Sept. 8, 1970 A. W. LOSSING 3,527,290

HEAT EXCHANGER

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FIG-1

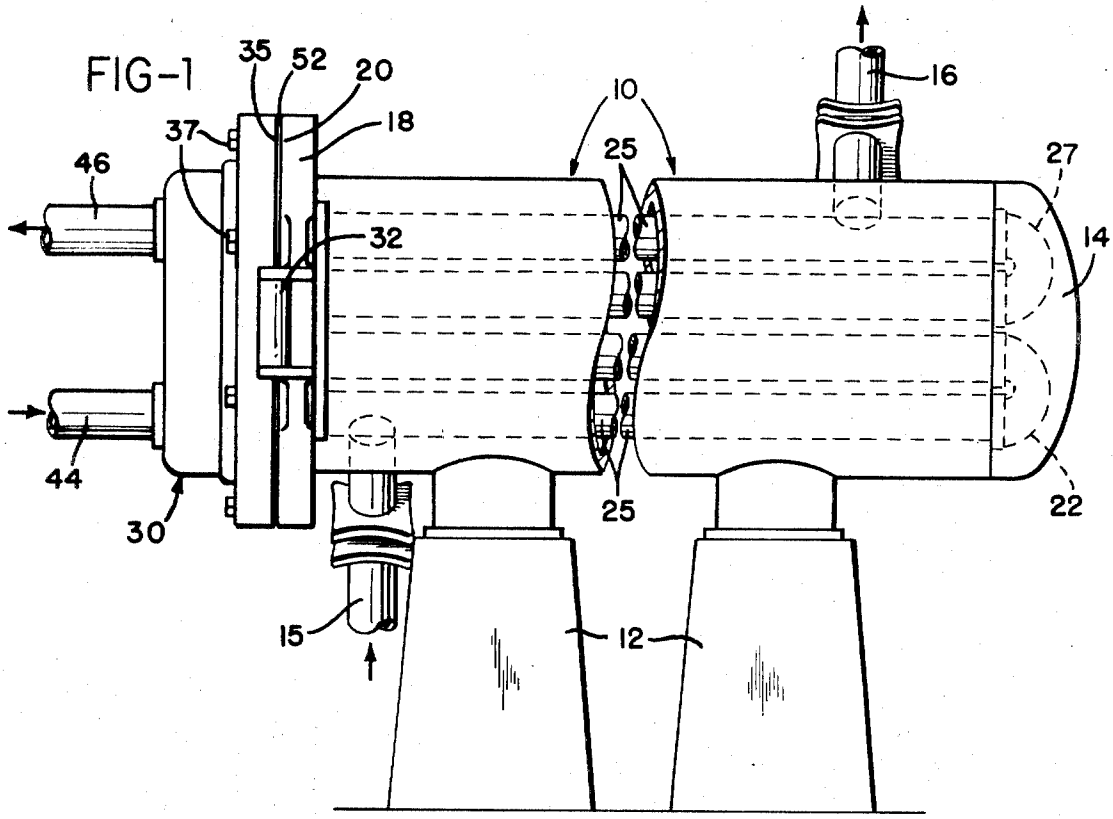
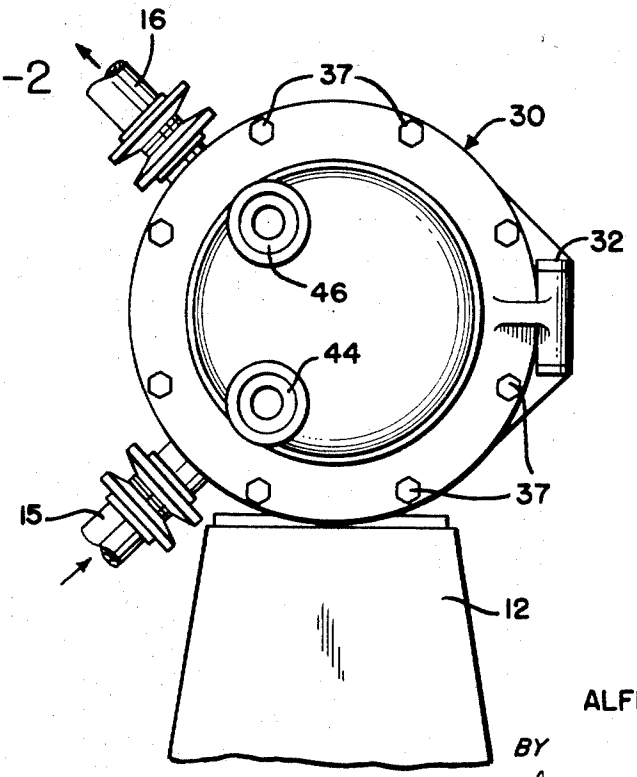



FIG-2




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FIG-3

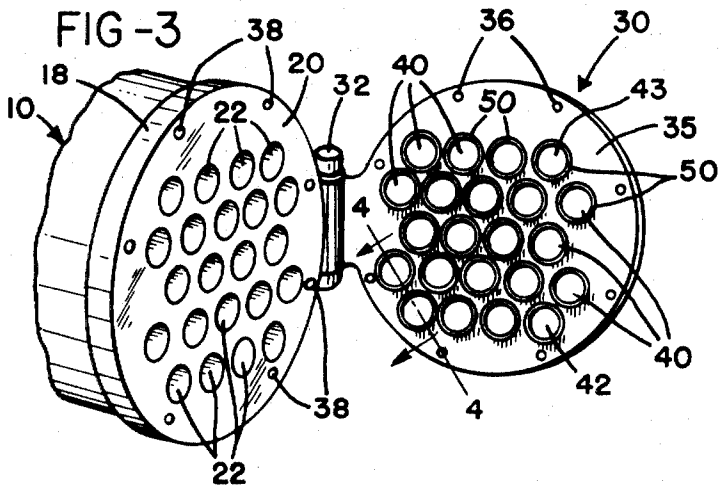



FIG-4

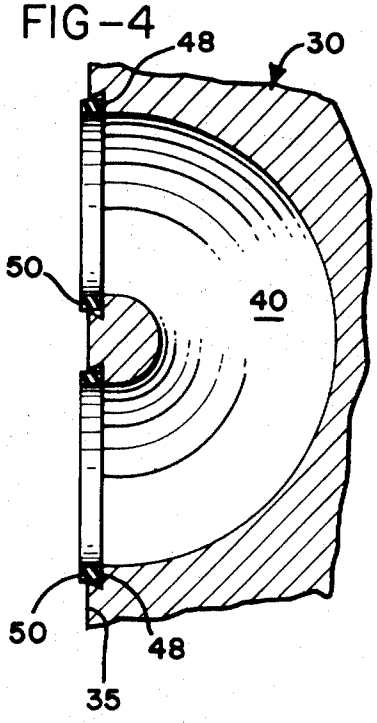



FIG-5

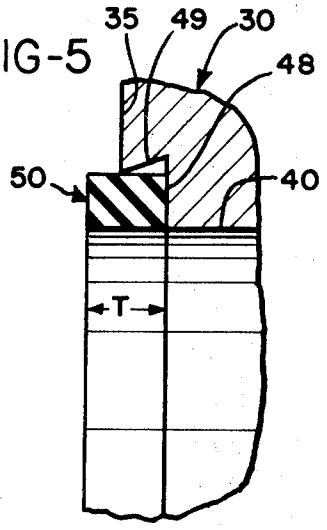
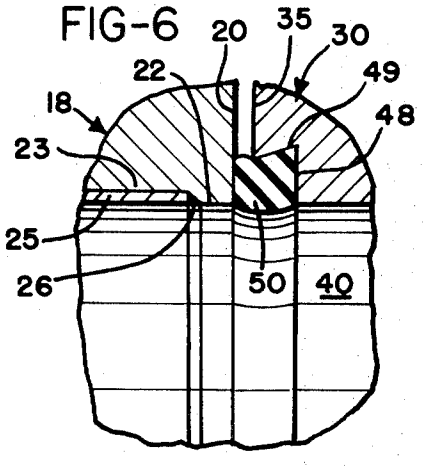



FIG-6



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3,527,290

# HEAT EXCHANGER

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Int. Cl. F28f 9/02; F16l 5/00
U.S. Cl. 165—70 8 Claims

## ABSTRACT OF THE DISCLOSURE

The housing of a heat exchanger encloses multiple tubes each terminating at an end plate having a flat face, and a pivotally supported head member includes a mating flat face and multiple passages which align with the tubes. Resilient annular gaskets are located between the faces in surrounding relation with the ends of the passages, and each gasket includes a portion which projects into a corresponding annular recess formed within the face of the head member.

## BACKGROUND OF THE INVENTION

In a heat exchanger including an elongated cylindrical casing or housing adapted to receive a heat transfer fluid and enclosing a plurality of axially extending interconnected tubes each terminating at an end plate, commonly a pivotally supported head is secured to the end plate with peripherally spaced screws. The head incorporates a plurality of U-shaped return passages and inlet and outlet passages which align with the tubes within the housing to provide for directing the fluid to be heated or cooled in a serpentine-like flow path through the tubes.

Usually, the end plate and the head have mating flat circular faces, and a large flat resilient gasket is employed between the faces covering the entire area of each face. The gasket has a plurality of holes which align with the passages within the head and the tubes within the housing for preventing the fluid being circulated through the tubes and passages from flowing from one passage to another between the faces of the end plate and the head.

When such a heat exchanger is employed for cooling a liquid food product such as beer during its processing, it is not unusual for the housing and the head to be subjected to a wide temperature range. For example, in the production of beer, the heat exchanger may initially receive the beer at approximately 200° F. from a boiler or pasteurizer for purposes of cooling the beer down to a temperature of 50° F. Furthermore, the heat exchanger is frequently used to remove the heat generated by fermentation and for final cooling of the beer down to 36° F. at the conclusion of the fermenting cycle, and it is also common to employ the heat exchanger to cool the beer to approximately 28° F. immediately before filtering, bottling, or filling kegs.

As a result of the heat exchanger being subjected to the substantial temperature range of 28° F. to 200° F. and the closing forces imparted by the peripherally spaced screws, the head will warp or bow slightly causing leaks to develop among the passages between the faces of the end plate and the head. Since the large gasket covers each face and is clamped between the head and end plate by the peripherally spaced screws, the leaks among the passages are frequently not detected, As a result, a small quantity of beer is sometimes entrapped between the faces and the gasket creating almost ideal conditions for the growth of bacteria during periods when the equipment is idle and likely sources of contamination of the sterile beer being circulated through the tubes and passages at a later date.



## SUMMARY OF THE INVENTION

The present invention is directed to a heat exchanger of the character described above and particularly to an improved means for forming a seal between each tube within the housing and its correspondingly aligned passage within the head. In accordance with a preferred embodiment of the invention, the face of the head is provided with an annular undercut recess surrounding the end of each passage, and an annular resilient gasket is located within each recess. Each gasket projects from the face of the head and is adapted to engage the face of the end plate of the housing when the head is drawn towards the end plate by the peripherally spaced screws. Since the total face area of the individual gaskets is much less than that of a full gasket, the force necessary to effect a seal between the end plate and the head is greatly reduced.

Each of the gaskets has sufficient thickness so that a space or gap is produced between the face of the head and the face of the end plate of the housing. Thus, if a leak did develop between one of the gaskets and one of the faces when the head bows, the escaping fluid would not flow into an adjacent passage but would drip to the floor below where it would be quickly detected. It has been found, however, that the separate and individual gaskets for the passages and aligned tubes will maintain an effective seal even when the head bows slightly when subjected to a wide temperature range.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an elevational view of a heat exchanger incorporating sealing means constructed in accordance with the invention and with a center portion broken away;

FIG. 2 is an end view of the heat exchanger shown in FIG. 1 and showing the head in its closed position;

FIG. 3 is a fragmentary perspective view of the heat exchanger showing the head in an open position;

FIG. 4 is a fragmentary section taken through the head generally on the line 4—4 of FIG. 3;

FIG. 5 is an enlarged fragmentary section of a portion of the head shown in FIG. 4; and

FIG. 6 is an enlarged fragmentary section showing the head portion of FIG. 5 when the head is closed.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

The heat exchanger shown in FIGS. 1 and 2 includes an elongated cylindrical casing or housing **10** supported on each end by a pedestal **12** and having a crowned end cover **14**. The particular heat exchanger shown is intended for cooling beer and is adapted to receive a recirculated heat transfer fluid such as liquid ammonia through an inlet **15** connected to one end of the housing **10**. Ammonia vapor is discharged from the opposite end of the housing **10** through an outlet **16** and is recirculated through a compresser system (not shown).

A circular header or end plate **18** is rigidly secured to the end of the housing **10** opposite the end cover **14** and includes a flat face **20** having a plurality of cylindrical openings **22** (FIG. 6) each extending to a slightly larger counterbore **23**. A corresponding plurality of tubes **25** extend axially within the housing **10**, and each tube **25** has one end extending into one of the counterbores **23**

where it is secured by a peripheral weld **26**. The tubes **25** are supported in spaced relation within the housing **10** by a pair of axially spaced vertical support members (not shown), and a plurality of U-shaped conduits **27** (FIG. 1) interconnect the end of adjacent tubes in the space enclosed by the end cover **14**. Each opening **22** has a diameter the same as the inside diameter of the tube **25** received within its corresponding counterbore **23**, and each weld **26** is ground so that it forms a smooth continuation of the inner surface of the corresponding tube **25** and opening **22**.

A head **30** is mounted on the end plate **18** by a hinge **32**. A flat circular face **35** is formed on the head **30**, and a plurality of peripherally spaced holes **36** are formed within the head. A set of screws **37** (FIG. 2) extend through the holes **36** and are threaded into correspondingly spaced holes **38** formed within the end plate **18**.

A plurality of U-shaped return passages **40** (FIG. 4) are formed within the head **30** and the ends of each passage **40** terminate at the face **35**. The head **30** also has a pair of straight passages **42** and **43** which are connected to an inlet line **44** (FIG. 1) and an outlet line **46**, respectively. The passages **40**, **42** and **43** are arranged within the head **30** so that they align with the openings **22**, and each passage has an inner diameter the same as the inner diameter of its corresponding aligned opening **22**. Thus the beer which is to be cooled is received within the inlet line **44** and is directed successively through the tubes **25** as a result of the interconnection provided by the U-shaped conduit **22** and the U-shaped return passages **40** until the beer is discharged from the line **46**.

In accordance with the invention, an annular recess **48** (FIGS. 4–6) is formed within the face **35** of the head **30** surrounding each end of each of the passages **40**, **42** and **43**, and each recess **48** has a circumferential undercut formed by a frustoconical surface **49**. An annular or ring-like resilient gasket **50** is positioned within each recess **48** and has a rectangular cross-section as shown in FIG. 5. Preferably, each gasket **50** is formed of neoprene and has a durometer within the range of 50 to 80. The thickness T of each gasket **50** is approximately twice the depth of its corresponding recess **48** so that each gasket **50** projects outwardly from the face **35** of the head **30**. Thus when the head **35** is closed and the screws **38** are tightened, each gasket **50** is deformed so that its cross-sectional configuration resembles that shown in FIG. 6.

As a result of the thickness T of each gasket **50**, when the head **30** is closed and secured to the end plate **18**, a space or gap **52** (FIG. 6) is defined between the face **20** of the end plate **18** and the face **35** of the head **30**. The compressive forces on each gasket **50** causes the gasket to expand into the undercut portion of its corresponding recess **48**, and after the head has been closed for a period of time, each gasket **50** takes a partial set so that when the head is opened for cleaning, a portion of each gasket will remain within the undercut and thereby retain the gasket with the head **30**.

From the drawings and the above description, it becomes apparent that a heat exchanger constructed in accordance with the invention provides desirable features and advantages. For example, by providing a separate resilient gasket **50** for each opening **22** within the end plate **18** and the correspondingly aligned passage within the head **30**, and by constructing the gaskets with sufficient thickness to produce a gap **52** when the head **30** is closed against the end plate **18**, a dependable and effective seal is formed between each opening **22** and corresponding passage. Furthermore, the gaskets **50** will maintain their seal even when the face **35** of the head **30** bows slightly when subjected to a substantial differential in temperature.

If a leak should develop between one of the gaskets **50** and the face **20** of the end plate **18**, the escaping liquid would flow downwardly around the gaskets **50** located below the leaking gasket and would drip down onto the floor where it would be easily detected. However, there is no danger of the escaping liquid flowing past another gasket **50** and into another opening **22** where it could possibly contaminate the fluid being cooled at a later time. The recesses **48** surrounding the ends of the passages **40**, **42** and **43** also provide the feature of retaining each gasket **50** so that when the head **30** is moved to an open position for cleaning purposes, the gaskets **50** will remain in their proper positions concentrically aligned with the corresponding passages within the head **30**.

The recesses **48** are preferably formed within the face **35** of the head **30** so that the tubes **25** may be easily cleaned without any danger of damaging the gaskets **50**. However, it is conceivable that the recesses **48** could be formed within the face **20** of the end plate **18** in surrounding relation with the openings **22**. Furthermore, while the gaskets **50** are preferably retained within the recesses **48**, it is within the scope of the invention to eliminate the recesses **48** and to secure gaskets **50** to one of the faces **20** or **35** with a suitable cement.

While the form of apparatus herein described constitutes a preferred embodiment of the invention, it is to be understood that the invention is not limited to this precise form of apparatus, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

**1.** A heat exchanger adapted for cooling a liquid food product, comprising a housing, header means connected to said housing and having a substantially flat face, a plurality of generally parallel spaced tubes extending within said housing, each said tube having one end secured to said header means, means defining a corresponding opening within said face for each said tube, means connecting the opposite ends of selected said tubes, a head member releasably secured to said housing and including a substantially flat face disposed in closely spaced relation to said face of said header means, means defining a plurality of return passages within said head member, said passages having ends terminating at said face of said head member in substantially aligned relation with said openings for said tubes, said passages cooperating with said means connecting the opposite ends of said tubes to provide for directing a fluid through said tubes, a separate annular resilient gasket for each said tube within said housing and positioned in a compressed condition between said faces in surrounding relation with the correspondingly aligned said opening and passage, and means for retaining each said gasket on one of said faces to prevent leaking of the liquid from one said tube to another between said faces.

**2.** A heat exchanger as defined in claim **1** wherein said retaining means for each said gasket comprise an annular recess within one of said faces in surrounding relation with the adjacent end of the corresponding said passages and each said gasket including a portion projecting into the corresponding said recess.

**3.** A heat exchanger as defined in claim **2**, wherein each said recess has a peripheral undercut, and said portion of the corresponding said gasket projects into said undercut when said head member is secured to said housing.

**4.** A heat exchanger as defined in claim **2** including hinge means pivotally connecting said head member to said housing, and said recesses being formed within said face of said head member.

**5.** A heat exchanger as defined in claim **1** wherein each said gasket has a durometer within the range of 50 to 80.

**6.** A heat exchanger as defined in claim **1** wherein each said tube and the corresponding said passage and said gasket each have substantially the same inside diameter.

**7.** A heat exchanger as defined in claim **1** wherein each said gasket has a rectangular cross-sectional configuration.

**8.** A heat exchanger as defined in claim **1** wherein the diameter of each said opening is substantially the same as

the inner diameters of the corresponding said tube and gasket.


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165—77, 158, 178; 285—13, 127, 157, 379