

May 27, 1952

M. P. PENN

2,598,191

METHOD OF MAKING FIN ELEMENTS

Filed Oct. 22, 1948

2 SHEETS—SHEET 1

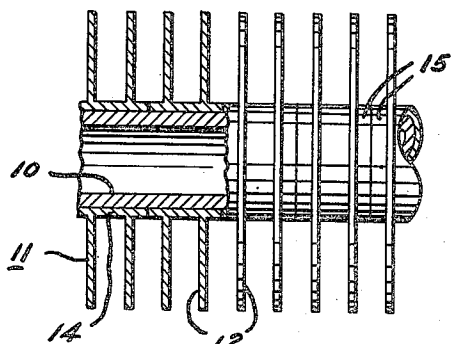


Fig. 1

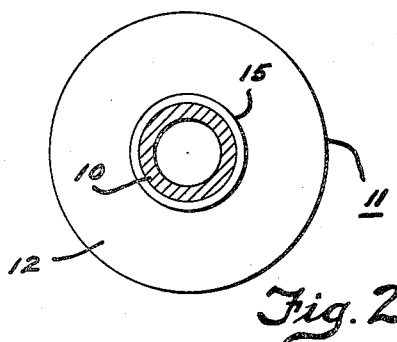


Fig. 2

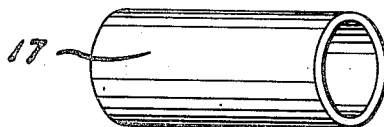


Fig. 3

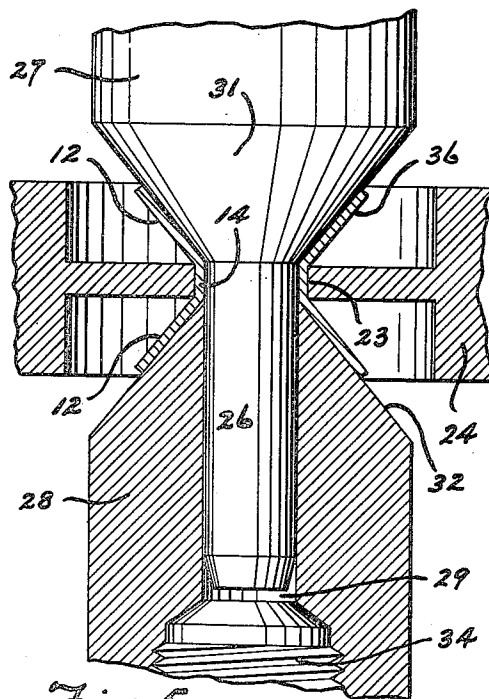
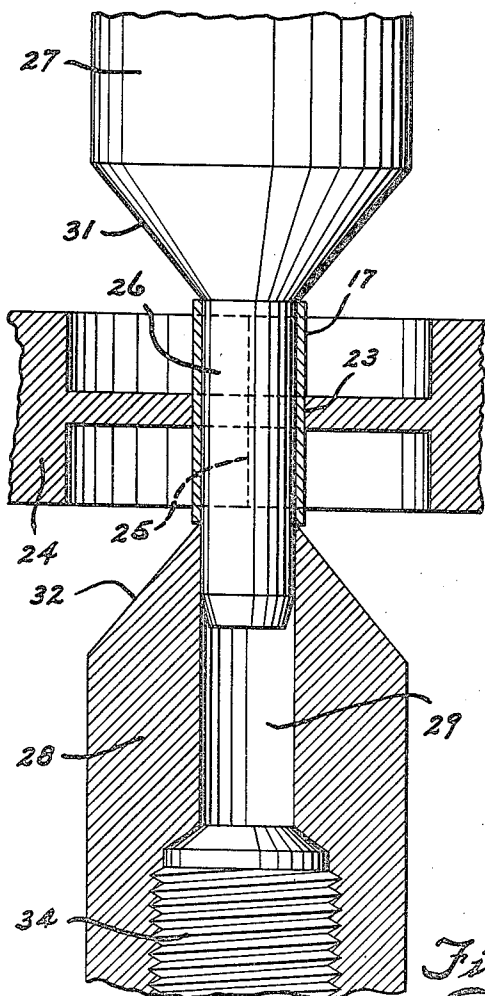


Fig. 5

INVENTOR.

MELVIN P. PENN.

BY

Fig. 4 Spencer, Hardman & Fehr.
HIS ATTORNEYS.

May 27, 1952

M. P. PENN

2,598,191

METHOD OF MAKING FIN ELEMENTS

Filed Oct. 22, 1948

2 SHEETS—SHEET 2

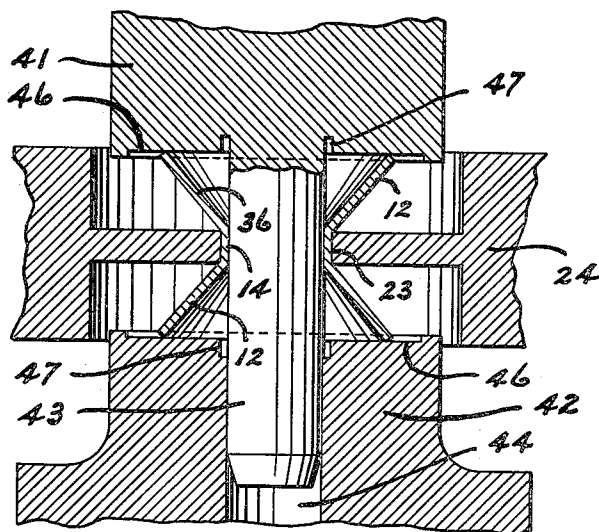


Fig. 6

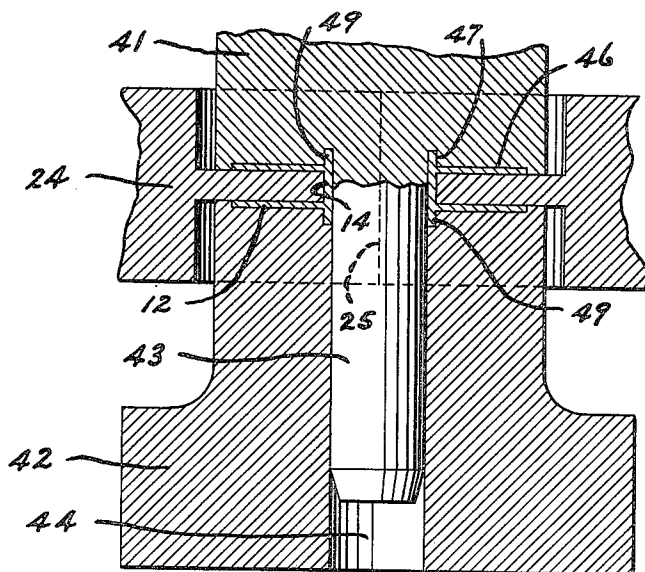


Fig. 7

INVENTOR.

MELVIN P. PENN.

BY

Spencer, Hardman & Feltz.
HIS ATTORNEYS.

UNITED STATES PATENT OFFICE

2,598,191

METHOD OF MAKING FIN ELEMENTS

Melvin P. Penn, Dayton, Ohio, assignor to General Motors Corporation, Dayton, Ohio, a corporation of Delaware

Application October 22, 1948, Serial No. 55,882

1 Claim. (Cl. 29—157.3)

1

2

This invention relates to refrigeration and particularly to heat exchange elements employed in refrigerating systems.

An object of my invention is to provide an improved, more efficient and lower cost heat transfer device or heat exchanger.

Another object of my invention is to provide an improved fin element adapted to be mounted on a fluid conduit of a heat exchanger and an improved method of fabricating the fin.

A still further object of my invention is to provide an improved method of making a fin element from malleable metal tubes each of which elements is provided with spaced apart radial fin portions, a collar portion and short tubular end portions forming continuations of the collar portion thereof and extending beyond one side of the fin portions.

A more specific object of my invention is to provide a method of making a fin element by flaring end portions of a metallic tube to form a hollow spool member and then deforming the spool member to provide a means for spacing one element from another when the elements are mounted on a conduit of a heat exchanger.

Further advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein a preferred form of the present invention is clearly shown.

In the drawings:

Fig. 1 is a side view partly in section and partly in elevation of a portion of a fluid conducting conduit of a heat exchanger having fin elements constructed in accordance with the present invention thereon;

Fig. 2 is an end view of the device shown in Fig. 1;

Fig. 3 is a view of a tubular piece of malleable metal from which the fin elements on the heat exchanger conduit shown in Figs. 1 and 2 are fabricated;

Fig. 4 is a view partly in section and partly in elevation showing forming members in contact with the tube and ready to perform one step in the method of making fin elements of the present invention;

Fig. 5 is a view similar to Fig. 4 and shows the forming members moved to complete the first step in the method of making the fin elements;

Fig. 6 is a sectional view of other forming members showing a further step in the present method; and

Fig. 7 is a view similar to Fig. 6 showing move-

ment of the forming members in completing the method of providing the finished fin elements.

Referring to the drawings, for illustrating my invention, I have shown in Fig. 1 thereof a portion of a metal conduit 10 of a heat transfer device or heat exchanger such, for example, as a condenser or evaporator employed in refrigerating and the like systems. Conduit 10 has a plurality of fin elements 11 mounted thereon for increasing the heat transfer surface thereof. The fin elements 11 may be formed of any suitable metal and are, as hereinafter described, fabricated from aluminum tubes while the conduit may be formed of any suitable metal such as copper or steel. Fin elements 11 may be secured in intimate thermal contact with the outer surface of conduit 10 in any suitable manner as is conventional in the art. Each element 11 has a pair of spaced apart circular fin portions 12 formed integral with and extending radially from a collar portion 14. Each element 11 also has short tubular extensions 15 concentric with and forming continuations of the collar portion 14 at the side of each fin portion 12. The extensions 15 on the one side of fin element 11, opposite the sides thereon joined to or integral with the collar portion 14, serve to space the fin portions 12 of the elements the proper or equal distance apart when a plurality of the elements 11 are placed adjacent one another on the conduit 10. These short extending tubular portions 15 are of utmost importance since they eliminate the use of expensive rake or rack like tools or dies for spacing fin elements on a conduit prior to or at the time the fin elements are secured thereto. The fin elements 11 may be secured to the conduit 10 by brazing the same thereto, expanding the wall of conduit 10 outwardly against the collar portion 14 of the elements or in any other well-known and conventional manner. Ordinarily a completed heat exchanger will include a plurality of lengths of finned tubing or conduit of the type shown in Fig. 1 either connected in series or in parallel.

I have illustrated, in the presently disclosed method of fabricating fin elements, only those parts of the mechanisms or machines which act directly upon the elements for the sake of simplicity and since the manner of causing movement and operation of parts of such machines is well-known to those skilled in the art. In Fig. 3 of the drawings I show a tube 17 of malleable metal, such, for example, as copper or aluminum capable of being rolled out without cracking or breaking and/or of flowing under pressure.

3

Due to the high heat conducting and malleability properties of aluminum or aluminum alloys I employ a tube 17 of aluminum metal which is adapted to be deformed by my method to provide one of the tubular fin elements 11 shown in Fig. 1. Tube 17 is preferably of substantially pure aluminum known to the trade as commercial aluminum and consisting of 0.2% copper, 1.0% iron and silicon, .05% manganese, .10% zinc, .05% each of other alloys and the remainder pure aluminum.

Prior to starting the fabricating method a portion of the outer wall surface of tube 17 along the center thereof is confined by walls of a hole or opening 23 provided in a plate 24. Plate 24 is composed of two half parts disposed in end-to-end relationship with their ends abutting one another at the line indicated by the reference character 25 (see Figs. 4 and 7). Each half part of plate 24 has a circular notch cut inwardly from their abutting ends extending throughout an arc of 180°. Thus when the half parts of plate 24 are brought into end-to-end engagement the notches form walls of the opening or round hole 23. The half parts of plate 24 are bolted or otherwise suitably clamped together with walls of hole 23 tightly engaging tube 17 and thereafter a plunger 26, formed on a round movable forming member 27, is inserted into the opening of the tube. In this manner both the inner and outer wall surfaces of tube 17 along a portion thereof centrally of its ends are confined. After confining these wall surfaces of tube 17, by plate 24 and plunger 26, the tube is ready to be deformed. Before describing the operation of deforming tube 17 it is desired to point out that a second or lower movable forming member 28 is also associated with the tube and that this member 28 has a hole 29 therein for the reception of plunger 26. Member 27 has a conical surface 31 intermediate the enlarged portion thereof and the plunger portion 26. Member 28 is also provided with a conical surface 32 at its upper end. The smaller end portions of the conical surfaces 31 and 32 engage end portions of the inner wall of tube 17.

Movement of members 27 and 28 toward one another and toward plate 24 causes the conical surfaces 31 and 32 thereon to be forced into tube 17 and the walls adjacent the ends of the tube are flared outwardly relative to the confined central wall portion thereof. Both members 27 and 28 have a shaft 34 attached thereto and secured to a pressing device, air cylinders or any other suitable means for moving the members 27 and 28 in a direction toward one another. If desired the forming members 27 and 28 may also be rotated simultaneously with their movement toward one another. Thus when the members 27 and 28 are moved toward one another to apply pressure to both ends of the tube, the end portions thereof are progressively moved or flared outwardly as indicated by the final position of the forming members 27 and 28 illustrated in Fig. 5 of the drawings. It will be noted by reference to Fig. 5 that the plunger 26 on member 27 has moved into the hole 29 in member 28 and that the tube 17 has, by virtue of its being centrally confined and by having its ends flared outwardly, been formed into a hollow spool-like member 36 including the collar portion 14 and the two spaced apart fin portions 12. After this step in the method has been completed the movable members 27 and 28 are separated and the plunger 26 withdrawn from the member 28 and moved outwardly of the spool member or element 36. The

4

members 27 and 28 are then moved out of vertical alignment with the spool member 36 and other forming or die members moved into vertical alignment therewith.

Two opposed round die or forming members 41 and 42 (see Fig. 6) are moved into engagement with the ends of the flared fin portions 12 of spool member 36. The upper die member 41 is movable toward the lower member 42 and has a plunger 43 depending therefrom. Plunger 43 is moved into the collar portion 14 of member 36, so as to take the place of plunger 26 in confining the inner wall surface of the collar, and extends into a hole 44 provided in the die member 42. The plunger 43 maintains the dies 41 and 42 in vertical alignment with one another while again confining the inner wall surface of collar portion 14 of the member 36. Die member 42 may be stationarily mounted. The outer wall surface of collar 14 is still confined by walls of the opening 23 in plate 24. Any suitable press or the like may be employed for moving die member 41 toward the stationary die member 42. Each die member 41 and 42 is provided with a large shallow circular counterbore 46 and an inner smaller but deeper counterbore 47 concentric with bore 46 for a purpose to now be described. As member 41 is moved downwardly from its position shown in Fig. 6 both counterbored surfaces 46 of members 41 and 42 engage the edges or ends of the outwardly flared portions 12 of spool shaped element or member 36 and force the portions 12 to move in a further outward direction until they are substantially perpendicular to the axis of the collar portion 14 of member 36. Continued downward movement of member 41 to the position thereof shown in Fig. 7 of the drawings brings the face portions of the die members 41 and 42, outwardly of the counterbores 46, into close relationship to the upper and lower surface of plate 24. In this position the forming dies 41 and 42 confine substantially all portions of member 36 except the portions adjacent the deep counterbores 47. It is to be understood that the depth of the counterbores 46 is less than the wall thickness of portions 12 of member 36 so that when the die members 41 and 42 are forced into the position illustrated in Fig. 7, with their face portions tightly engaging the plate 24, force applied to the member 36 and particularly the fin portions 12 thereof compresses the portions 12 and this compression causes the metal thereof to flow into the counterbores or cavities 47. Flow of a part of the material of fin portions 12 of element 36 into the cavities created by the counterbores 47 forms the tubular end portions 49 (see Fig. 7) concentric with and forming continuations of the collar portion 14 of the fin element. These portions 49 extend a short distance beyond one side of the fin portions 12 of element 11 and provide on each element means for spacing adjacent fin portions 12 of the separate elements 11 a desired distance apart when the elements are strung or mounted on conduit 10. To remove the double fin element 11 from the machine or press, die members 41 and 42 are moved outwardly away from one another and thereafter the two parts of plate 24 are separated from one another on the line indicated by the reference character 25. Another tube 17 may then be placed in the machine or press, confined and deformed as described.

From the foregoing it should be apparent that I have, in addition to providing an improved fin element for use on conduits of heat exchangers,

5

also provided a novel method of making or fabricating the fin. By deforming a short length of malleable metal tubing and utilizing all the material thereof for essential portions of a fin element I reduce waste to a minimum and eliminate the necessity of performing further steps to provide the finished element. My invention permits the production of many fin elements in a short period of time and thus reduces the cost of finning a conduit to thereby lower the manufacturing cost of a heat exchanger or heat transfer device.

While the form of embodiment of the invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adapted, as may come within the scope of the claims which follow.

What is claimed is as follows:

The method of making fin elements adapted to be mounted on a conduit of a heat exchanger which consists in, confining the inner and outer wall surfaces of a malleable metal tube along a part centrally of the ends thereof, flaring the ends of the tube beyond said confined surfaces outwardly to form the same into a hollow substantially spool-shaped member having an intermediate collar portion and conical end portions, and then in a single die set performing the operations of moving said conical end portions of said member into perpendicular relationship to the axis of said collar portion while still confining said wall surfaces to form a pair of axially spaced apart radially extending fins, confining at least a part of the edges of said fins to restrict radial outward flow of the material thereof and simul-

6

taneously confining all wall portions of said member except those at the base of said fins on the sides thereof opposite the sides joined to said collar portion, and applying pressure to said member to cause the material thereof to flow at said unconfined portions axially relative to and concentric with said collar portion to form a short axial extension thereof beyond each fin.

MELVIN P. PENN.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
736,551	Roemer	Aug. 18, 1903
1,046,138	Babbitt et al.	Dec. 3, 1912
1,297,141	Gibbons	Mar. 11, 1919
1,420,970	Cornell, Jr.	June 27, 1922
1,521,864	Broido	Jan. 6, 1925
1,791,887	Davis et al.	Feb. 10, 1931
1,922,351	Brown	Aug. 15, 1933
2,070,539	Muhleisen	Feb. 9, 1937

FOREIGN PATENTS

Number	Country	Date
733	Switzerland	Mar. 15, 1889
19,886	Great Britain	Sept. 6, 1906
294,687	Great Britain	July 30, 1928
343,398	Germany	Nov. 1, 1921
399,995	Great Britain	Oct. 19, 1933
502,579	Great Britain	Mar. 21, 1939
593,824	Great Britain	Oct. 27, 1947