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METHOD OF MAKING COUNTERFLOW FLUID CONDENSERS

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FIG. 1

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ABSTRACT OF THE DISCLOSURE
A counterflow fluid condenser which includes a pair of opposite chambered manifold heads and a plurality of telescopically associated pipe pairs connected between said heads to the respective chambers thereof, there being defined one independent path with appropriate inlet and outlet for condensate and another independent path with appropriate inlet and outlet for coolant; the manifold heads each being formed as elongate U-shaped housing divided into a plurality of chambers by spaced cross-baffles seated therein and supported by respective parallel spaced rib pairs formed along the inner surface of the floor and sides of said housing, a plurality of bridging plates seated on respective ones of bridging ribs likewise formed on the inner surface of the side walls of said housing, the floor of said housing being provided with first perforations of size and configuration to receive therethrough the outer one of said pipe pairs and the bridging plates each being provided with a second perforation for receiving therethrough the inner one of said pipe pairs; said bridging baffles also having means for receiving stud fasteners and suitable washer and cover means being secured to the bridging plates utilizing said stud fasteners; the coolant path traversing said chambers and the condensate path being non-communicating with said chambers, the novel method of making the condenser being characterized by the steps of forming a manifold head sub-assembly by impressing a plurality of grooves in one face of a sheet metal blank at predetermined locations thereof simultaneously forming ribs on the opposite face thereof, bending said grooved blank to an inwardly ribbed, U-shaped configuration to define a floor having sections defined between the rib pairs and opposite equal side walls with the grooves on the exterior thereof, perforating said floor within each section, assembling cross-baffles and bridging plates utilizing said ribs as support therefor so as to define the plurality of manifold chambers, one chamber for each section, engaging respective ones of said pipe pairs through respective ones of said perforations, installing the stud fasteners on the bridging plates and thereupon copper-brazing the thus constructed subassembly in an oven and thereafter applying and securing suitable washers and covers to opposite manifold heads thereof to complete the counterflow condenser; the coolant and condensate inlets and outlets being provided in one of said manifold heads.

This invention relates generally to fluid condenser apparatus and more particularly is concerned with a novel method for the manufacture of counterflow fluid condensers and the article resulting therefrom, said method and article characterized by the elimination of machining steps for the formation of the manifold heads thereof. Heretofore, in the construction of counterflow fluid condensers particularly of the water cooled type, and other similar equipment, formation of the manifold heads thereof required expensive precise machining of solid bars and thereafter soldering of the resulting heads to the pipes. Machining is an expensive process and required highly skilled highly paid personnel and sophisticated costly equipment so that there is a long felt need for a more economical method of manufacturing such articles.

It is the principal object of this invention to provide a method for the manufacture of counterflow fluid condensers which eliminates the steps of machining in forming the manifold heads thereof and results in structures fully meeting the most diverse technical standards for articles of this type.

Another object of this invention is to provide a method of manufacturing counterflow condenser subassemblies engaging the necessary piping to said manifold subassemblies to form a condenser subassembly, brazing the completed condenser subassembly and thereafter assembling suitable washers and covers to said brazed condenser subassembly to form a condenser.

Another important object of this invention is to provide a method of forming each manifold head from sheet metal parts, comprising the steps of impressing a plurality of grooves at predetermined locations in one face of a sheet metal blank of predetermined dimensions simultaneously forming coextensive protrusions or ribs in the opposite face thereof, bending said grooved blank to a housing of U-shaped configuration with the protrusions interior thereof to define chamber sections, said grooves, and coextensive ribs, being arranged in spaced pairs to define the chamber sections, and single grooves, and coextensive ribs, are located adjacent the free ends of the side walls and between the respective groove pairs to provide support means for the respective preformed cross baffle and bridging plates subsequently assembled to said housing to define the chambers of said manifold head.

Other advantages and objects of the invention will be evident to the skilled artisan from the ensuing description of a preferred embodiment of the invention with reference to the accompanying drawings.

In the drawings:
FIG. 1 is a schematic view of a counterflow fluid cooled condenser constructed in accordance with the method of the invention and shown substantially in section to illustrate interior details thereof.

FIG. 2 is an exploded view on an enlarged scale of one portion of the manifold head and pipe subassembly of the condenser illustrated in FIG. 1.

Although the method and article of the invention is described in respect of a counterflow water cooled condenser it is not limited thereto but is applicable to similar equipment and those utilizing other fluid coolants. Particularly, the method of the invention provides for the manufacture of counterflow condensers without resort to machining steps for the formation of manifold heads thereof. This is accomplished by utilizing preformed parts preferably of sheet metal, to form the subassembly, permanently sealing the subassembly together as by brazing in the case of sheet metal and thereupon installing appropriate covers and washers to complete said article.

Referring now to the drawings, with reference to FIG. 1, the counterflow fluid condenser constructed in accordance with the invention is designated generally by reference character 10. The condenser 10 includes a series of internal pipes 12 and a series of external pipes 14, said pipes 12 and 14 being arranged concentrically and in pipe pairs, generally shown at 15. Pipes 12 are longer than and extend out of the ends of pipes 14. A pair of manifold heads 16 and 16' are disposed at opposite ends of said pipe pairs 15. Covers 17 and 17' are applied to the heads 16 and 16' over suitable washers 18 of adequate thickness to create connecting chambers 20 between the respective internal pipes 12. Such covers 17 and 17' are
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The manifold heads 16 and 16' each comprise a housing 26 preferably formed of sheet metal and having a substantially U-shaped cross-sectional configuration defining a floor 28 and a pair of sidewalls 30 and 32 of substantially equal dimension. A number of perforations 34 for attachment of pipes 14 are provided in the floor 28. Cross-baffles 36 and 38 are disposed in the housing 26 between the side walls 30 and 32 conveniently dividing the housing 26 crosswise into chambers 40, each of floor 28 of having one of the perforations 34 formed therein. Of the cross-baffles 36 and 38, baffle 36 has central perforation 42 while baffle 38 is imperforate. Where communication between chambers or to the chambers is desired, baffles 36 and 38 are utilized; where no communication is desired the imperforate baffle 38 is utilized. The respective perforate and imperforate baffles 36 and 38 are utilized to define the coolant circulating chambers 40 of the manifold as well as to mount the respective inlet and outlet coolant pipes in one of the manifold heads, that is, head 16'.

The condensate circulating chambers 20 are defined by the washers 18, the covers 17 and 17' and the bridging plates 46, and are independent of the coolant circulating chambers 40 described herein being supported upon ribs 12.

A plurality of small plates hereinafter described as bridging plates 44 are preformed with perforations 46 and smaller perforations 48. Perforations 46 centrally are located in each in the plates 44 and of a size and configuration to receive tightly the inner pipe 12 which carries the condensate. Pipe 12 is sealed hermetically to said plate 44 as by solid solder, preferably so that the end thereof is flush with the outer surface 50 of plate 46. Pipes 12 and 12' pass through preformed perforations 49 forming the inlet and outlet respectively for condensate. Passageways 62 in the washers communicate to pipe 12 and 12'. It is contemplated that certain of the plates 44' and 44'' may alternatively each respectively have the ends of selected pipes 12 passing entirely through their perforations 46' and through perforations 49 respectively forming the inlet 52 and outlet 54 for the condensate. Plates 44' are disposed as end plates in housing 16' and have like pipes 13 engaged through their openings 46'' to serve as inlet 53 and outlet 55 for coolant. Small perforations 48 are provided on the bridging plates 46 at suitable locations thereon. These perforations 48 are of a size and configuration to receive the stud ends 58 of stud bolts 22, the threaded ends 60 being utilized for attaching the covers 17 and 17' respectively to the manifolds 16 and 16' of condenser 10.

Thus, the counterflow fluid-cooled condenser 10 is seen as having a pair of independent paths indicated by following arrow A-B and C-D respectively. Path A-B is the coolant path while path C-D functions as the condensate path.

In accordance with the method of the invention, each housing 16 and 16' is formed by first forming an elongate substantially rectangular sheet metal blank (shown in bent form in FIG. 2) of suitable length and width dimensions. A plurality of grooved pairs 62 are formed in one face of the sheet metal blank transverse thereto and parallel spaced along the length thereof to define the blank into sections. Simultaneously with the formation of the groove pairs 62, a series of second, single grooves 64 is impressed into the same blank face spacer inwardly of the lateral edges of said blank and having the ends 64' thereof spaced only slightly from the ends 61 of said parallely transverse grooves 62, said spaced pair between respective groove pairs 62. The distance of said grooves 64 inwardly of the lateral edges of the blank preferably is selected equal to the thickness of the bridging plate 46 so that the surfaces 50 may be flush with the free ends of walls 30, 32, when plates 44 are mounted to the housings 16, 16' as explained below. The impression of groove pairs 62 and grooves 64 in the blank is conducted, say by use of an oblong die, so that matching protrusions or ribs 66 and 68 are formed in the opposite face of said blank. Thereafter the blank is formed by bending to a U-shaped configuration to define the housings 16 and 16' with the ribs 66 and 68 on the inner surface and the grooves 62 and 64 are on the outer surface of the respective housings 16 and 16'. One may say that the blank is first grooved and then bent outwardly of the groove face to the U-shaped configuration. Perforations 34 may be formed prior to, simultaneously or subsequent to the formation of grooves 62 and 64 and, also, may be formed subsequent to the forming of the blank to form the housing. In fact, the order of forming the perforations 34 is certainly not critical through the method of the invention.

It will be seen that the ribs 66 are arranged in pairs and will be referred to as rib pairs 66. These rib pairs respectively, form channels 70 running continuously along the sidewalls 30 and 32 crossing floor 28 along the inner face 72 of housing 16, for example. The spacing between the ribs 66 and hence the cross-sectional dimension of channels 70 is selected substantially to be equal to the thickness of the cross-baffles 36 and 38.

Respective cross-baffles 36 and 38 are slidably engaged within channels 70 and thereafter the plates 44 are mounted to rest upon ribs 68. The stud bolts 22 may be preattached to plates 44 or attached subsequent to mounting of said plates to the housing 16 between the baffles 36 and/or 38 and side walls 30 and 32 resting supported on ribs 68. Preferably the edges of the sidewalls 30 and 32 of the housing 16 are flush with the outer surface 50 of plates 44.

The respective pipes 12 and 14 are passed through perforations 46 and 48 respectively and hermetically sealed to the respective plates 44 and floor 28 of housings 16 and 16'. Then the thus completed subassembly, absent covers 17, 17' and washers 18, is copper brazed in an oven in accordance with well-known brazing techniques. In this way all the parts of the manifold heads 3 and 3' are sealably secured one to the other and to their respective internal and external pipes satisfying fully the most vigorous technical requirements of these articles and obviously, much more economically than where machining processes are required.

It is obvious that this method favors mass-production from a few preformed specified parts. The penetration of the copper to all joints comes about through capillary action during the brazing process as well known in the art. Because of the grooves and resulting support means formed on housings 16 and 16', there is no damagining.

I claim:

1. A method of manufacturing counterflow condenser of the fluid cooled type which include a pair of chambered manifold heads bridged by a plurality of external pipe pairs of concentrically arranged pipes defining a pair of independent fluid paths through the condenser, said method comprising the steps of:

(a) forming a pair of grooved perforate housings and a plurality of modular perforate and imperforate plate members configured to define when assembled within the housing a pair of hollow chambered manifold-head-sub-assemblies,
(b) arranging said plate members interior of said housings to form said manifold-head-sub-assemblies,
(c) arranging a plurality of concentrically arranged pipe pairs between said manifold-head-sub-assemblies and in communicating relation with the interior chambers thereof,
(d) permanently sealing said manifold-head-sub-as-
semsibles and pipe pair plurality together to form a sealed counterflow-condenser-sub-assembly, and (e) thereafter, applying a plurality of washers and cover plates to each sealed manifold-head-sub-assembly of said sealed counterflow-condenser-sub-assembly to complete the counterflow condenser.

2. The method as claimed in claim 1 in which the plurality of modular perforate and imperforate plate members are formed as baffle members and bridging members, and arranging said baffle and bridging members in a manner to space across the grooved housing so that the baffle members define the interior chambers and each chamber has one perforation of the housing opening thereinto and each bridging member covers one chamber with its perforation aligned with said one perforation.

3. The method as claimed in claim 2 in which fastening means are installed on the bridging members.

4. The method as claimed in claim 2 in which said grooved housing is formed by first forming a blank, dividing the blank into sections by impressing a series of groove pairs and a series of single grooves arranged in predetermined locations in one face thereof, thereby defining a matching series of rib pairs and ribs in the opposite face thereof bending said grooved blank to a U-shaped configuration with said one face defining the exterior surface of the housing.

5. The method as claimed in claim 4 in which selected ones of said baffle members are assembled to the housing by slidably engaging same within channels defined by said interior rib pairs.

6. The method as claimed in claim 5 in which said bridging members are assembled to said housing by seating them side by side and supported upon the said single ribs.

7. The method as claimed in claim 1 in which the sealing is performed by brazing in an oven.

8. The method as claimed in claim 1 in which each said manifold-head-sub-assembly is formed by forming a selectively perforated blank, impressing recesses in one face of the blank to divide same into sections equal in number to the number of external pipes of the condenser and thereby forming matching protrusions in the opposite face of the blank, forming the blank to a U-shaped configuration and thereby forming the housing and providing channel retainer means and support means interior of the said housing and defined by said protrusions, forming said modular plate members as baffle members and bridging members, installing selected ones of the perforate and non-perforate baffle members in said channel retainer means to define the interior chambers equal in number to said sections, covering the said so-defined chambers with perforate bridging members by seating same on said support means, thereafter completing the counterflow-condenser-sub-assembly by installing said external and internal pipes respectively to said housing and said bridging members to establish communication to and through said chambers respectively, and installing outwardly protruding fastener means to said bridging members to enable subsequent fastening of the washers and covers to the sealed counterflow-condenser-sub-assemblies.

9. The method as claimed in claim 8 in which the blank is perforated prior to formation thereof to the U-shaped configuration.

10. The method as claimed in claim 1 in which each manifold-head-sub-assembly is formed by forming a blank, dividing the blank into sections equal in number to the number of external pipes of the condenser by pressing said blank against a suitable die to obtain in one face thereof parallel groove-pairs arranged parallel one to the other and spaced to divide the blank into said sections and single grooves adjacent the lateral edges of the blank but spaced therefrom, the single grooves being normal to said groove pairs and parallel one to the other, and thereby forming matched protrusions on the opposite face of the blank corresponding to said groove pairs and grooves, forming the blank to a U-shaped configuration thereby forming the housing and providing retainer-like channel means and support means interior thereof and defined by the said protrusions, perforating the formed blank at selected locations so as to provide passage for said internal and external pipes, preforming said modular plate members as perforate and imperforate baffle members and bridging members, installing selected ones of said baffle members in said channel means crossways thereof to define the interior chambers, in number equal to the number of sections, covering each of said chambers with perforate bridging members by seating same in edge-to-edge relation on said support means thereby completing said manifold-head-sub-assemblies, installing said external and internal pipes respectively to and through said housing and said bridging means to establish communication to and through said chambers respectively, and thereafter installing outwardly protruding fastener means to said bridging members to enable subsequent fastening of the washers and covers to the manifold-head-sub-assemblies of the sealed counterflow-condenser-sub-assembly.

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