

Aug. 27, 1935.

E. S. CORNELL, JR

2,012,269

FIN TUBE STRUCTURE

Filed Nov. 29, 1932

4 Sheets-Sheet 1

Fig. 1.

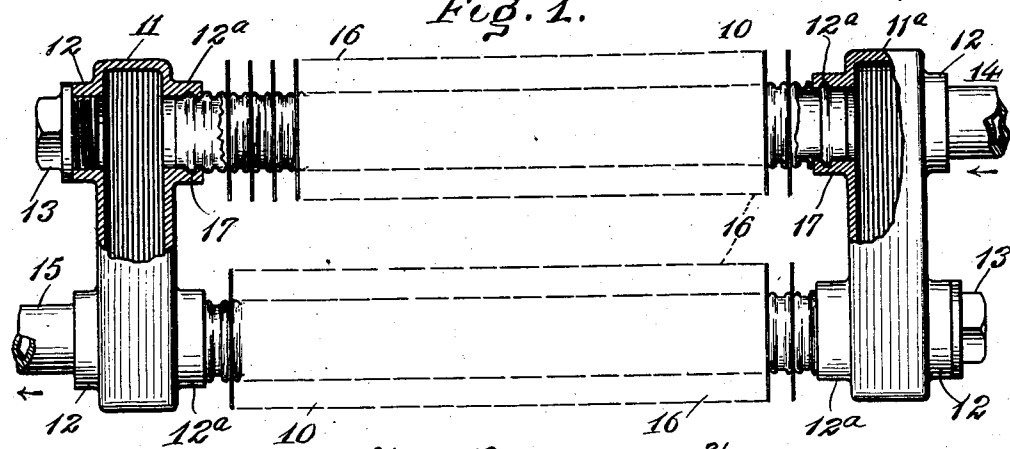


Fig. 2.

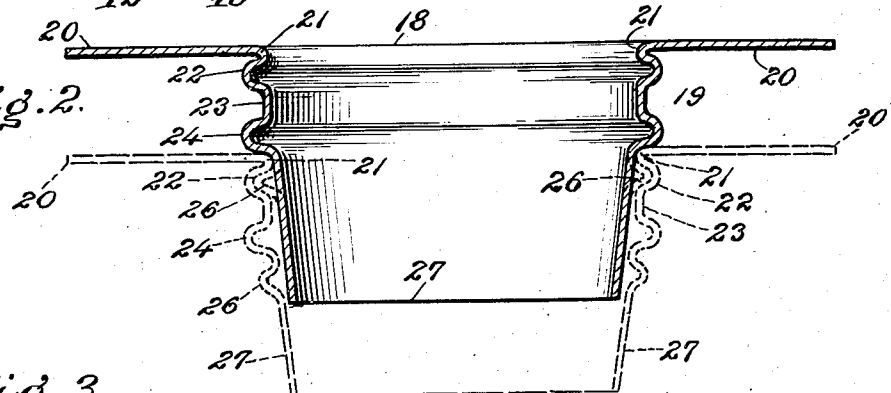
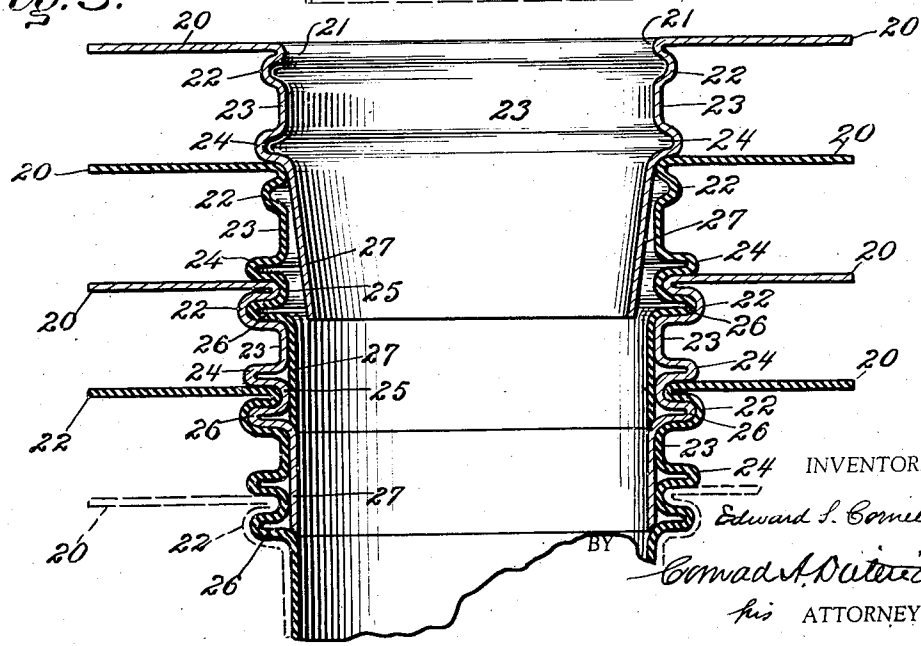


Fig. 3.



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Aug. 27, 1935.

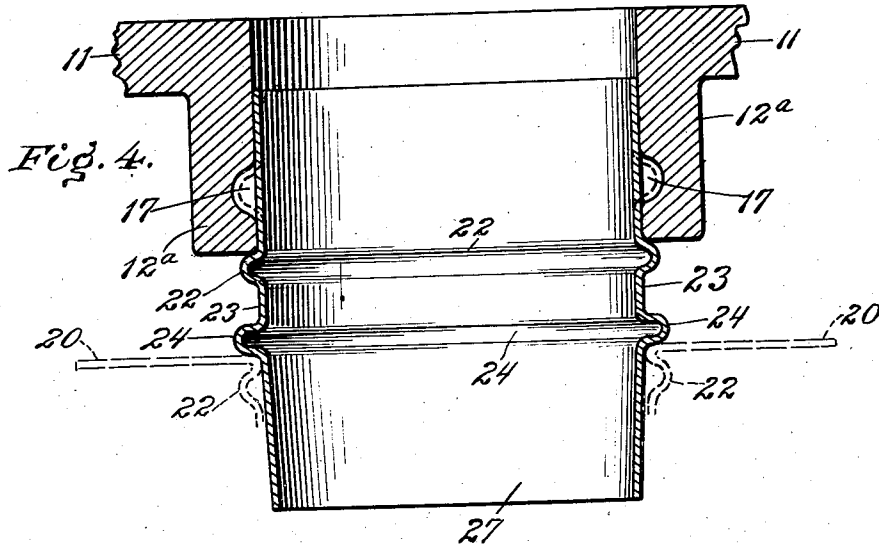
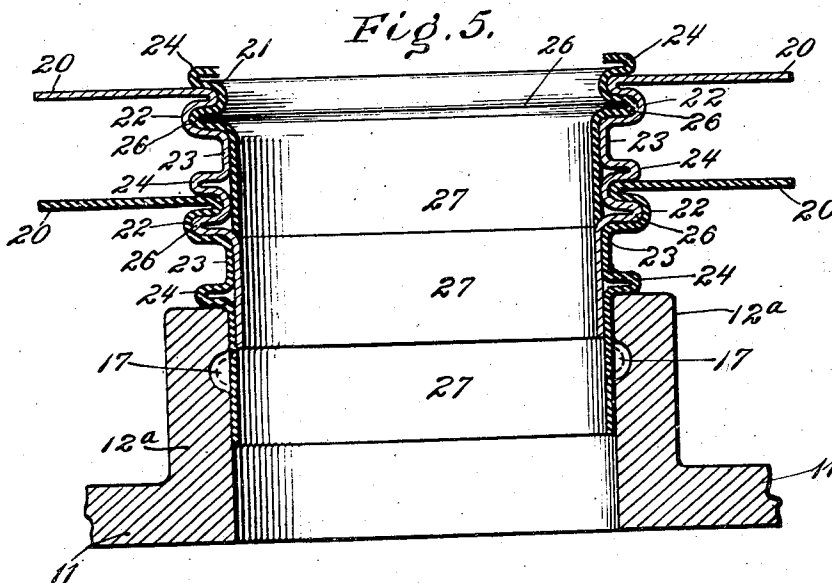
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4 Sheets-Sheet 2



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Fig. 6.

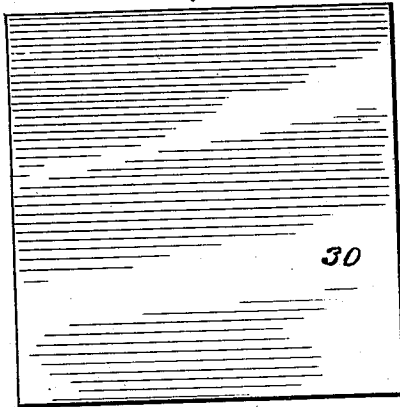


Fig. 7.

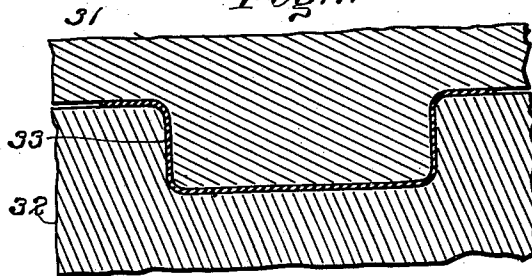


Fig. 9.

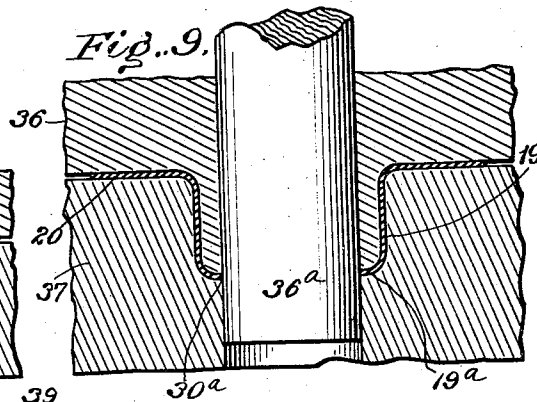


Fig. 8.

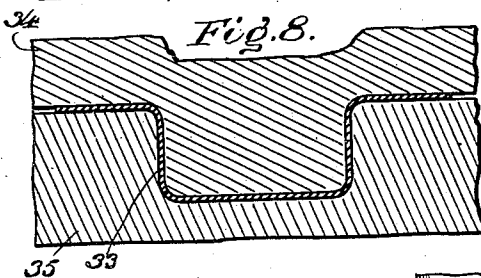


Fig. 10.

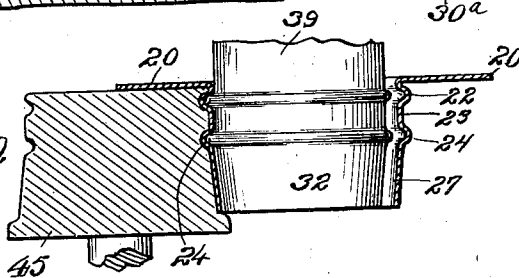
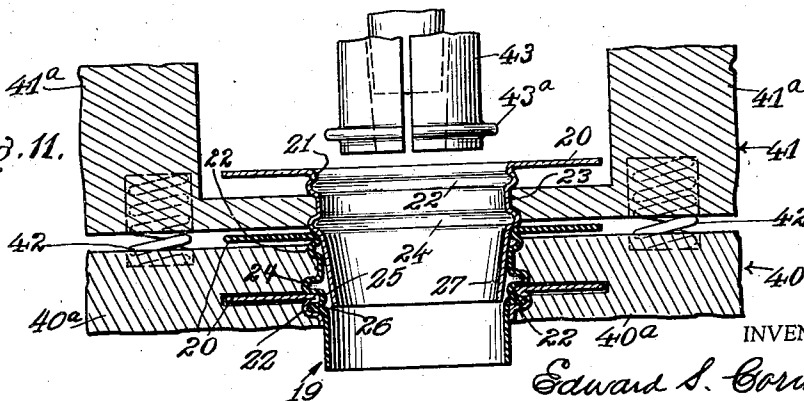


Fig. 11.



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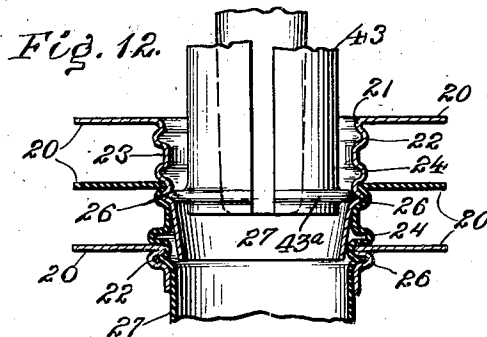
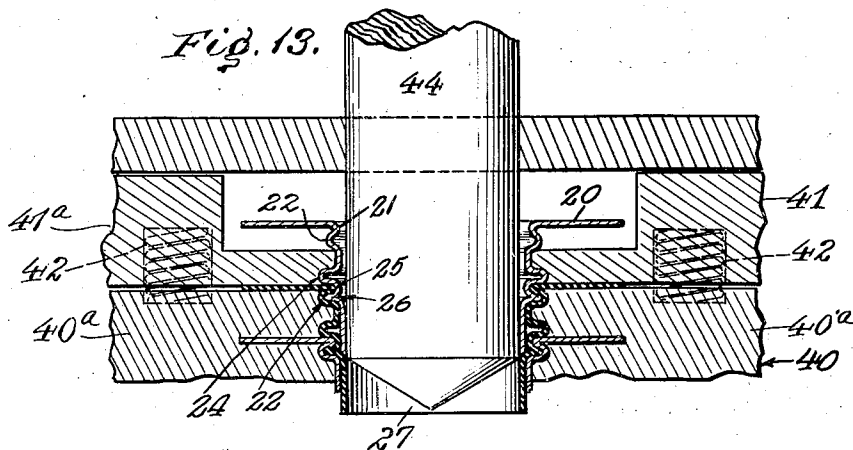
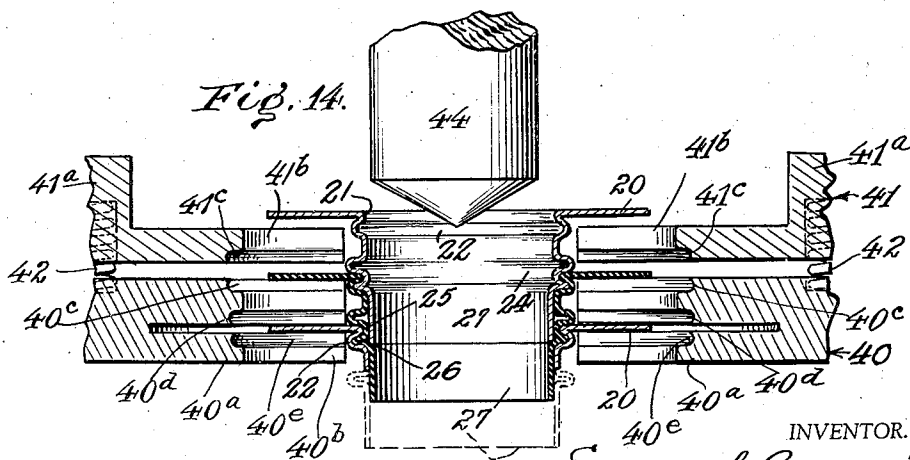
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FIN TUBE STRUCTURE

Filed Nov. 29, 1932

4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE

2,012,269

FIN TUBE STRUCTURE

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Application November 29, 1932, Serial No. 644,786

21 Claims. (Cl. 257—263)

My invention relates to improvements in heat exchange apparatus, and the same has for its object more particularly to provide an extended surface element or structure which is simple in construction, efficient in operation, and easy and inexpensive to produce.

Further, said invention has for its object to provide an extended surface or finned tube element for use as a component part of radiators for house heating purposes, of radiators for cooling systems for motor vehicles, as a refrigerating unit for mechanical refrigerators, and for other purposes.

Further, said invention has for its object to provide an extended surface or finned tube structure of the character specified in which a series of similarly shaped elements are united in the form of a double-walled construction whose outer wall portions are provided with extended surface members, and whose inner wall portions meet in substantially end to end relation to form a smooth unbroken wall surface for the tube structure as a whole, and serve to reinforce the same.

Further, said invention has for its object to provide an element of the character specified in which a plurality of interengaging sections are secured together in fluid-tight relation, without generally requiring a separate medium, to form an elongated tube provided at intervals with extended surface members or fins.

Further, said invention has for its object to provide an element of the character specified in which the inner edges of the extended surface members or fins are firmly secured in a relatively large mass of metal constituting part of the tubular member of a cooperating contiguous element.

Further, said invention has for its object to provide an element of the character specified, formed of sheet metal in which the inner edge of its extended surface member and the adjoining portion of the wall of its tubular member are firmly clamped in good heat conducting relation between a pair of annular ribs or flanges extending laterally-outwardly from the wall of the tubular member of a contiguous element.

Further, said invention has for its object to provide a finned tube structure whose outer wall includes an annularly corrugated or folded portion, having fins between certain of said corrugations or folded portions, and whose inner wall consists of a series of registering cylindrical portions arranged in end to end relation with the cylindrical portion of one element completely

covering the inner ends of the corrugations and folds of a contiguous element, and forming a substantially smooth, unbroken wall of the tube structure as a whole.

Further, said invention has for its object to provide a finned tube structure composed of a series of interengaging elements in which the tubular member of each element is transversely corrugated to form a series of relatively-narrow cylindrical wall portions, and annular ribs or flanges extending outwardly therefrom at substantially right angles to the longitudinal axis of its tubular member between certain of which is secured the finned end or portion of a contiguous element.

Further, said invention has for its object to provide a finned tube structure in which portions of the cylindrical wall of the tubular member are formed of a single thickness of sheet metal, and the annular, laterally-disposed ribs or flanges extending therefrom, which are adapted to embrace the cooperating fins and parts of contiguous elements, comprise double thicknesses of the metal in order to reinforce the tube structure as a whole, and to form fluid-tight joints between the several cooperating parts thereof.

Other objects will, in part, be obvious and, in part, be pointed out hereinafter.

To the attainment of the aforesaid objects and ends, my invention consists in the novel features of construction, and in the combination, connection and arrangement of parts hereinafter more fully described, and then pointed out in the claims.

In the accompanying drawings—

Figure 1 is a side elevation showing a radiator incorporating one form of fin tube constructed according to, and embodying my said invention;

Fig. 2 is an enlarged detail central section of one of the tubular elements forming a constituent part of a fin tube;

Fig. 3 is a similar view showing a number of connected tubular elements to form a fin tube;

Fig. 4 is an enlarged detail central section of an end member or ferrule for securing one end of a tube to a header;

Fig. 5 is a similar view showing the manner of securing the opposite end of a tube to its respective header;

Fig. 6 is a face view showing a metal disk from which a tubular element is formed;

Fig. 7 is a central section showing a pair of dies showing the form of the blank resulting from the first drawing operation;

Fig. 8 is a similar view showing the form of the blank resulting from the second drawing operation;

Fig. 9 is a similar view showing the form of blank resulting from the third drawing operation, and the bottom of the blank pierced;

Fig. 10 is a partial central vertical section, showing male and female rolls for transversely corrugating the wall of the produced blank and tapering the end thereof;

Fig. 11 is a central section showing a pair of dies and two tubular elements or blanks in position ready for the first assembling operation;

Fig. 12 is a view similar to Fig. 10 showing the expanding tool forming the bead upon the upper or inner element and pressing the same into engagement with the inner side of its registering corrugation of the lower or outer element;

Fig. 13 is a similar view showing the dies having compressed the several corrugations of contiguous elements to duly unite the same, and the mandrel having straightened and swedged the tapering end of the upper or inner element against the inner side or wall of the lower or outer element, and

Fig. 14 is a similar view showing the dies separated horizontally to release the connected tubular elements, and the swedging mandrel retracted.

In said drawings, referring more particularly to Fig. 1, 10 designates a radiator for heat exchange purposes. In said illustration the radiator is shown as comprising two hollow cast metal headers 11, 11^a provided upon their outer and inner sides, respectively, with bosses 12, 12^a. The bosses 12 upon the outer side of each header are threaded to receive screw plugs 13, and the ends of supply and return pipes 14, 15, communicating respectively with a source of heating fluid. The bosses 12^a upon the inner sides of said headers are designed to receive and hold the ends of the fin tubes 16 which may be secured thereto by any suitable or convenient means. In the present instance, and for the purposes of illustration only, the inner surfaces of the bosses 12^a are provided with annular grooves 17 into which the tubular ends of the fin tubes 16 are expanded by an expanding tool which may be introduced into the headers 11, 11^a through the bosses 12 upon the outer sides of the headers and which are thereafter sealed by the plugs 13.

Each fin tube 16 consists of a plurality of elements 18, shown at Fig. 2, connected together to form the unitary structure 16 shown at Fig. 1, and as an enlarged detail, at Fig. 3. Each element 18 includes a tubular portion 19, and a flat, circular flange portion 20 extending laterally from one end of said tubular portion 19. The tubular portion 19, before the element is connected to the remaining or contiguous elements constituting the tube, is provided with a series of inwardly and outwardly extending corrugations and folds, 21, 22, 23, 24, and terminates at its free end in an inwardly tapering or reduced end 27 to facilitate the fitting thereof into the flanged end of a contiguous element. When the tubular portion 19 of one element is fully secured to its next contiguous element the reduced tapering end 27, which has then been expanded against the inner side or wall of said contiguous element, will form an apron whose lower end will be substantially in engagement with the upper portion or end of the apron 27 of said contiguous element, and form therewith a substantially smooth, unbroken inner wall completely enclosing or covering the corrugated portions of said tubular elements, and serving

to reinforce interiorly the tube 16 as a whole.

In forming the tubular element 18 a sheet of metal 30 of copper or other suitable material, as shown at Fig. 6 is subjected to the action of a set of dies 31, 32, as illustrated at Fig. 7, and a shallow central depression 33 formed. The thus shaped blank is then subjected to the action of a similar second set of dies 34, 35, and the central depression 33 of the blank deepened, as shown at Fig. 8. The deepened blank is then subjected to a third set of dies 36, 37, and the central depression in the blank still further deepened and the bottom 38^a punched out by the punch portion 38^a, as shown at Fig. 9, producing a blank of the form shown in central section at said Fig. 9 in which the flange 20, and tubular portion 19 are smooth with the free end of the tubular portion 19 provided with a short inwardly extending flange 19^a.

The blank as thus developed is next subjected to the action of suitable dies or rolls, such as 39, 45, illustrated at Fig. 10, and the outwardly extending annular beads or corrugations 22 and 24 formed thereon, and the inwardly-extending flange, at the lower or free end of the tubular portion 19, tapered inwardly at 27. By preference the corrugation 24 is made somewhat deeper than the corrugations 22, and said corrugations are spaced apart by an intermediate portion 23, and the corrugation 22 separated from the lateral flange 20 by a narrow rounded corrugation 21. The corrugation 24 is united directly with the upper end of the downwardly and inwardly tapering end 27 of the tubular portion 19, as shown at Fig. 2.

Hereupon the blank illustrated at Fig. 2 is secured within the expansible and contractible members 40^a of a lower die 40 with the corrugations 22 and 24 of the blank disposed respectively in the grooves 40^c and 40^d (Fig. 14) formed on the inner face 40^b of said die 40. Said die members 40^a are also provided with grooves 40^e adapted to receive the corrugation 22 of the lowermost blank,—two blanks, as shown at Fig. 11, having been previously connected together. A third blank is now inserted between the cooperating two-part members 41^a of an upper die 41, which said two dies 40 and 41 are normally maintained in separated relation vertically by the springs 42. The members 41^a are contractible to grip the upper blank, and the inner side 41^b thereof conforms to the contour of the corrugations 23 and 24 of the blank, a groove 41^c (Fig. 14) receiving the corrugation 24.

When the several blanks are clamped in position as shown in Fig. 11, an expanding die 43 having a bead 43^a at its lower end is lowered into the assembled blanks, and the wall of the tubular portion 19 of the upper blank adjacent the upper end of the tapering portion 27 forced outwardly to form the annular corrugation 26, and pressed into intimate contact with the inner side of the annular corrugation 22 of the intermediate blank, as shown at Fig. 11. This operation serves to shorten the length of the tapering portion 27 of the upper blank and bring the lower edge thereof into engagement with the upper end of the tapering portion of the lower blank. By now bringing the dies 40, 41 fully together as shown at Fig. 13, the interlocking corrugations 21 and 25 will be doubled or flattened, and the corrugation 24 of the upper blank and the interlocking corrugations 22 and 26 will be likewise flattened and brought into engagement with opposite sides of the contiguous flange 20 of the intermediate blank. Whereupon a mandrel 44 is forced into

the assembled blanks, and the end of said tapering portion 27 of the upper blank swedged outwardly against the inner side or wall of the lower blank, as shown at Fig. 13 thereby bringing the inner sides of said tapering portions 27 into alignment and into close contact with the inner sides of the lower or outer blank to form a substantially smooth, unbroken inner wall for the tube structure as a whole.

The dies 40, 41 are then opened, as shown at Fig. 14, the assembled blanks released and advanced one step, whereupon the operation above described is repeated until a sufficient number of tubular elements have been assembled to form a tube 16 of the desired length.

It is to be noted that the tubular flanges 19, as well as the fins 20 may be of any desired shape and size, and that the fins may be separated more or less as conditions may require.

Having thus described my said invention, what I claim and desire to secure by Letters Patent is:

1. A fin tube structure comprising a plurality of interengaging elements each including an extended surface member, a tubular flange extending therefrom, and a pair of flat, annular ribs extending laterally outwardly from said tubular flange at substantially right angles thereto and firmly embracing therebetween the inner edge of the extended surface member of a contiguous element, substantially as specified.

2. A fin tube structure comprising a plurality of interengaging transversely corrugated elements each including an extended surface member, a tubular flange extending therefrom, and a pair of annular ribs formed integrally therewith and extending laterally outwardly from said tubular flange and firmly embracing therebetween the inner edge of the extended surface member and the adjoining wall portion of its tubular flange of a contiguous element, substantially as specified.

3. A fin tube structure comprising a plurality of interengaging elements each including an extended surface member having an aperture therein, and a transversely corrugated tubular member extending from said aperture; certain adjacent corrugations of each tubular member being collapsed and embracing therebetween the apertured portion of the extended surface member of a contiguous element, substantially as specified.

4. A fin tube structure comprising a plurality of interengaging tubular elements each including an extended surface member; each of said tubular elements having a plurality of parallel, flat, annular ribs in laterally interfolded cooperating flat annular ribs of contiguous elements to form fluid-tight joints between said elements, substantially as specified.

5. A fin tube structure comprising a plurality of interengaging tubular elements each including an extended surface member; each of said tubular elements having a plurality of inwardly and outwardly projecting parallel annular folds engaging with cooperating annular folds of contiguous elements to form fluid-tight joints between said elements, substantially as specified.

6. A fin tube structure comprising a plurality of interengaging tubular elements each including an extended surface member; each of said tubular elements having a plurality of annular beads extending at substantially right angles to the longitudinal axis of the element and engaging with cooperating annular beads of contiguous elements

to form fluid-tight joints between said elements, substantially as specified.

7. A fin tube structure comprising a plurality of interengaging tubular elements each including an extended surface member; each of said tubular elements having a plurality of collapsed annular corrugations engaging intermediate the same the cooperating collapsed annular corrugations of contiguous elements to form fluid-tight joints between said elements, substantially as specified.

8. A fin tube structure comprising a plurality of interengaging tubular elements each including an extended surface member; each of said tubular elements having a plurality of annular corrugations, said corrugations having certain of their inner and outer bends collapsed to form parallel annular ribs engaging cooperating collapsed annular corrugations and parts of contiguous elements to form fluid-tight joints between the same, substantially as specified.

9. A fin tube structure comprising a plurality of interengaging tubular elements formed of sheet metal each including an extended surface member; each of said tubular elements having a plurality of annular corrugations, and certain of said corrugations having their bends collapsed to form laterally extending ribs confining therebetween and intimately embracing cooperating ribs and parts of contiguous elements to form fluid-tight joints between the same, substantially as specified.

10. A fin tube structure comprising a plurality of interengaging tubular elements formed integrally of sheet metal each including an extended surface member; each of said tubular elements having a plurality of annular corrugations, and certain of said corrugations having their bends collapsed to form flat ribs extending at substantially right angles to the longitudinal axis of the element and intimately embracing therebetween cooperating ribs and parts of contiguous elements to form fluid-tight joints between the same, substantially as specified.

11. A fin tube structure comprising a plurality of interengaging tubular elements formed of sheet metal each including an extended surface member extending from one end thereof; each of said tubular elements having a plurality of annular corrugations, and certain of said corrugations having their bends collapsed to form flat parallel ribs extending at substantially right angles to the longitudinal axis of the element and intimately embracing therebetween cooperating ribs and parts of contiguous elements to form fluid-tight joints between the same, substantially as specified.

12. A fin tube structure comprising a plurality of interengaging elements formed of sheet metal each including an extended surface member; each of said tubular elements having a plurality of relatively-narrow cylindrical wall portions and a plurality of annular corrugations extending therefrom, certain of said corrugations having their bends collapsed to form laterally extending ribs confining therebetween and intimately embracing cooperating ribs and parts of contiguous elements to form fluid-tight joints between the same, substantially as specified.

13. A fin tube structure comprising a plurality of interengaging tubular elements formed of sheet metal each including an extended surface member extending laterally from one end thereof; each of said tubular elements having a plurality of relatively-narrow cylindrical wall portions and

a plurality of annular corrugations extending therefrom, and certain of said corrugations having their bends flattened to form flat, parallel ribs disposed at substantially right angles to the longitudinal axis of the element and intimately embracing cooperating ribs and corrugations of contiguous elements to form fluid-tight joints between the same, substantially as specified.

14. A fin tube structure comprising a plurality of interengaging elements each including an extended surface member having an aperture therein and a transversely corrugated tubular member extending from said aperture; said member having a portion of its wall along the edge of said aperture folded against one side of said extended surface member to form a thickened edge, and certain of the corrugations of each tubular member being flattened to form parallel ribs closely embracing the thickened apertured portion of the extended surface member of a contiguous element, substantially as specified.

15. A fin tube structure comprising a plurality of interengaging elements each including an extended surface member and a tubular flange extending therefrom having a transversely corrugated portion interfolded with the cooperating corrugated portion of contiguous elements, and a tubular apron portion extending from said interfolded corrugated portion; the apron portions of said elements, when assembled, forming the inner wall of the tube structure as a whole, substantially as specified.

16. A fin tube structure comprising a plurality of interengaging elements each including an extended surface member and a tubular flange extending therefrom; said tubular flange having a transversely corrugated portion interfolded with the registering corrugated portions of contiguous elements, and a tubular apron portion extending from said interfolded corrugated portion and completely covering the inner corrugated wall of the contiguous element and forming a substantially smooth, unbroken wall of the tube structure as a whole, substantially as specified.

17. A fin tube structure comprising a plurality of interengaging elements each including an extended surface member, and a tubular flange extending therefrom; said tubular flange having a transversely corrugated portion interfolded with the registering corrugated portions of contiguous elements, and a smooth, substantially cylindrical

portion extending from said interfolded corrugated portion registering and cooperating with the corresponding cylindrical portion of a contiguous element and forming therewith the substantially smooth, unbroken inner wall of the tube structure, substantially as specified.

18. A fin tube structure comprising a plurality of interengaging elements each including an extended surface member, and a tubular flange extending therefrom; said tubular flange having a series of transverse corrugations interengaging with registering corrugations of a contiguous section, and a tubular apron portion extending from said corrugated portion; the tubular apron portions of said elements meeting substantially in end to end relation and forming the smooth, substantially unbroken inner wall of the tube structure as a whole, substantially as specified.

19. A fin tube structure comprising a plurality of interengaging elements each including an extended surface member and a tubular flange extending therefrom; said tubular flange having a series of parallel, horizontal ribs extending therefrom angularly with respect to the normal of said tubular flange and annularly interfolded with the registering flange portions of contiguous elements, substantially as specified.

20. A fin tube structure comprising a plurality of interengaging elements each including an extended surface member and a tubular flange extending therefrom; said tubular flange having the alternate exterior and interior surfaces of its wall portion in engagement, respectively, with the interior and exterior surfaces of the wall portions of contiguous elements and annularly interfolded therewith, substantially as specified.

21. In a fin tube structure including a plurality of interengaging elements, a terminal member comprising a tubular portion and a pair of annular ribs arranged in spaced relation to each other intermediate the ends of said tubular portion, and each end of said tubular portion extending from said ribs terminating in a smooth cylindrical end portion; one of said end portions being adapted to be interfolded circumferentially with the registering ribs of a contiguous element and the other of said ends adapted to be circumferentially engaged with a header substantially as specified.

EDWARD S. CORNELL, JR.

CERTIFICATE OF CORRECTION.

Patent No. 2,012,269.

August 27, 1935.

EDWARD S. CORNELL, JR.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 3, first column, line 57, claim 4, after "ribs" strike out "in" and same line, after "interfolded" insert the word with; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 16th day of March, A. D. 1937.

(Seal)

Henry Van Arsdale
Acting Commissioner of Patents.

CERTIFICATE OF CORRECTION.

Patent No. 2,012,269.

August 27, 1935.

EDWARD S. CORNELL, JR.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, first column, line 29, after "separate" insert sealing; and line 51, after the syllable "tion" strike out the comma; same page, second column, line 2, after "element" strike out the comma; line 44, strike out the word "connected" and insert the same after "elements", same line; and line 51, after "disk" insert the words or plate; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 3rd day of March, A. D. 1936.

Leslie Frazer

Acting Commissioner of Patents.

(Seal)