March 2, 1971 P. PASQUALINI 3,566,502

METHOD OF MAKING COUNTERFLOW FLUID CONDENSERS

Filed Feb. 23, 1968 2 Sheets-Sheet 1

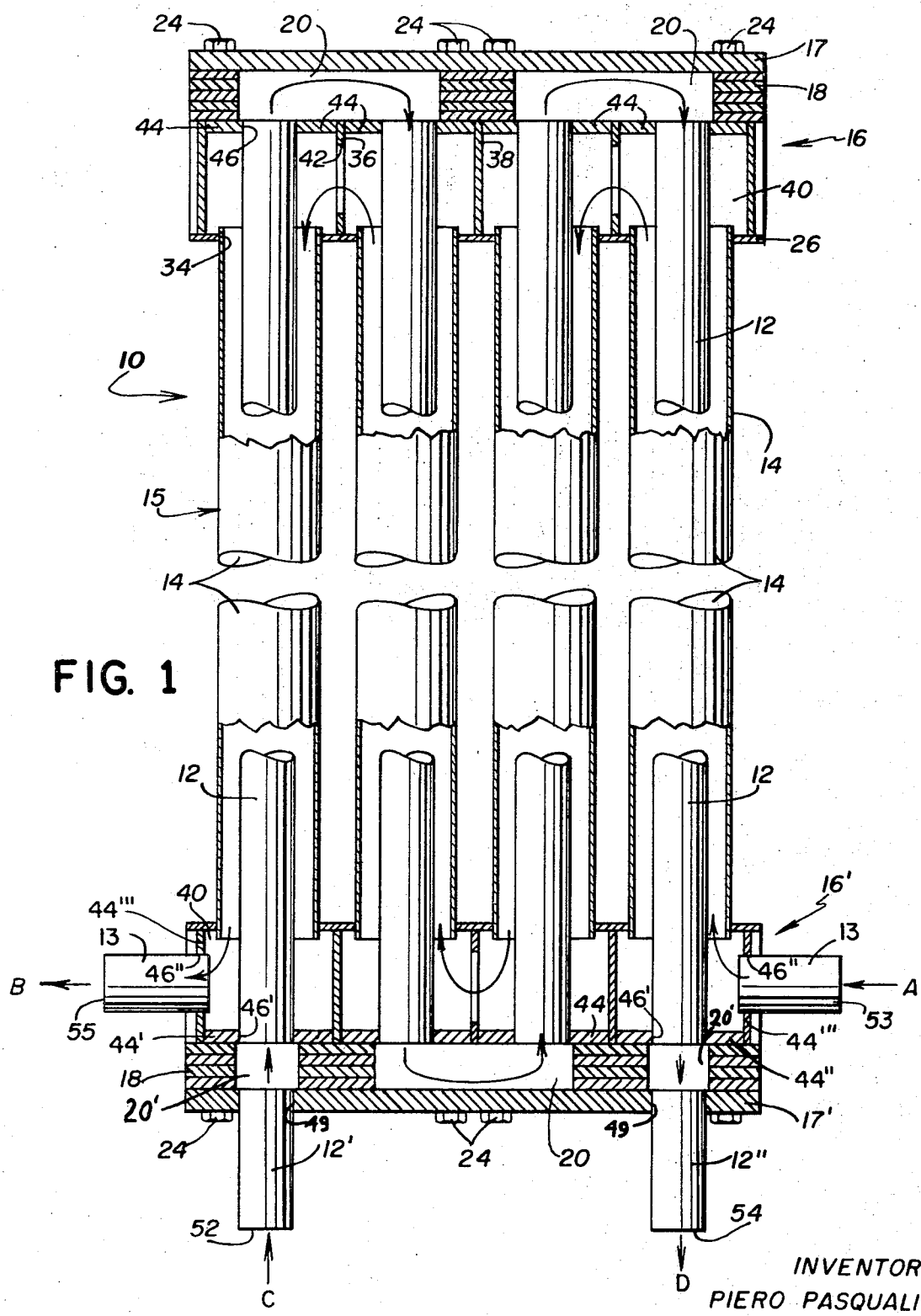


FIG. 1

INVENTOR
PIERO PASQUALINI.

BY Silverman & Cass

ATTYS.

March 2, 1971 P. PASQUALINI 3,566,502

METHOD OF MAKING COUNTERFLOW FLUID CONDENSERS

Filed Feb. 23, 1968 2 Sheets-Sheet 2

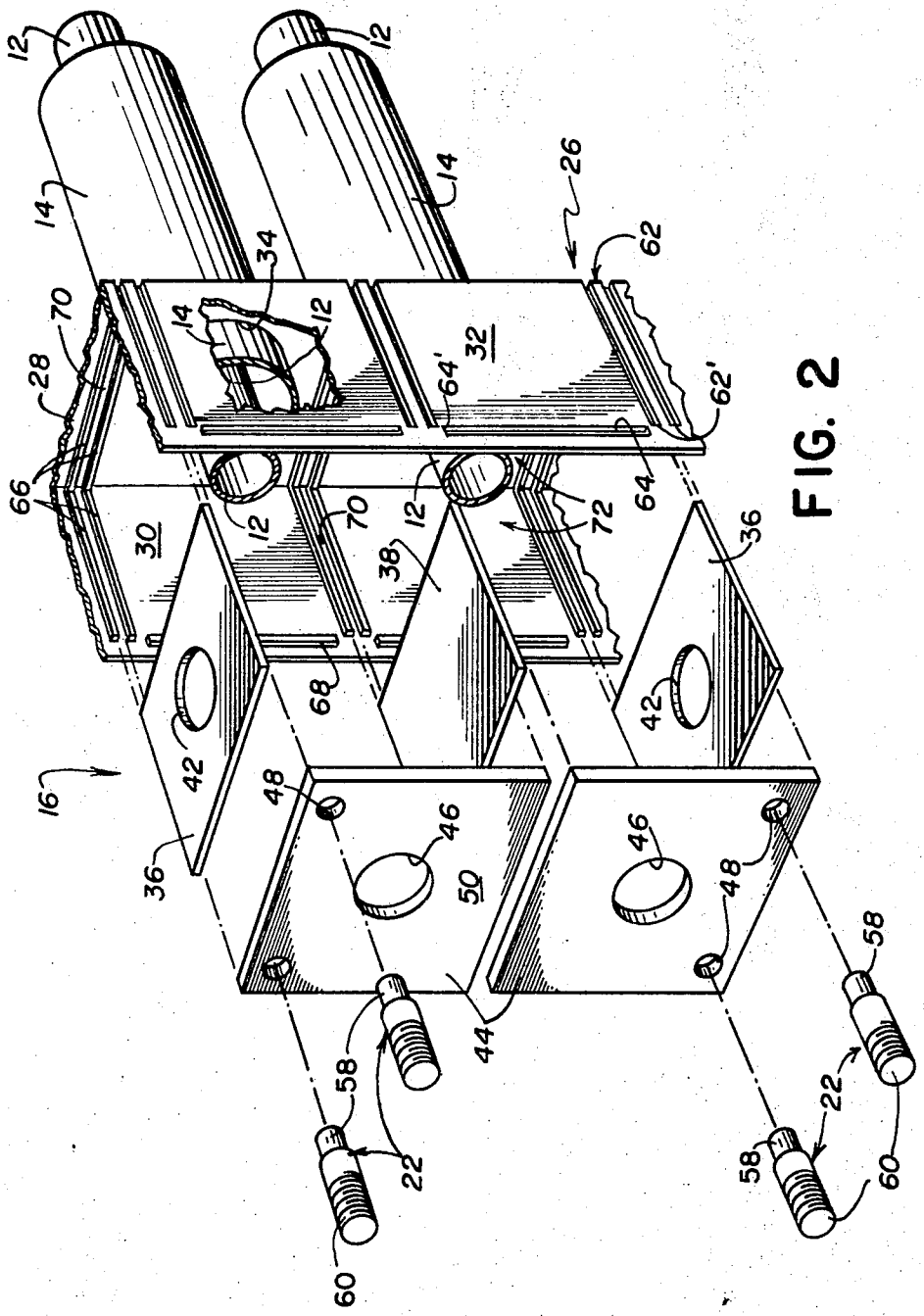


FIG. 2

INVENTOR
PIERO PASQUALINI
BY Silverman & Cass
ATTYS.

United States Patent Office 3,566,502 Patented Mar. 2, 1971

3,566,502

METHOD OF MAKING COUNTERFLOW FLUID CONDENSERS

Piero Pasqualini, Via Antonini 26, Milan, Italy

Filed Feb. 23, 1968, Ser. No. 707,587
Claims priority, application Italy, Mar. 4, 1967, 13,351/67
Int. Cl. B21d *53/02;* B21k *29/00*
U.S. Cl. 29—157.3 10 Claims

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 thereon 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 thereafter copper-brazing the thus constructed subassembly in an oven and thereafter applying and securing suitable washers and covers to opposite manifold heads thereafter 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 manufacturing 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 condensers which includes the steps of forming a pair of manifold head 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 the completed 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, beign 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 baffles 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, arranging said parts to a subassembly, permanently sealing the subassembly together as by brazing in the case of sheet metal and thereafter 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

affixed to the manifold heads **16** and **16'** by fastening means comprising stud bolts **22** and nuts **24**.

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 perforation **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**, the floor of each having one of the perforation **34** formed therein. Of the cross-baffles **36** and **38**, baffle **36** has a central perforation **42** while baffle **38** is imperforate. Where communication between chambers or to the chambers is desired, baffles **36** 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 chamber **40** as will be described hereinafter.

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 one in each of the plates **44** and of a size and configuration to receive tightly therethrough 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 **20** in the washers communicate to pipes **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 as means 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 impresed 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 parallel transverse groove pairs **62**, said grooves **64** being located 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 with or subsequent to the formation of grooves **62** and **64** and, also, may be formed subsequent to the bending of the blank to form the housing. In fact, the order of forming the performations **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 **34** 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 damaging distortion during soldering processes as may be expected in prior art methods of making these articles. It also should be understood that while the method and article herein disclosed utilize sheet metal, the invention is applicable to other materials, even suitable plastics and plastic molding joining techniques.

I claim:

1. A method of manufacturing counterflow condensers 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-

semblies 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 same 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.

References Cited

UNITED STATES PATENTS

1,930,879	10/1933	Linderoth et al.	165—70
2,804,283	8/1957	Ruszkowski et al.	165—158X
2,825,463	3/1958	Thomas	210—176
2,095,266	10/1937	Prickett et al.	29—469X

JOHN F. CAMPBELL, Primary Examiner

D. C. REILEY, Assistant Examiner

U.S. Cl. X.R.

29—469; 113—118