

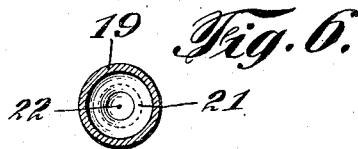
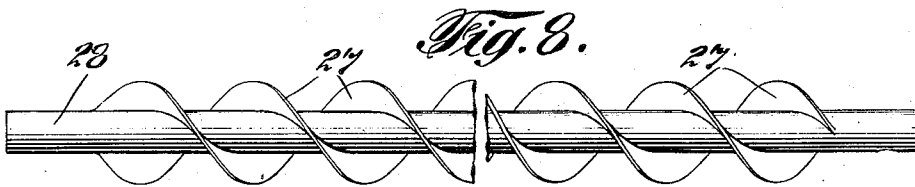
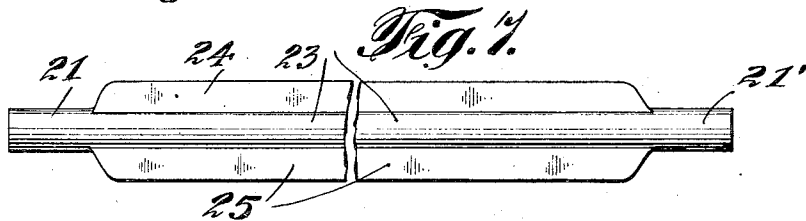
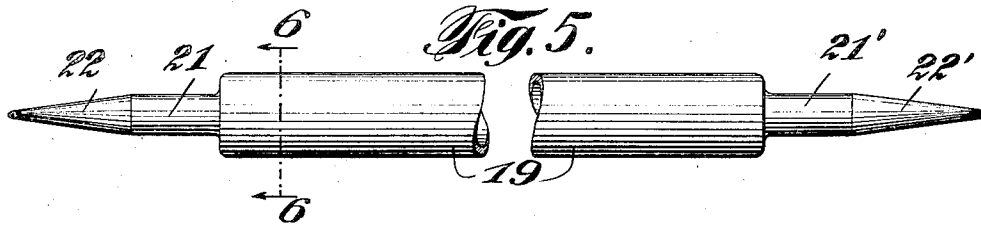
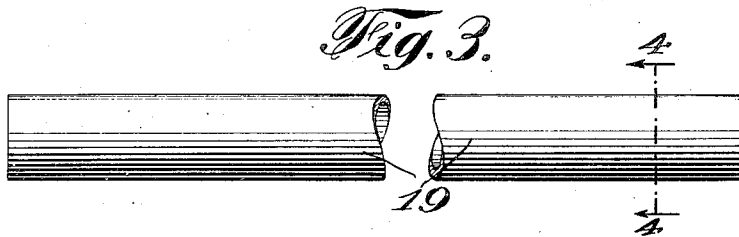
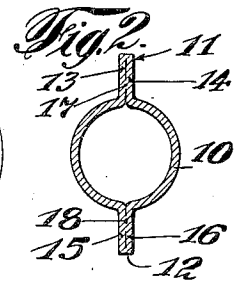
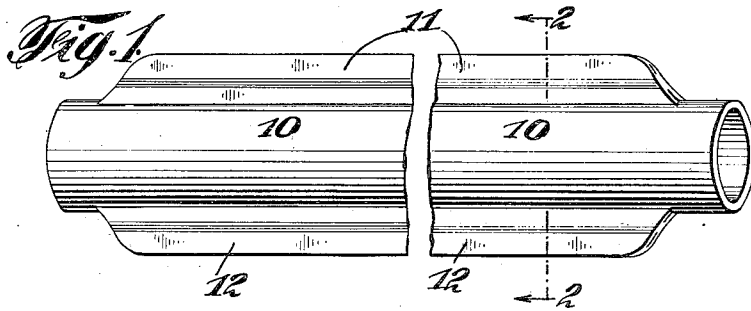
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W. LONSDALE

1,786,571

METHOD OF MAKING HEAT EXCHANGER TUBES

Filed Feb. 27, 1929



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UNITED STATES PATENT OFFICE

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METHOD OF MAKING HEAT-EXCHANGER TUBES

Application filed February 27, 1929. Serial No. 343,221.

My present invention relates to a method of making tubes for heat exchange apparatus and more particularly to a method by which a seamless tube is so constructed as to be provided with one or more fins or lateral projections which may extend longitudinally of the tube, or may be disposed in a spiral relationship thereto. The form of tube to which my invention relates is adapted for use in various types of heat exchange apparatus, for example, it may be advantageous for use in boilers, condensers, feed water heaters, super heaters, economizers, and various types of heat exchangers utilized in refining oil. The purpose of so constructing the tube is to increase the heat transfer surface thereof.

I am aware that heretofore in various types of apparatus to which I have referred the tubes employed have been so constructed as to have a relatively large heat transfer surface. For instance, boiler tubes have heretofore been fitted with a ribbed sleeve, or a series of such sleeves, spaced relatively close to each other and shrunk on the tube so as to provide an extended area for increasing the heating surface. I am also aware that heretofore in tubes employed in condensers and other forms of heat exchange apparatus the tubes have been provided with laterally extending fins or webs. In all instances of this kind, however, so far as I am aware, each tube has been constructed in parts and the parts welded together, or otherwise connected to one another. In the use of tubes of this type in heat exchange apparatus, whether the tubes are provided with flanged collars and shrunk thereon, or whether the tubes are made in parts and welded together, there is the ever present likelihood of the parts working loose and thereby impairing the heat transfer efficiency of the apparatus in which they are employed.

The object of my invention is the provision of a tube so constructed that the same includes no parts to work or otherwise become loose and to thereby furnish a tube of relatively greater strength and one in the use of which the efficiency of the apparatus cannot well be affected by or through any fault of the tube until the tube itself has been worn

out. In carrying out the invention I produce a tube in the following manner: first by swaging, or otherwise reducing, an end, or both ends, of a tubular body to substantially the cross sectional dimensions of the finished tube, then by drawing the said reduced end or ends of the tube to the exterior dimensions of the finished article, and then forming a rib or ribs in the main portion of the tubular body by drawing the same through a suitable die employed for this purpose, resulting in a seamless ribbed tube as will be hereinafter more particularly described.

In the drawing Figure 1 is a perspective view illustrating a heat exchanger tube made in accordance with this invention.

Fig. 2 is a section on line 2—2, Fig. 1,

Figs. 3 to 8 inclusive are illustrative of the manner of forming the tube and in these illustrations Fig. 3 is a longitudinal elevation of a tube,

Fig. 4 is a section on line 4—4, Fig. 3,

Fig. 5 is an elevation illustrating the form the tube assumes after the first operations thereon,

Fig. 6 is a section on line 6—6, Fig. 5,

Fig. 7 is an elevation of a tube after the fins have been formed therein and the cross section of the body of which is precisely the same as shown in Fig. 2,

Fig. 8 is an elevation showing a tube with spirally disposed fins thereon.

The heat exchanger tube formed in accordance with my present invention preferably consists of a cylindrical body portion made of any suitable metal and in any necessary length. The tube is formed as hereinafter described to include oppositely disposed fins or flanges 11 and 12 which may be made to extend longitudinally of the body of the tube and to be integral therewith so that the tube is seamless. Also as hereinafter described the fins or flanges may be made to extend spirally of the body of the tube without departing from the invention. As illustrated in Figs. 1 and 2 the parts of the fin 11 are indicated at 13 and 14, and the parts of the fin 12 at 15 and 16, and these parts respectively are preferably made to contact with each other along their inner faces, as in-

5 dicated at 17 and 18, although, of course, in
 some instances it may be necessary or de-
 sirable to leave an appreciable space between
 the inner faces of the parts of the tube form-
 ing either or both, or all, of the fins or the
 10 flanges associated therewith, it being under-
 stood that the tube as shown in Figs. 1 and 2
 having oppositely disposed fins is merely il-
 15 lustrative of the type of tube made in ac-
 cordance with the invention and that the
 number of these fins may be more or less as
 the use of the invention requires, it further-
 more being understood that the fins may be
 made to extend any predetermined portion of
 the length of the tube and that also the cylin-
 20 drical end portions of the tube may be of any
 required length.

In forming this heat exchanger tube I
 take a tubular body 19 appreciably larger in
 25 cross section than the tubular body of the
 finished tube. The tubular body in its origi-
 nal form is illustrated in Figs. 3 and 4. The
 tubular body first has either one or both
 end portions thereof swaged so as to be of ma-
 30 terially reduced cross section. For example,
 the left hand end of the tubular body, as in-
 dicated in Fig. 5, is swaged to include a por-
 tion 21 which may be substantially cylin-
 35 drical and an extreme portion 22 which is
 preferably conical. In like manner the op-
 posite end of the tubular body 19 may be
 swaged to have a cylindrical portion 21' of
 reduced cross section and a conical extremity
 40 22'. The respective extremities of the tube
 are then successively engaged by a draw-
 bench tongs and drawn through a die so that
 first the portion 21 and then the portion 21'
 are drawn to an exterior diameter the same
 45 as that desired in the finished product. This
 is the end portion 10, as indicated in Fig. 1.
 Next the tube thus formed is drawn through
 a die having belled entrance slots whereby
 the originally larger portion of the tube in-
 50 termediate of the thus reduced ends thereof
 is formed to provide the ribs irrespective of
 the number thereof.

In thus reducing the intermediate por-
 tion of the tube the body thereof, as indicated
 at 23, is of substantially the same exterior and
 55 interior diameter as the end portions 21 and
 21' thereof, while the ribs 24 and 25 may be
 made, as now will be readily understood, to
 extend any desired proportion of the length
 of the finished tube. With the tube thus
 60 formed the rough taper extremities thereof
 are then sawed or otherwise cut off, leaving
 the substantially parallel cylindrical ends
 which are uniform in diameter with the in-
 termediate parts of the body of the tube in
 65 which the fins are formed, as shown in Fig. 7.

As illustrated in Fig. 8 the fins 27 extend-
 ing from the cylindrical body 28 of the tube
 may be so constructed as to form a helix by
 twisting the tube, or if necessary in any in-
 65 stances where the pitch of the helix is extreme

or acute, the spiral fin may be formed by
 rotating the die at the same time the main
 or body portion of the tube is drawn there-
 through to form the fins.

Due to the fins extending from the body
 70 of the tube the heat exchange surface there-
 of is materially increased and because of the
 fact that the fins are made integral with the
 body of the tube there is substantially no
 liability of their being separated therefrom,
 75 resulting in a greater efficiency of the appa-
 ratus in which the tubes are employed and
 also resulting in a much longer life of each
 tube. It is to be understood as coming
 within the structure as contemplated by the
 invention to make a tube having any desired
 number of fins and place them longitudinally
 of, or spirally with, or in any other asso-
 80 ciation with the body of the tube, and fur-
 thermore that irrespective of the configura-
 tion of the fin or fins these parts may, if nec-
 essary or desirable, be continued to either or
 both ends of the tube with which they may be
 associated.

I claim as my invention:

1. The method of making a seamless heat
 exchanger tube consisting in first reducing
 an end portion of an oversized tubular body
 to the desired transverse section of the fin-
 90 ished tube, and then forming an integral fin
 in the oversized tubular body and in doing
 so reducing its transverse section to that of
 the previously reduced end portion thereof.
2. The method of making a seamless heat
 exchanger tube consisting in reducing an end
 95 portion of an oversized tubular body to a
 cylindrical part with a transverse section of
 that of the finished tube and a conical ex-
 tremity, and then forming an integral fin
 in the oversized tubular body and in so do-
 100 ing reducing its transverse section to that
 of the cylindrical part of the reduced end
 portion thereof.
3. The method of making a seamless heat
 exchanger tube consisting in swaging an end
 105 portion of an oversized tubular body to sub-
 stantially the desired transverse section of
 the finished tube, then drawing the swaged
 end portion of the oversized body through
 a die to the desired transverse section of the
 110 finished tube, and then forming an integral
 fin in the oversized tubular body and in so
 doing reducing its transverse cross section to
 that of the drawn end portion thereof.
4. The method of making a seamless heat
 exchanger tube consisting in swaging an end
 115 portion of an oversized tubular body to cause
 the said end portion to include a cylindrical
 part of substantially the desired transverse
 section of the finished tube and an extremity
 120 of conical configuration, then drawing the
 cylindrical part of the reduced end through
 a die to cause the same to be of the same
 transverse section as the finished tube, and
 then forming an integral fin in the oversized
 125

tubular body and in so doing reducing its transverse section to that of the previously reduced cylindrical part at the end thereof.

5 The method of making a seamless heat exchanger tube consisting in swaging an end portion of an oversized tubular body to include a part of substantially the same transverse section as that of the finished tube, and an extremity of conical configuration, then drawing the said reduced end of the tube through a die to further reduce the same to the transverse section of the finished tube, and then drawing the oversized tubular body through a die to form an integral fin thereon and in so doing to reduce the transverse section of the oversized tubular body to that of the previously reduced end portion thereof.

6. The method of making a seamless heat exchanger tube consisting in swaging an end portion of an oversized tubular body to have a cylindrical part of substantially the same cross section of the finished tube and a conical part at the extremity thereof, then drawing the cylindrical reduced end part through a die to the transverse section of the finished tube, then drawing the said oversized tubular body through a die having a belled entrance slot therein to form an integral fin and reduce the transverse section thereof to that of the cylindrical part of the previously reduced end portion, and then cutting off the conical extremity at the end of the tube.

7. The method of making a seamless heat exchanger tube consisting in reducing portions at both ends of an over-sized tubular body to the transverse section of the finished tube, and then forming an integral fin in the oversized tubular body and in so doing reducing the transverse section thereof to that of the previously reduced end portions thereof.

8. The method of making a seamless heat exchanger tube consisting in reducing a portion at both ends of an oversized tubular body so that both end portions comprise a cylindrical part having a transverse section of the finished tube and a conical part at the extremity thereof, and then forming an integral fin in the said oversized tubular body and at the same time reducing the transverse section thereof to that of the cylindrical parts of the previously reduced end portions.

9. The method of making a seamless heat exchanger tube consisting in swaging portions at both ends of an oversized tubular body to a cylindrical part having a transverse section appreciably greater than that of the finished tube, then successively drawing the reduced cylindrical parts at the ends of the oversized tubular body through a die to have a transverse section of the finished tube, and then forming an integral fin in the oversized tubular body and simultaneously reducing the transverse section thereof to that

of the previously formed cylindrical end parts thereof.

10. The method of making a seamless heat exchanger tube consisting in swaging portions at both ends of an oversized tubular body to provide at both ends thereof a cylindrical part having a transverse section appreciably greater than that of the finished tube and a conical part at the extremity thereof, then successively drawing the said cylindrical end parts through a die to a transverse section corresponding to that of the finished tube, and then forming an integral fin in the oversized tubular body and simultaneously reducing its transverse section to that of the previously formed cylindrical parts at the ends thereof.

11. The method of making a seamless heat exchanger tube consisting in swaging a portion at both ends of an oversized tubular body to provide at each end thereof a cylindrical part of appreciably greater transverse section than that of the finished tube and a conical part at the extremity thereof, then successively drawing the said reduced cylindrical parts of the end portions of the oversized tubular body through a die to reduce each of the same to the transverse section of that of the finished tube, and then drawing the said oversized tubular body through a die to form an integral fin therein and simultaneously reduce the transverse section thereof to that of the previously reduced cylindrical parts at the ends thereof.

12. The method of making a seamless heat exchanger tube consisting in swaging a portion at both ends of an oversized tubular body to provide at each end thereof a cylindrical part of appreciably greater transverse section than that of the finished tube and a conical part at the extremity thereof, then successively drawing the said reduced cylindrical parts of the end portions of the oversized tubular body through a die to reduce each of the same to the transverse section of that of the finished tube, then drawing the said oversized tubular body through a die to form an integral fin thereon and simultaneously reducing the transverse section thereof to that of the previously reduced cylindrical parts at the ends thereof, and then cutting off the conical parts at the extremities of the cylindrical ends of the tube.

13. The method of making a seamless heat exchanger tube consisting in successively swaging the end portions of an oversized tubular body to provide in the said end portions cylindrical parts of appreciably greater transverse section than that of the finished tube and a conical part at the extremity of both thereof, then successively drawing the said cylindrical parts through a die to reduce the same to the transverse section of the finished tube, and then forming a spirally

disposed fin in the oversized tubular body and simultaneously reducing the transverse section thereof to that of the previously reduced end portions.

14. The method of making a seamless heat exchanger tube consisting in successively swaging the end portions of an oversized tubular body to produce in each end thereof a cylindrical part of transverse section appreciably greater than that of the finished tube and a conical part at the end thereof, then successively drawing the said cylindrical parts at the ends of the tubular body through a die to the same transverse section as that of the finished tube, then drawing the said oversized tubular body through a die and simultaneously turning the die to form an integral spirally disposed fin and at the same time reduce the transverse section of the tubular body to that of the previously reduced cylindrical parts at the ends thereof, and finally cutting off the conical parts at the ends of the tube.

15. The method of making a seamless heat exchanger tube consisting in reducing an end portion of an oversized tubular body to a cylindrical part having the transverse section of the finished tube, and then forming a spirally disposed fin in the said oversized tubular body and simultaneously reducing the transverse section thereof to that of the previously reduced cylindrical end part thereof.

16. The method of making a seamless heat exchanger tube consisting in swaging an end portion of an oversized tubular body to a cylindrical part having a transverse section appreciably greater than that of the finished tube, then drawing the reduced cylindrical end part through a die to a transverse section corresponding to that of the finished tube, and then drawing the said oversized tubular body through a die and simultaneously turning the die to form a spirally disposed fin in the said oversized tubular body and at the same time reduce the transverse section thereof to that of the previously reduced cylindrical end part thereof.

17. The method of making a seamless heat exchanger tube consisting in reducing a part of an oversized tubular body to the desired transverse section of the finished tube and then forming an integral fin in another part of the oversized tubular body and in so doing reducing its transverse section to that of the previously reduced part thereof.

Signed by me this 19 day of Feb. 1929.

WM. LONSDALE.

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