PROCESS AND APPARATUS FOR FORMING GASKETS FOR CONTAINER ELEMENTS
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2 Claims. (Cl. 117—93.)

ABSTRACT OF THE DISCLOSURE

A container closure lining machine having an induction heating coil surrounding the infeed stack of closures. The coil is maintained sufficiently above the work surface of the machine to prevent significant loss of energy into the work surface, and also to give adequate time for rim temperature equalization to take place, as the closures drop through the distance between the coil and the sequential feeding means, thereby avoiding pits in the lining. Also, the process including the above steps.

This invention relates to the application of container sealing compositions to container closures, and particularly to a method of application which eliminates the conventional “drying” step in ovens which previous practice has required.

In the language of the container closure industry, the gasket which is interposed in the area between the closure and its associated container is known as the “lining.” Most linings are formed by flowing a liquid composition, usually a water or a solvent dispersion of an elastomer, together with suspended, inert solids onto the sealing area of the closure. This operation, also, is known as “lining.” Compositions from which the “linings” are formed are known as “lining compounds.”

Although, as will become obvious, the process which we describe is useful for lining metallic closures of many types, it is particularly well suited to the manufacture of lined can ends. Such a process will be described as the preferred example.

Can ends are lined by forcing a liquid lining composition through a nozzle and into the “channel,” a gutter which is formed adjacent the periphery of the can end.

Two general types of lining machines are used: reciprocating and rotary.

Reciprocating container closure lining machines include a reciprocating “knife” which engages one closure from the bottom of a stack of closures and transports it to a rotating chuck where the peripheral strip of sealing compound is applied to the closure by flowing a pressurized liquid composition through a nozzle which opens and closes in timed relation to the movement of the closure through the machine. As the knife moves across the table, its forward portion engages the closure which has just been lined on the rotary chuck, and tucks it beneath a stack of closures which pile up vertically on the output end of the machine.

In rotary machines, the closures are moved by a dial beneath nozzles which themselves rotate. But whatever the type of closure lining machine, they possess a common characteristic. Closures, channel side up, are stripped from a feed stack and move to the lining station.

As the demand for container closures, particularly can ends, has risen to astronomical figures, the industry has been faced with the necessity of increasing its output. In part, this has been accomplished by progressively increasing the speeds at which the lining machines operate, until today the output of container closure lining machines lies, approximately, between 300 and 350 lined ends per minute for each nozzle in operation.

Container lining compounds commonly are water or solvent dispersions of various elastomeric substances in which a substantial proportion of solid, inert material is also suspended. The total solids in such a composition commonly run from approximately 35 to approximately 50% of the total weight. The remainder, a suspending fluid, is either water or an organic solvent, which, subsequent to lining, must be removed by evaporation in order to consolidate the solids of the lining composition into a solid sealing mass. Therefore, following lining, the lined closures in stacks pass through “drying” ovens where the evaporation of the suspending liquid takes place.

For thorough drying, a substantial residence time is essential. Necessarily, the ovens are bulky, and particularly if solvent-based compounds are used must be provided with a variety of antipollution safeguards.

Briefly, we have found that if metallic closures are heated so that the area on which the compound is to be applied is at a temperature sufficiently high to evaporate the suspending liquid prior to the application of container sealing compound, the applied compound will receive sufficient heat from the closure to evaporate substantially all of the liquid which it contains. Evaporation takes place almost immediately. The speed is in contrast to the time required for oven drying. We believe that the speed of drying which is orders of magnitude faster than that obtained in oven drying practice may be explained by the fact that the vaporized liquid, starting at the heated interface between metal and lining compound can move rapidly through the still liquid layers above. The vapor is not forced to diffuse through a consolidated surface layer of dried lining compound. Such a surface layer, when the lined end is heated in an oven, always forms first, and drying progresses inwardly at a slower, asymptotic rate.

Of the various means which could be used for preheating the closures before the lining is applied to each, we have found that the most uniform and dependable results are obtained by inductively heating the stack of closures prior to releasing each closure from the stack.

By the present invention, the necessity for separate drying ovens is completely eliminated. The process produces closures which may be so thoroughly dried that the retained fluid, five minutes after lining, will average about 25% or less by weight. Since operative parts are more open to view, the closure heating means which we employ will be shown applied to a reciprocating type closure lining machine.

In inductively heating a metal part, it is well recognized that, with equal energy input, the speed of heating bears a direct relation to the frequency. However, since in this instance all ends in the feed-stack are heated simultaneously, the speed of heating a single end about to be fed is relatively unimportant. Accordingly, the frequency at which the coil is energized is to a certain extent optional. For all practical purposes, frequencies ranging between 60 cycles and 10 megacycles are suitable for obtaining the benefits of the present invention. In this regard, it should be noted that the higher the frequency, the less penetration into the metal. Although coil efficiency, i.e., the transfer of energy to the can ends at a frequency of 60 cycles, is low, the overall efficiency, when the coil is energized at 60 cycles compares favorably with the total energy demanded by high frequency equipment. In the latter case, the major part of the energy loss occurs not in transfer between coil and end, but in the oscillator. Almost equally effective results may be obtained by energizing a coil containing approximately 100 turns, with 60 cycle energy as is obtained by energizing a 12-turn coil at 450,000 cycles.

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In the drawings:

FIG. 1 is a perspective view of a container closure lining setup energized at 450,000 cycles, and FIG. 2 is a perspective side-view of a lining machine and the heating coil.

Referring to FIG. 2, a conventional lining machine, 10, is provided with an infed stacking rack, 11, formed of four insulating (fiber glass) rods, 12—12. Heating coil, 13, surrounds the rods, 12, which project upwardly from the normal infed base or "hopper," 15. Assuming that the ends to be lined are for cans for a #303 can, the coil, 13, may consist of 12 turns of 3/4" outside diameter copper tubing, 4½" in diameter. The individual turns of the coil, 13, are spaced apart sufficiently to produce a coil length of from 6 to 10'. Coil, 13, is connected through the leads, 16 and 17, to the output of an inductive heating equipment. Leads, 16 and 17, not only conduct the electrical energy to the coil, but also carry cooling water which is circulated through the coil tube, 13.

The lowermost turn of coil, 13, is positioned a few inches above the working surface of the machine. This distance will be variable because of differences in the structure of different lining machines, but the coil always should be maintained sufficiently above the metallic working surface to prevent substantial loss of energy.

The residence time which the ends experience after they drop below the end of coil, 13, and before they arrive at the lining station has an important effect. It allows time for the high rim temperatures to be dissipated by heat flow from the rim toward the center of the can end. The output energy in the coil at the frequency employed should be adjusted so that the periphery of the closure, at the moment of lining, is at a temperature developing sensible heat which is sufficient to vaporize the suspending fluid in the can sealing composition but not sufficiently high to cause disruptive ebullition of the composition.

Considerable boiling and pitting of the lining will occur if the temperature of the closure in the area on which the lining is applied is too high. Of course, the temperature will vary according to the actual operating conditions employed, e.g., the mass of the end, the rate of travel of the end, the amount of composition applied and the like. In general, however, it is preferred that the temperature of the periphery of the closure, at the moment of lining, be between plus or minus 30 degrees Fahrenheit of the boiling point of the suspending fluid of the sealing composition and more especially, between plus or minus 10 degrees Fahrenheit of the boiling point of the suspending fluid.

It is convenient to provide means which allow the coil, 13, to be raised and locked in a raised position in case it is necessary to free a jam which may occur in the feeding mechanism. The latch, 27, attached to one of the rods, 12 (FIG. 2), maintains the coil in an elevated position while the jam is being freed. Electrical interlocking means disconnect the energy source from the inductive heating transformers whenever the machine stops, either by reason of a jam or because of shut-down at the end of a run.

Since a number of ends will occupy the gap between the end of the heating coil, 13, and the infed, it is necessary, in starting the machine, to prevent "wet ends" from being packaged. This is accomplished by loading the infed stack at the beginning of each start-up with a sufficient number of brightly colored ends to occupy the space below the heating area and the infed slide. Composition deposited on these ends will not be dried. The colored ends are removed from the packing tray as they are delivered by the machine. The succeeding ends will have come up to the proper lining temperature.

EXAMPLE I

The infed stacking rack of a Dewey and Almy #19 lining machine was modified by replacing the steel stack-holding rods with rods made of fiber glass. These were 3,400,009 surrounded by a copper coil 4½" in diameter made of 3/4" outside diameter copper tubing. The coil was supported approximately 5" above the infed hopper of the lining machine. A commercial can sealing composition, based primarily on styrene-butadiene rubber and containing 254 parts of volatiles in 308 total parts by weight, was fed onto the can ends at a rate of 317 linear feet per minute. The weight of each lining applied to the can end was sufficient to yield a dry film weight of about 75 milligrams. The coil was connected to a Lepel high frequency laboratory inductive heater and operated at power levels in the coil from 2.5 to 2.6 kw. at 450,000 cycles. Temperature of the can ends was determined by painting strips of "Templac" (a temperature indicating lacquer) on the various ends to determine the maximum temperatures reached by concentric zones of the end. At the energy input given, the following temperature profile was recorded:

Across the central panel of the end—150° F. From ¼ of an inch from the edge—200° F. From the edge—225° F. ¾" from the edge—275° F. 1½" from the edge—250° F.

The temperatures at the periphery of the ends as measured by a surface pyrometer had dropped to 180–185° F., within 2 to 3 seconds after the compound was applied to the ends. When the apparatus was operated at a plate current of 1.83 amperes, and a plate voltage of 3225 volts, but at the same frequency, the temperature at the periphery of the ends as measured by the surface pyrometer had dropped to about 185° F., within 2 to 3 seconds after contact of the compound with the ends. Lined ends leaving the machine were tested for retained fluid. Analysis showed the retained moisture to average 1½ %.

EXAMPLE II

A coil of 4½" diameter having 100 turns was substituted for the high frequency coil used in Example I. The 100-turn coil was energized at 40 volts and 200 amperes by a regular 220 volt primary alternating current 60-cycle transformer. After 2 minutes, the temperature profile determined as given in Example I showed a 225° F. lacquer melted for a distance of ¾" in from the periphery. At the periphery, the temperature dropped to about 185° F. within 2 to 3 seconds after the compound was applied. The resulting lined ends showed the same percentage of retained fluid as in Example I.

Referring to FIG. 1, the machine, 10, receives ends from a press and curler, 2, over a transport belt. B. These unlined ends continuously replace the infed stack, 11, which is surrounded by the coil, 13. Ends are stripped from the bottom of the stack, 11, by the slide, 18, and are placed on the rotating chuck (not shown because it lies directly beneath an end, 19). Compound is applied to the rotating end through the nozzle, 21. (For clarity in illustration, the conduits which supply lining compound to the nozzle are not shown.) As the ends leave the chuck they are pushed beneath the stack of ends in the outfeed stack, 22, they are met by a blast of hot air projected on the ends from the blower, 23. The hot air carries the vapor away from the end and prevents recondensation in the outfeed stack, 22. If the equipment is provided with a "magnetic upstacker," 24, part of the blast may be directed on the ends which fan out as they are individually picked up by the magnetic rolls, 25.

The high frequency generator, 26 (or commercial frequency transformer), is connected to the flexible leads, 16 and 17. Use of the hot air blower, 23, although recommended, is optional, for some machines, particularly those of the rotary type, produce enough air movement to remove the vapor. It is the usual experience that ends, by the time they have reached the outfeed stack, 22, are sufficiently dry.

Since no other drying means is required, and no further handling of the ends except packing them in the con-
ventional shipping containers is required, the system achieves substantial savings in floor space requirements, in over-all energy demand, and in labor, when compared to oven drying.

The term "commercial frequencies" is intended to mean alternating current frequencies, usually 50 or 60 cycles, at which electrical energy is supplied by power companies.

We claim:

1. The method of producing substantially dry container closures, while said closures are passing through a container closure lining machine, having means to feed closures through the said machine, which includes simultaneously heating a plurality of container closures maintained in a feed stack by surrounding said closures with an induction heating coil while in said stack and transferring energy from said coil to said stack, releasing the closures to said feeding means sequentially but only after an individual closure has ceased being heated for a time sufficient to dissipate excessive rim temperatures into the sealing areas of said closure, and then applying a sealing composition having a liquid component to the sealing area while the said sealing area is at an elevated temperature, whereby the said elevated temperature is sufficient promptly to evaporate the liquid component of said sealing composition, and ebullition and resulting pitting of the lining is avoided.

2. In a container closure lining machine wherein means are provided to feed closures across a work surface from an infeed stack to lining and outfeed stations, said machine including a plurality of rods extending vertically upwards from said work surface and forming a support for said infeed stack, the improvement wherein said rods are made of electrically insulating material, a multiturn coil surrounds and is supported by said rods a distance above said work surface sufficient to prevent substantial loss of energy into said work surface, and means are connected to said coil to energize the coil and thereby simultaneously heat all closures encompassed within the turns of the coil, the said feed means feeding sequentially closures which have been heated by passing through said coil, whereby closures having their sealing areas at an elevated temperature sufficient to evaporate the suspending fluid of a container sealing composition are presented to the lining station.

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