June 25, 1968 L. W. CLINE 3,389,478

APPARATUS FOR THERMALLY CONDITIONING ARTICLES AND THE LIKE

Filed March 3, 1966 2 Sheets-Sheet 1

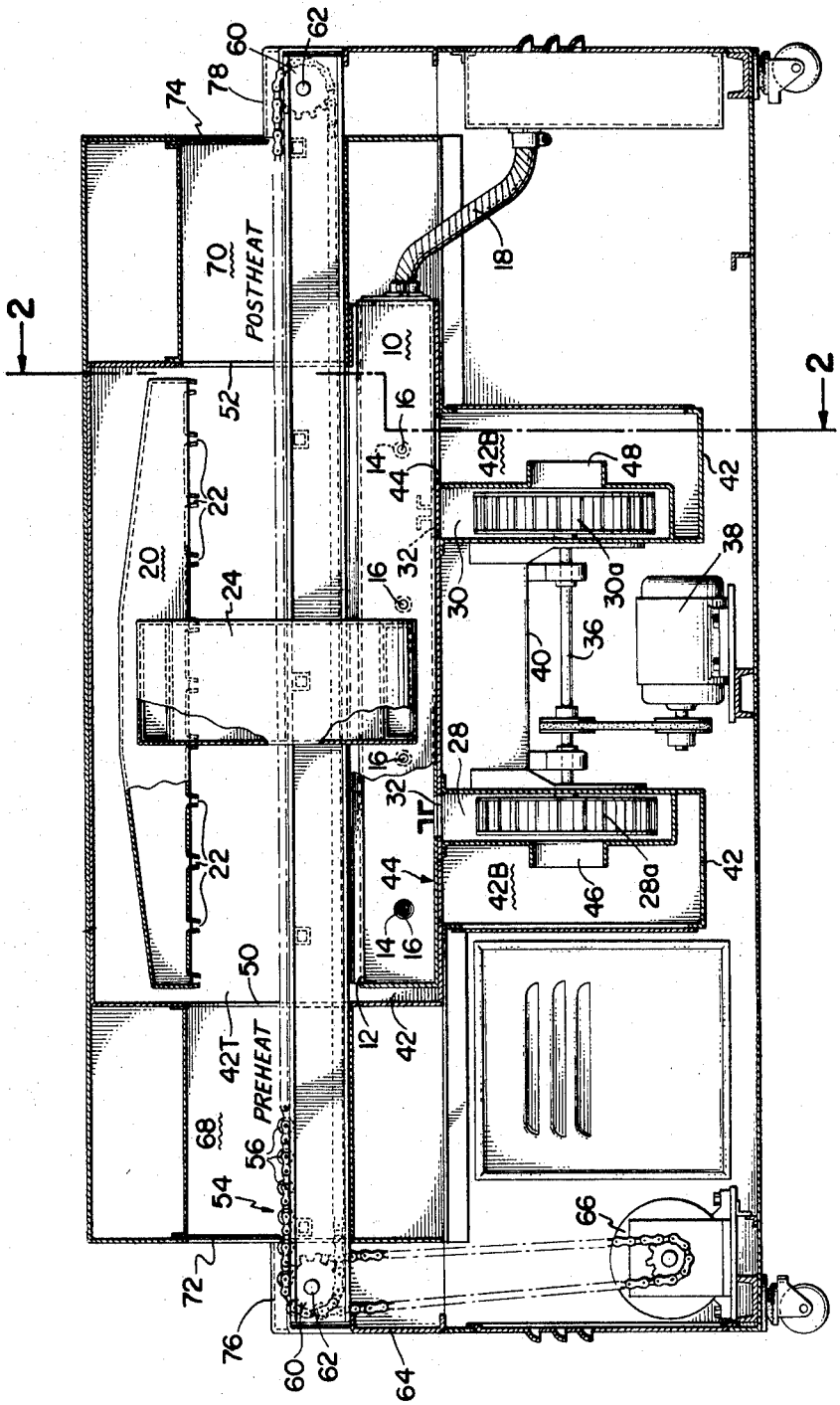


Fig. 1.

INVENTOR.
Leslie W. Cline

BY

Marshall J. Bean
ATTORNEY

WITNESS
Nicholas Leszak

June 25, 1968 L. W. CLINE 3,389,478

APPARATUS FOR THERMALLY CONDITIONING ARTICLES AND THE LIKE

Filed March 3, 1966 2 Sheets-Sheet 2

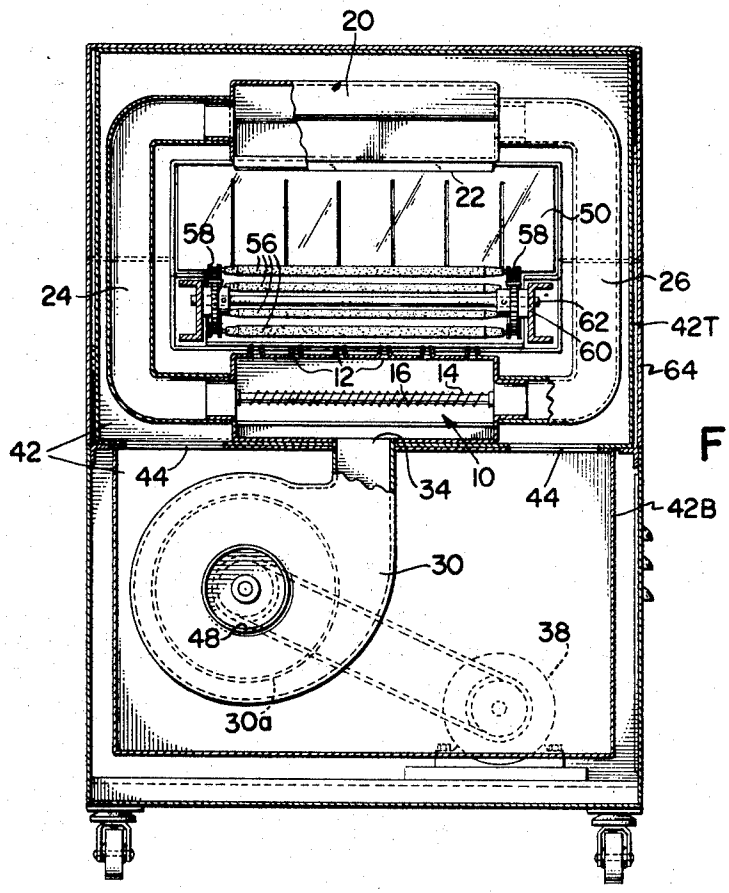


Fig. 2.

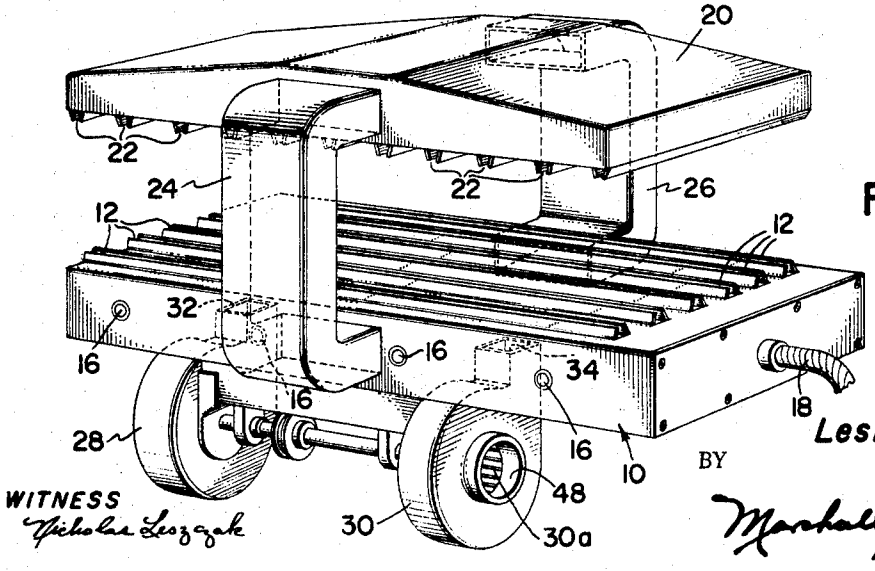


Fig. 3.

INVENTOR.
Leslie W. Cline

BY

Marshall J. Breen
ATTORNEY

WITNESS
Nicholas Leozgak

United States Patent Office 3,389,478
Patented June 25, 1968

3,389,478

APPARATUS FOR THERMALLY CONDITIONING ARTICLES AND THE LIKE

Leslie W. Cline, Brockton, Mass., assignor, by mesne assignments, to Anderson Electric Corporation, Leeds, Ala., a corporation of Alabama

Filed Mar. 3, 1966, Ser. No. 531,385
2 Claims. (Cl. 34—216)

ABSTRACT OF THE DISCLOSURE

A heat shrink tunnel is herein disclosed for heat shrinking plastic film wrappers about articles and the like. The tunnel has a pair of vertically spaced plenum chambers defining a passage therebetween for the passage of the articles. The upper plenum chamber is provided with a plurality of elongate slot nozzles extending transversely of the passage and the lower plenum chamber is provided with a plurality of elongate slot nozzles extending longitudinally of the passage, the nozzles directing heated air towards the articles from both above and below the articles in a criss-cross lattice pattern. Pre- and post-heat chambers are respectively located at the entrance and exit of the passage for gradually increasing and decreasing the temperature of the articles to prevent thermal shock.

This invention relates in general to heat exchange apparatus, and in particular to apparatus of the type that may, for example, be used to heat-shrink plastic film about packages and the like.

Present practice with respect to the heat shrinking of plastic film generally is to direct very hot high speed turbulent air onto such film. This technique is inefficient, and corollarily costly, because it tends not to wet the film with hot air for heat exchange purposes, but rather limits the time during which hot air is in contact with such film; that is, the air, being high speed, tends to bounce off and away from the film, whereby heat exchange is ineffective.

The present invention remedies the defects of the prior art by providing a lattice of thermal planes, each of which is comprised of a steady stream of low speed hot air. Plastic film, for example, passed through the lattice is thoroughly wetted by the air and, hence, heat exchange is maximal. To provide the aforesaid lattice, a pair of spaced apart plenum chambers are employed. The chambers are provided with respective pluralities of opposing slots, and the slots of one chamber are angularly oriented, about a common imaginary axis between the chambers, with respect to the slots of the other chamber. Hot air directed into the chambers emerges from the respective slots of the chambers to envelope in bath-like manner anything between the chambers.

In a presently preferred form of the invention, the two plenum chambers are joined by interconnecting ducts, whereby hot air, forced by common blower apparatus directly into one chamber, nevertheless also gets forced into the other chamber via the ducts. To minimize heat loss, and thereby improve the efficiency of the apparatus, both plenum chambers and the blower apparatus are supported within an externally insulated baffle compartment, with only the input to the blower apparatus and the plenum chamber slots opening deliberately into such compartment. In this way the exhausted, but still hot, air from the plenum chambers is recirculated around such chambers and back into the blower apparatus, whereby attendantly heat loss from the chambers to the compartment is minimal since the temperature gradient therebetween is itself minimal.

A principal object of the invention is to provide improved apparatus for use in altering the temperature of an article or the like.

Another object of the invention is to provide apparatus for producing a lattice of thermal planes through which articles and the like may be passed for heat exchange purposes.

Another object of the invention is to provide efficient heat exchange apparatus, which apparatus utilizes at least one plenum chamber, having output nozzle means, and pump apparatus for applying thermally conditionable air into said chamber, said chamber and said pump apparatus being both so enclosed within a baffle compartment that only the output nozzle means of the plenum chamber and the input to said pump open deliberately into the baffle compartment.

Another object of the invention is to provide apparatus for producing a lattice of thermal planes through which articles and the like may be passed for heat exchange purposes, which apparatus is provided with a vestibular section that is heated as a result of its proximity to said lattice, and whereby thermal shock to said articles and the like is minimized.

The invention will be described with reference to the figures, wherein:

FIG. 1 is a cutaway sectional view of apparatus embodying the invention,

FIG. 2 is a view of the apparatus of FIG. 1 taken substantially along line 2—2 thereof, and

FIG. 3 is a perspective view of a portion of the apparatus of FIG. 1.

The invention is described in relation to a heat shrink tunnel for heat-shrinking plastic film around packages which are automatically conveyed into and out of such apparatus.

Referring to the figures, a first plenum chamber **10** has a plurality of elongated slot nozzles **12**, and contains therein heating coils **14**. The coils **14**, which are supported on electrically nonconductive rods **16**, are electrically energized by power supplied via a cable **18**. A second plenum chamber **20**, having elongated slot nozzles **22**, is supported above the plenum chamber **10**, in spaced apart relation therewith, by means of a pair of ducts **24**, **26**, thereby defining a passage between the chambers. The ducts **24**, **26** open into both plenum chambers **10**, **20** and the nozzles **12** and **22** of respectively the chambers **10** and **20** open into the passage and are preferably orthogonally arranged with respect to each other. That is, nozzles **12** in chamber **10** extend longitudinally of the passage and nozzles **22** in chamber **20** extend transversely of the passage.

Blowers **28**, **30** direct air into the base of the plenum chamber **10** via respective orifices **32**, **34** and, because of back pressures within the chamber **10** resulting from the constrictive nozzles **12**, air is forced from the chamber **10** to the chamber **20** via ducts **24**, **26**. The impellers **28***a* and **30***a* of respectively the pumps **28** and **30** are supported on a common shaft **36** which is pulley-driven by means of a motor **38**, and such shaft **36** is rotatably supported in a bracket **40**. The pumps **28** and **30** and coils **14** constitute a means for supplying heated air to both of the plenum chambers.

A three-part baffle compartment **42** surrounds the pumps **28**, **30** and both plenum chambers **10**, **20**, with the top part **42T** of the baffle compartment housing the plenum chambers **10**, **20** and the bottom two parts **42B** thereof housing respective pumps **28**, **30**. The baffle compartment top and bottom parts **42T** and **42B** are interconnected by ports **44**, with the inputs **46** and **48** respectively of the pumps **28** and **30** opening into their respective baffle compartment parts **42B**, and the elongated

output nozzles **12** and **22** of the plenum chambers opening into the top part **42T** of the baffle compartment.

Ingress to the baffle compartment **42** to the space or passage between the plenum chambers **10**, **20**, and egress from such compartment are respectively via sectioned curtains **50**, **52**, which may for example be of rubberized material. An open conveyor **54**, consisting of spaced apart rollers **56** that interconnect a pair of parallel chain linkages **58**, constitutes a means for conveying articles and the like into the baffle compartment **42** and through the passage between the plenum chambers. Each chain linkage **58** meshes with a pair of sprockets **60** on respective shafts **62** and such, shafts are rotatably supported by the frame **64**; the conveyer is driven by a motor **66** that chain-drives one of the shafts **62**. The conveyer is designed in this fashion, i.e. with through-openings among its plural parts, in order to permit the free flow of air within the region between the plenum chambers **10**, **20**.

Hot air that leaks from the baffle compartment **42**, e.g. via the sectioned curtains **50**, **52**, is trapped at least to some extent, within ante- and post-compartments **68**, **70**. This is an important aspect of the instant apparatus not only because it works to economize on the heat required of the apparatus, but more importantly because it affords compartments for gradually heating and cooling the articles being conveyed, whereby thermal shock to such articles is kept minimal. The ante or preheat compartment **68** has an entrance sectioned curtain **72** and the post or postheat compartment **70** has an exit sectioned curtain **74**. The frame **64** preferably is so designed that it has external shoulder-like limbs **76**, **78** on which articles may rest as they are conveyed into and out of the apparatus of the invention.

In operation, an article to be heated is placed on the conveyer **54** in the region of the shoulder-like limb **76**. The conveyer **54** carries the article on its rollers **56** through the curtain **72** and into the ante-compartment **68**, wherein the temperature of the article is gradually raised to an intermediate temperature by heat lost from the baffle compartment **42**. After traversing the ante-compartment **68**, the article passes through the curtain **50** and enters the passage between the plenum chambers **10**, **20** where a criss-cross lattice pattern of heated air impinges upon the articles. As the conveyer **54** carries the articles through the curtain **52**, the article enters a region (post-compartment **70**) of gradual cooling, i.e. down from the camparatively high temperatures of the baffle compartment **42**, after which time it exits on the conveyer through the curtain **74**.

While the invention has been described in its preferred embodiment, it is to be understood that the words which have been used are words of description rather than of limitation, and that changes within the purview of the appended claims may be made without departing from the true scope and spirit of the invention in its broader aspects.

Having thus set forth the nature of the invention, what is claimed herein is:

1. Heat exchange apparatus comprising first and second spaced plenum chambers defining a passage therebetween, each of said chambers having a plurality of elongate slot nozzles, the nozzles in the first chamber opening into said passage and extending longitudinally thereof and the nozzles in said second chamber opening into said passage and extending transversely thereof, means for supplying heated air to both of said plenum chambers, and means for conveying articles through the passage between the chambers, said conveying means comprising an open conveyor for permitting substantially free flow of air therethrough, whereby a criss-cross lattice pattern of heated air from said nozzles impinges upon the articles as they are conveyed through said passage.

2. The apparatus of claim **1** including a preheat compartment: the ingress region of said baffle means and a postheat compartment substantially enclosing the egress region of said baffle means, whereby the temperature of the articles as gradually increased and decreased prior to entering and after leaving said baffle means, respectively, thus preventing thermal shock.

References Cited

UNITED STATES PATENTS

3,070,901	1/1963	Allander et al.	34—160 XR
1,910,868	5/1933	Webb	34—225 XR
2,677,336	5/1954	Spooner	34—225 XR
2,906,627	9/1959	Payton et al.	53—184 XR
3,175,565	3/1965	Dawson	34—216 XR
3,222,800	12/1965	Siegel et al.	53—184 XR
3,226,839	1/1966	Monaghan	34—225 XR
3,309,835	3/1967	Peppler	53—184 XR

FREDERICK L. MATTESON, JR., *Primary Examiner.*

JAMES W. WESTHAVER, *Examiner.*

A. D. HERRMANN, *Assistant Examiner.*