spears 10a. Of course, the intervals between the intermittent movements of the lower run 11' are long enough to insure that the media which is admitted into the interior of the ampoules 10 at the various cleaning stations 12, 12a may take full effect. Thus, an ampoule which has entered the first cleaning station 12 may be rinsed with cold water, and such ampoule is thereupon rinsed once, twice, or more often with hot water or with another liquid at the next cleaning stations 12. The thus rinsed ampoule is thereupon dried by jets of hot gases at one or more additional cleaning stations and is subsequently advanced to the first of three sterilizing stations 12a at each of which its interior is treated with a hot fluid, such as atmospheric air which is admitted at elevated pressure.

It goes without saying that a simplified version of my apparatus may utilize a conveyor which is adapted to support only one or a limited number of longitudinally extending rows of suspended ampoules, or that the ampoules may be arranged in staggered rows or in specially arranged groups. Of course, the distribution of various treating stations is then such that their needles are aligned with and may extend into the interior of such staggered rows or otherwise arranged groups of ampoules. Such modifications are too obvious to require separate illustration.

The present invention is more specifically concerned with the construction of the needles 15, and particularly of such needles which are used to convey a heated fluid into the interior of the respective ampoules. One transversely extending row of such needles is shown in FIG. 2 which illustrates that the row contains twelve needles. A comparison of FIGS. 1 and 2 will indicate that the lower run 11' of the conveyor 11 may support several hundred ampoules so that the illustrated apparatus is especially suited for mass-treatment of ampoules and similar containers in pharmaceutical plants, in bottling plants and in similar establishments wherein each container must undergo a series of treatments prior to being filled with a fluid or comminuted substance.

It is assumed that the needles 15 of FIG. 2 are mounted at one of the sterilizing stations 12a at which rows of washed and dried ampoules 10 are treated with a hot gas, such as air, to insure that each ampoule is properly sterilized prior to reaching a filling station. Each needle 15 assumes the form of an elongated fluid-conveying tube which comprises a lower end portion 15a, a helically convoluted median portion or heating coil 15c, and a vertical upper end portion 15b which is preferably coaxial with the lower end portion. The fluid-evacuating

discharge end 28 of each portion 15a may extend through the spear 10a and into the internal space 10b of a momentarily aligned ampoule 10, see FIG. 3. At least the median portion 15b of each needle 15 consists of current-conducting material, such as steel, which is heated in response to flow of electric current therethrough.

As shown in FIG. 2, the lower end portions 15a of the row of needles 15 extend through and are supported by a horizontal bar 18a which is located at a level below and which is suspended on a second horizontal bar 17a. This bar 17a is secured to the carrier 16 so that it may reciprocate in directions indicated in FIG. 1 by the arrows 17, 18 and to respectively move the lower ends 28 into the interior of or upwardly and away from the momentarily aligned ampoules. The bar 17a constitutes a bus bar and is connected to a power source 19a by means of a conductor 19. This power source may comprise a suitable source of electrical energy and a transformer or the like. The lower bar 18a is a conductor of electric current and is provided with a ground connection 20 so that the electric circuit of the source 19a is completed as soon as this source supplies electric current through the conductor 19, the current then flowing through the bus bar 17a, through the coils 15c, through the bus bar 18a, and to the ground connection 20. Thus, the conductor 17a and the connection 20 together constitute a means for applying electric current from the source 19a to the needles 15. It will be noted that the bus bar 17a is insulated from the carriage 16 by suitable insulators 21, and the arrangement of FIG. 2 further comprises a second set of insulators 22 which prevent direct flow of electric current from the upper bus bar 17a to the lower bar 18a. The ground connection 20 may be in sliding contact with the grounded housing H. It is assumed that the ampoules consist of glass, but it is equally possible to utilize containers which consist of suitable metallic or synthetic plastic material.

FIG. 2 shows the manner in which the longitudinally and transversely extending flexible elements of the lower conveyor run 11' form interstices for reception of spears 10a.

FIG. 3 shows on a greatly enlarged scale a single needle 15 which is identical with the needles 15 of FIG. 2 but which is connected with a non-illustrated source of electrical energy in a somewhat different way. In this embodiment of my invention, the upper end 15c' of the heating coil 15c is connected directly with a conductor 23 which leads to a transformer or directly to a suitable source of electrical energy, not shown. The lower end 15c'' of the coil 15c is connected with a second conductor 23a which constitutes a ground connection. The conductors 23, 23a are respectively connected with current-conducting sleeves 24, 24a which are welded or soldered to the ends 15c', 15c'' and which are respectively surrounded by insulators 25, 25a provided in the horizontal walls of a receptacle 26 which accommodates the coil 15c. As shown in FIG. 3, the receptacle 26 forms part of a carriage which serves as a means to reciprocate the needle 15 in directions indicated by the arrows 17, 18, and the position of the receptacle 26 is such that the lower end portion 15a of the needle extends through the open end 10a and that the discharge end 28 of this lower end portion may evacuate a jet of hot air or another fluid directly into the internal space 10b of the ampoule 10. The upper end portion 15b has a fluid-receiving upper end which is connected to a conduit 27 containing a valve 27a and connected to a suitable source of fluid, such as an air compressor 28.

For example, the overall length of the convoluted median portion 15b which constitutes a heating coil may be about 2 m., and this coil may be heated to a temperature of about 400° C. to insure that the fluid flowing therethrough is heated to the sterilization temperature. If the fluid is air, it is advisable to heat such air to a temperature of about 300° C. which is sufficient to insure

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satisfactory sterilization of the ampoule 10 even if the air is not conducted through a microfilter, such as the filter 29 in the conduit 27, which serves to separate bacteria from the fluid. If desired, the valve 27a may open and close in synchronism with reciprocatory movements of the receptacle 26 to insure that the compressor 28 is sealed from the coil 15c at the time the discharge end 28 is withdrawn from the interior of an ampoule and that the valve remains closed until after the end 28 enters the interior of the next ampoule.

The conduit 27 may assume the form of a flexible pipe of rubber or synthetic plastic. However, it is equally possible to mount the compressor 28 directly on the receptacle 26 so that the compressor may share all reciprocatory movements of the needle. In such instances, the end portion 15b may be connected directly with an outlet of the compressor.

It will be readily understood that the receptacle 26 may accommodate one or more longitudinally or transversely aligned rows of needles 15 so that this receptacle then constitutes a portion of or the entire carrier 16 of the apparatus shown in FIG. 1. Furthermore, the compressor 28 may be replaced by a source of liquid if the needles 15 of the type shown in FIGS. 2 and 3 are utilized to convey and to simultaneously heat a liquid treating medium. The temperature of the coils 15c will depend on the strength of the electric current and on the characteristics of the material of which the needles are made. It will be noted, particularly in FIG. 3, that the coils 15c are closely adjacent to the discharge ends 28 so that the fluid passing through the lower ends 15c'' of such coils has no time to become cooled prior to entering the internal spaces of the respective ampoules.

Referring again to FIG. 1, the arrangement at the sterilizing stations 12a is preferably such that the temperature of fluid admitted into the ampoules at the first sterilizing station is sufficiently high to insure that the ampoules remain sterilized on their way to the second sterilizing station, and the same applies to the travel of ampoules between the second and third sterilizing stations. Of course, it is not always necessary that the needles at each of the sterilizing stations be heated to identical temperature; thus, the heating action of needles at the first sterilizing station may be higher than the action of needles at the second sterilizing station, or the temperature of fluid discharged at the third sterilizing station may be higher than that of the fluid which is discharged at the first two sterilizing stations. Also, and as explained hereinabove, the number of sterilizing stations may be reduced to a single station or to two stations, but it is also possible to provide four, five or more sterilizing stations, depending on the nature of the material which is to fill the ampoules and on certain other factors.

In certain conventional ampoule-treating machines of which I have knowledge at this time, the needles which are utilized at the various cleaning, filling and other stations of such machines are connected with sources of heated fluid so that the fluid might become cooled on its way toward the ampoules. In certain other types of machines, special heating devices are provided in the connections between the needles and the respective sources of fluid. Such machines occupy too much space which is at a premium and, furthermore, the cost of known heating devices is rather high. Since a large number of treating stations is normally accommodated in a common housing, and since the provision of needles which simultaneously constitute heating means for the conveyed fluid permits elimination of all special heating devices, the apparatus of my invention is much more compact than and may be constructed at a cost substantially below the cost of conventional apparatus.

Owing to the fact that the heating coils 15c may be located in close proximity of the open spears 10a of the ampoules, the air or other fluid which is heated by exchanging heat with the walls of the needles remains at

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desired temperature at the time it reaches the interior of the ampoules. Furthermore, there is no possibility that such heated fluid would mix with atmospheric air on its ways in the path defined by the respective needles. This is in contrast with the aforementioned conventional apparatus wherein the fluid is heated in the compressor proper or wherein the fluid is heated on its way toward the ampoules. In such apparatus, there is much more opportunity for heated fluid to come in contact with and to be cooled and/or contaminated by air which fills the interior of the housing.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic and specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. An apparatus for cleaning and sterilizing the interior of open ended ampoules and similar containers with a fluid, comprising, in combination, at least one fluid conveying tube having a first end portion adapted to be connected to a supply of fluid, a substantially rectilinear second end portion having an open end adapted to extend through an open end of an ampoule and similar container, and an intermediate helically convoluted tube portion extending between and being integrally connected at opposite ends with said tube end portions, at least said helically convoluted tube portion being of current-conducting material; means for applying electrical energy to said tube so that electrical current will flow at least through said helically convoluted portion to thereby heat fluid passing therethrough before it is discharged through the open end of said rectilinear second end portion; conveyor means for intermittently moving a series of open ended containers along a predetermined path so as to align said open end of said second end portion of said tube with the open end of said one container between the intermittent movements of said containers along said path; and means for moving said tube and at least said one container relative to each other in direction of said rectilinear second end portion so as to extend said rectilinear end portion in said open end of said one container to introduce heated fluid into the latter and to withdraw said end portion from said container to permit further transportation of the latter along said path.

2. An apparatus as defined in claim 1, wherein a plurality of fluid-conveying tubes are arranged substantially parallel to each other with the open ends of said second end portions spaced from each other in a given direction, and wherein said conveyor means intermittently move said series of open-ended containers along a path extending in said direction so as to align the second end portions of said plurality of tubes respectively with the open ends of said containers between intermittent movement of said containers along said path.

3. An apparatus as defined in claim 2, wherein said reciprocating means cooperate with said tubes for reciprocating the latter toward and away from said path so as to introduce said second end portions into the respective containers when the tubes are moved in a first direction and to withdraw said second end portions from the respective containers when the tubes are moved in the opposite direction.

4. An apparatus as defined in claim 2, wherein said fluid passed through said tubes is a gas and including a source of compressed gas in communication with the first end portion of each tube.

5. An apparatus as defined in claim 4, wherein the resistance of the current-conductive material of said helically convoluted portion and the electric energy sup-

plied thereto are such that the compressed gas while passing through said helically convoluted portion is heated up to sterilization temperature.

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15 21—78, 92; 134—21, 24, 32, 105; 141—11, 82; 15—304, 306; 34—105, 229