Nov. 22, 1966 H. W. ADAMS 3,286,477

HEAT TRANSFER METHOD

Filed Jan. 6, 1961

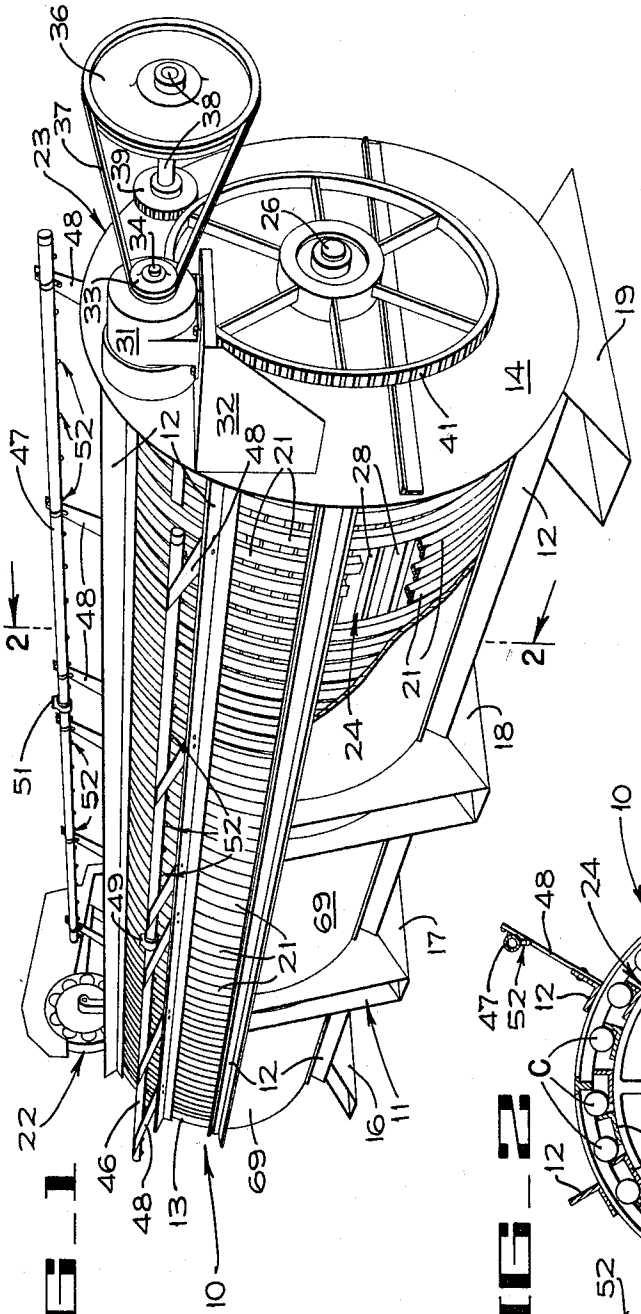


FIG_1

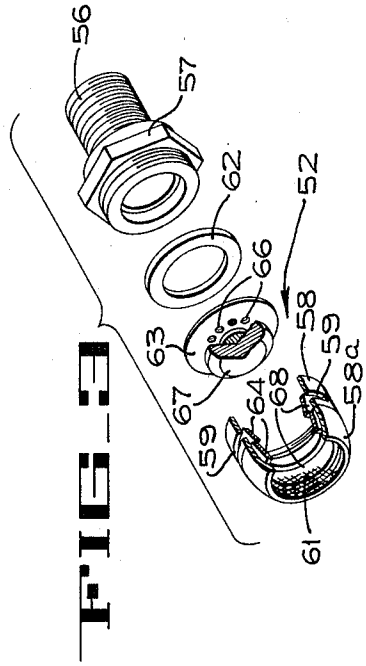


FIG_3

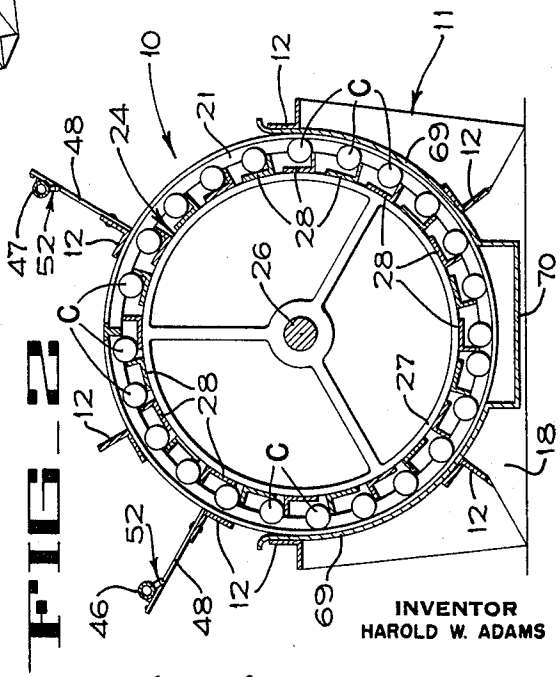


FIG_2

INVENTOR
HAROLD W. ADAMS

BY Hans G. Hoffmeister

ATTORNEY

United States Patent Office

3,286,477

Patented Nov. 22, 1966

3,286,477

HEAT TRANSFER METHOD

Harold W. Adams, San Jose, Calif., assignor to FMC Corporation, a corporation of Delaware

Filed Jan. 6, 1961, Ser. No. 81,082
5 Claims. (Cl. 62—63)

The present invention pertains to a heat transfer method and more specifically relates to a method of cooling containers in an open type spray cooler.

In open type evaporative spray coolers, cooling efficiency increases in direct proportion to the size of the surface of the container that is wetted by the cooling liquid. Heretofore water has been sprayed onto containers, hereinafter called cans, by fan type sprays or the like, as the cans pass continuously through the cooler. In one of these coolers, it has been found that approximately 8% of the water, that is supplied to cool the cans, never contacts the cans but is deflected by surfaces of the cooler outside the cooling area. Additionally, approximately 32% of the water is splashed off the cans or is drained down the spiral canways of this cooler and provides only a minor amount of cooling. Thus, approximately 40% of the water is ineffectively used. As a result, an excessive amount of cooling water must be used in such coolers and the cost of the cooling operation is high.

In accordance with the present invention, it has been discovered that replacement of the fan-type spray nozzles with aerating or foam nozzles greatly improves the cooling efficiency of the above cooler. It has been visually observed in comparative tests between fan nozzles and foam nozzles that the splashing is greatly reduced when foam nozzles are used and that the liquid being discharged from the foam nozzle follows the contour of the cans, rather than splashes off the cans. The result of these tests conclusively indicate that the cooling water from the foam nozzles more efficiently cools the cans.

The cooling foam in the above tests is formed of water having small bubbles of air entrained therein. Any of the well known foam forming nozzles may be used to form the foam used in the method of the present invention.

One object of the present invention is to provide an improved method of removing heat from a heated body.

Another object is to provide a method of more effectively applying a heat transfer liquid to a heated article.

Another object is to provide a method of more effectively applying water to cans to cool the same.

Another object is to provide a method of reducing splashing in an open spray cooler.

Another object is to provide a method of preparing a liquid so that the liquid will follow the contour of containers when directed thereagainst at high velocity.

These and other objects and advantages of the present invention will become apparent from the following description and the accompanying drawings, in which:

FIG. 1 is a perspective of an open type evaporative spray cooler used in performing the method of the present invention, certain parts being broken away.

FIG. 2 is a vertical section taken along lines 2—2 of FIG. 1.

FIG. 3 is an enlarged exploded perspective of one of the foam nozzles used to perform the method of the present invention, certain parts being broken away.

In the apparatus of FIGS. 1 and 2, an evaporative spray cooler **10**, of the well known reel and spiral type, is illustrated which comprises a frame **11** having longitudinally extending angle members **12** secured to end plates **13** and **14**. Support feet **16**, **17**, **18** and **19** are secured to the angle members **12** at intervals spaced longitudinally

thereof. A continuous spiral canway **21** of T-shaped cross-section is secured to the angle members **12** and extends from the inlet end **22** of the cooler to the discharge end **23** thereof. A reel **24** is disposed within the spiral **21** and comprises a shaft **26** which extends longitudinally of the cooler and which is journalled for rotation in the end plates **13** and **14**. A plurality of wheels **27** (only one being shown in FIG. 2) are secured to the shaft **26** and are spaced longitudinally therealong. The wheels **27** cooperate to carry a plurality of can supporting angle bars **28**. The bars which are secured to the wheels, are parallel to the shaft **26** and are disposed at equally spaced intervals around the wheels **27**.

The reel **24** (FIG. 1) is driven by a variable speed motor **31** which is mounted on a bracket **32** secured to the end plate **14**. A pulley **33** keyed to the output shaft **34** of the motor **31** is connected to a pulley **36** by belts **37**. The pulley **36** is keyed to a jack shaft **38** which is journalled on the cooler frame **11**. A spur gear **39** is secured to the jack shaft **38** and meshes with a gear **41** secured to the reel shaft **26**, when the motor is energized, the reel **24** is driven in a clockwise direction as viewed in FIGS. 1 and 2.

As seen in FIG. 2, cans C to be cooled are fed into the inlet end **22** (FIG. 1) of the cooler by any suitable feed means which deposits the cans between adjacent runs of the spiral canway **21** and upon adjacent ones of the angle bars **28**. The angle bars **28** of the rotating reel **24** then push the cans spirally through the cooler to the discharge end **23** thereof at which time they are discharged as by gravity from the cooler.

A pair of parallel, spaced cooling water manifolds **46** and **47** are connected to brackets **48** which are bolted to associated ones of the angle members **12**. The manifolds **46** and **47** are connected to a supply of cooling water by T-fittings **49** and **51**. A plurality of foam nozzles **52** communicate with each manifold and each nozzle is disposed substantially midway between adjacent turns of the spiral canway. The nozzles on the manifolds are preferably directed downwardly along paths which are substantially tangent to the reel **24**. Although the position of the manifolds need not be as shown, placement of the manifold **46** on a radial line of the reel at an angle of 60° counterclockwise from the top of the cooler and placement of the manifold **47** on a radial line of the reel at an angle of 30° clockwise from the top of the cooler as shown in FIG. 2 has proven to be very effective.

The foam nozzle **52** may be of any well known type and constitutes no part of the present invention. Each nozzle **52** (FIG. 3) is connected to its associated manifold by a nipple **56**. An annular bushing **57** is screwed onto the nipple, and a substantially cylindrical nozzle body **58** having an inwardly curved end **58***a* is screwed on the bushing. The nozzle body **58** has several air admitting slots **59** in its periphery and has a screen **61** covering its discharge end. A rubber washer **62** and a metal disc **63** are disposed within the body and are held in assembled position by an air deflecting ring **64** secured to the nozzle body **58**. A plurality of liquid discharge orifices **66** are formed in the disc **63** in circular array concentric with the axis of the nozzle **52**. A liquid dispersing body **67** is connected to and is concentric with the disc **63** and deflects the several streams of water from the orifices **66** outwardly toward the air deflecting ring **64**. The air enters the body, due to suction created by the flow of water therein, between the ring **64** and the wall of the body **58** which cooperate to define a passage **68**. The water and air mix in the body **58** and the mixture is discharged through the screen **61** as a foam which is used in the method of the present invention.

A semicylindrical sheet metal shell **69** (FIG. 2), having a trough **70** formed on the lower end thereof, may be provided to collect the spent cooling water and discharge it from the cooler. If desired, the level of the water in the trough and shell may be maintained at a level wherein the cans at the bottom of the cooler are submerged to increase the cooling rate. It is to be understood however, that the shell **69** and the trough **70** are not necessary for the successful performance of the method of the present invention since the spent water may be discharged directly onto the floor which may be sloped to drain the water to a desired point of discharge.

Comparison tests have been made with #10 cans of diced red peppers, at an initial temperature of approximately 205° F., between a cooler of the above type having fan type nozzles positioned substantially as shown in FIGS. 1 and 2 and a cooler having foam type nozzles also disposed in substantially the same position. In this test the foam nozzles were not used throughout the entire length of the cooler but were used in only the half of the cooler nearest the hot end **22**. The temperature of the cooling water was approximately 66° F. and the water was delivered at normal line pressures (35 to 55 p.s.i.g.).

When using equal amounts of cooling water (approximately 1,950 gallons) in the first half of the cooler, it required 80 minutes to cool the contents at the center of sample cans from 205° F. to 150° F. with the fan sprays, while it required only 52 minutes to cool the centers of contents of equivalent cans to a temperature of 160° F. This represents a cooling rate of 0.69° F./min. for the fan sprays and 0.87° F./min. for the foam sprays. Thus, the use of foam sprays according to the above tests improves the cooling rate approximately 26% over that of the fan sprays. This efficiency would, of course, be greater if field conditions had permitted the use of foam nozzles throughout the entire length of the cooler.

During the above tests, it was noted that cans that were cooled with the fan sprays cause vapor to form throughout approximately the first half of the cooler. When using foam nozzles, however, it was noted that the presence of vapor occurred in only the first few turns of the spiral canway **21** in an area which represented less than one tenth of the length of the cooler. In view of the above, the surface temperatures of cans sprayed with foam was taken and it was found that the surface temperature dropped from the initial temperature to 115° F. within the first two turns of the canway and thereafter dropped to 90° F. before completing fifteen turns. Thus, a larger temperature gradient between the contents at the center of the can and the outside surfaces of the can was effected when using foam as compared to spray nozzles. It is apparent therefore, that the foam cooled the contents faster.

Although it is not completely understood why the foam spray improves the cooling rate, the above tests and visual observations indicate that the air entrained in the cooling water cushions the impact of water upon the cans thereby greatly minimizing the splashing of water from the cans and also causing the water to follow the contour of the cans to wet substantially the entire surface thereof. It is also apparent that the water discharged from the foam nozzle is directed in a controlled, narrow stream between adjacent turns of the spiral canway and thus coolant is not lost by splashing off the canways as happens when fan sprays are used.

Although the heat transfer method of the present invention has been described in relation to cooling cans with a foam composed of air entrained in water, it is to be understood that the scope of the invention is broad enough to encompass both heating and cooling of articles by directing a heat transfer liquid against the article, which liquid has a gas entrained therein.

From the foregoing description it is apparent that, in the heat transfer method of the present invention, a heat transfer medium is employed, and this heat transfer medium is composed of a liquid having a gas entrained therein to form a foam. This foam is of a consistency which greatly retards splashing and readily follows the contour of the article from which heat is transferred even when the foam is directed at high velocity against the article. This foam does not require spreading at the nozzle to treat a wide surface but will spread upon contact with the surface being treated.

While one embodiment of the present invention has been shown and described, it will be understood that various other changes and modifications may be made without departing from the spirit of the invention or the scope of the appended claims.

Having thus described the present invention and the manner in which the same is to be used, what is claimed as new and desired to be protected by Letters Patent is:

1. A method of cooling articles having rounded exterior surfaces consisting of the steps of moving the articles along a predetermined path, introducing a gaseous medium into a cooling liquid to form a foam coolant, and applying a coating of the foam in heat transfer relation substantially entirely around the curved exterior surface of each article as it is moved along said path.

2. A method of cooling containers having rounded exterior surfaces consisting of the steps of moving the containers along a helical path, directing a cooling liquid toward the rounded exterior surfaces of the containers in a direction generally tangential of said containers, introducing a gas into said liquid prior to the contact of the liquid with the containers to form a foam coolant having qualities which minimize splashing and encourage the even spreading of the foam upon contact with the moving containers to more effectively wet the containers, and forming coatings of said foam in heat-transfer relation substantially entirely around the exterior surfaces of said containers.

3. A method of cooling containers having rounded exterior surfaces consisting of the steps of moving the containers along a helical path generated about a horizontal axis, directing cooling water tangentially of said path and downward at spaced points along said helical path toward the exterior surfaces of the containers as they move downwardly, introducing air into said water prior to the contact of water with the containers to form a foam coolant having qualities which minimize splashing and encourage the even spreading of the foam upon contact with the containers to more effectively follow the contour of the containers and wet the containers, and forming coatings of said foam in heat-transfer relation substantially entirely around the exterior surfaces of the containers.

4. A method of cooling containers having rounded exterior surfaces which consists of the steps of moving the containers along a helical path generated about a horizontal axis, directing cooling water tangentially of said path and at spaced points along said helical path toward the exterior surface of the containers as they move downwardly, directing cooling water tangentially of said path and at spaced points therealong onto the containers as they move upwardly, and introducing air into said water prior to the contact of water with the containers to form a foam coolant having qualities which minimize splashing and encourage the even spreading of the foam upon contact with the containers to more effectively follow the contours of the containers and wet the containers, and forming coatings of said foam in heat-transfer relation substantially entirely around the exterior surfaces of said containers.

5. A method of changing the temperature of articles having rounded exterior surfaces consisting of the steps of moving the articles along a predetermined path, mixing a gas with a liquid having a temperature different than the temperature of the articles to be processed to form a foamy heat-transfer medium and forming coatings of said foamy medium on substantially the entire exterior surface of the articles at spaced points along said path,

said foam having a consistency such that it clings to the exterior surface of the articles between said spaced points of application and provides a layer of material on substantially the entire surface of the articles.

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EDWARD J. MICHAEL, *Primary Examiner.*

ROBERT A. O'LEARY, *Examiner.*

D. R. MATTHEWS, *Assistant Examiner.*