Sept. 14, 1937. H. F. MAYNES 2,093,202

DEVICE FOR OPERATING ON ELEMENTS OF HEAT EXCHANGE UNITS

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Fig. 1.



Fig. 3.

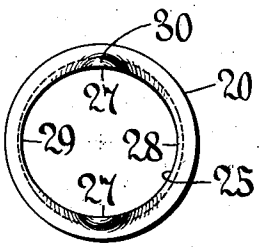
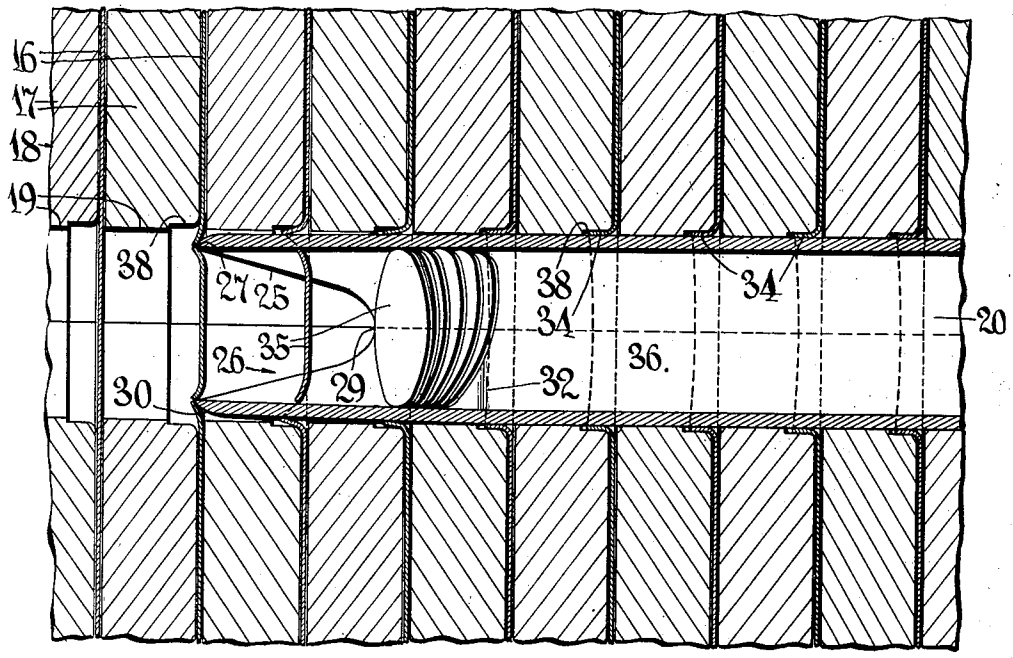


Fig. 2.



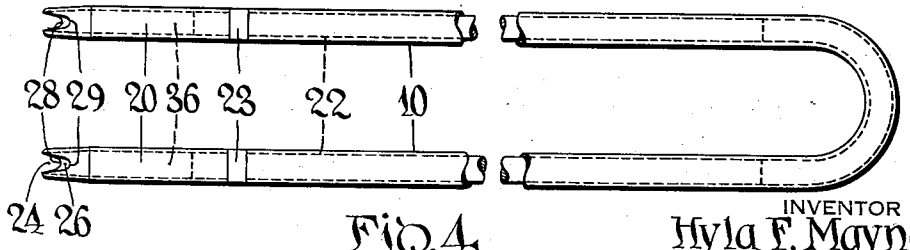


Fig. 4.

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DEVICE FOR OPERATING ON ELEMENTS OF HEAT EXCHANGE UNITS

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19 Claims. (Cl. 29—34)

This invention relates to the manufacture of heat exchange units, and it has particular relation to a device for cutting or forming fin elements of such units, together with structure facilitating the assembly of pipe sections with the fin elements.

The principal elements of the invention are adapted to be incorporated in the type of apparatus disclosed in my co-pending applications Serial No. 74,733, filed April 16, 1936, for Machine for making heat transfer units, and Serial No. 91,950, filed July 22, 1936, for Method of and apparatus for making heat transfer units, although such elements are not limited to use in connection with the inventions of these co-pending applications.

One object of the invention is to simplify the operations of assembling elements of a heat exchange unit and to insure proper positioning of the pipe sections with respect to fin elements of a heat exchange unit.

Another object of the invention is to provide an improved device for cutting out openings in blank fins that receive pipe sections therethrough and, at the same time, forming flanges around the openings cut in the fins.

Another object of the invention is to provide an improved cutting device adapted to be forced, together with a pipe section assembled therewith, through blank fins to form openings and flanges in the latter.

A device including the invention comprising a cutting head that has an edge or blade portion adapted to cut out a section or disk from a blank fin held in a jig, or the like, and merely by linearly forcing the head through such fin. The head is formed with a chamber which is so shaped as to insure proper stacking therein of the waste material cut from the fins and, at the same time, the outer surface of the head about the cutting edge is so shaped as to form an annular flange in the fins about the openings. The device can be tubular in form and provided with an adapter telescoped therewith and with a pipe section to be assembled with the fins in such manner that the cutting of openings in the fins, the forming of the annular flanges, and assembling of the pipe section with the fins can be accomplished in one operation.

In the drawing:

Fig. 1 is a diagrammatic plan of a heat exchange unit having cutters and adapters associated therewith;

Fig. 2 is a fragmentary vertical section of a jig and fins carried thereby, together with a cutter, and illustrating the operation of the invention;

Fig. 3 is a front end elevation of a cutter as viewed axially; and

Fig. 4 is a fragmentary plan of a cutter and adapter assembled with a pipe section.

In practicing the invention, pipe sections **10** for circulating fluid, and sheet metal fins **12** of a heat exchange unit **15** are assembled by holding the fins in spaced parallel relation in recesses **16**, and between adjacent parallel plates **17**, of a jig **18**, and then forcing the pipe sections through openings **19** formed in the jig plates, whereby the pipe sections are disposed transversely through the fins. The locations of the openings **19** with reference to the fins held in the jig correspond substantially to the locations of the pipe sections in the assembled unit of fins and pipe sections.

Cutters **20** are mounted telescopically upon adapters **22**, which are in the form of rods, and the latter are in turn, telescopically engageable with the pipe sections **10**. Suitable annular abutments or shoulders **23** are provided upon intermediate portions of the adapters to gauge the pipe sections and cutters thereon. This assembly of pipe sections, cutters, and adapters can be forced through the openings **19** in the jig, and hence, through the fins held therein. This operation can be accomplished either mechanically in the manner described in my co-pending applications above identified, or manually.

In the form of the invention shown in the drawing, each cutter **20** is substantially cylindrical or tubular and its forward end portion is provided with an irregular cutting edge **25** defined by notches **24** and **26** which can be formed of unequal depth by cutting along lines defined by planes disposed substantially obliquely on opposite sides of the end portion of the cutter, thus providing a forked or bifurcated configuration of the latter end portion. This cutting edge terminates forwardly in a pair of pointed diametrically opposite edge portions **27** and the cutting edge extends inwardly from the end portion of the cutter to the bottom or inner extremities **28** and **29** of the notches **24** and **26**, respectively. From this arrangement, it will be apparent that the cutting edge portions extend primarily from the pointed extremities **27** rearwardly and substantially obliquely with respect to the length of the cutter.

The forward ends or extremities **27** on their outer circumferential surfaces are rounded, as indicated at **30**, and thus, provide a tapering con-

figuration with respect to the over all circumference of the tubular cutter. At a circumferential location, indicated at **32**, on the internal surface of the tubular cutter, the inner wall or bore of such cutter tapers outwardly to the outer extremities **27** of the cutting edge. It will be observed that the inner extremities **28** and **29** of the notches do not extend to the location, indicated at **32**, of the beginning of the internal tapering of the tubular cutter. Therefore, by viewing the end of the tubular cutter (Fig. 3), it will be noted that the cutting edge or mouth of the tubular cutter presents a substantially oval or elliptical configuration wherein the longer axis is horizontally disposed and the shorter axis is vertically disposed.

Referring to Fig. 2, which illustrates the operation of the cutter as it passes through blank fins carried in the jig, it will be noted that the pointed extremities **27** first puncture the fin, which is composed of copper, or an alloy thereof, or other sheet metal material, and the rounded surfaces **30** commence turning a flange **34** outwardly from the body of the fin. As the cutter is forced through the openings **19** in the jig plates, the lines of cutting follow the oblique cutting edge portions toward the bottoms or inner extremities of the notches **24** and **26**, and upon passage of the notch extremity **28** beyond the plane of each fin, a piece or disk **35** of waste material corresponding in shape to the substantially elliptical configuration (Fig. 3) previously described, will have been partially severed from the fin body, but the piece **35** will not be completely severed until the rear notch extremity **29** passes the plane of the fin. In traversing the axial distance from the rear extremity **28** of the shallower notch **24** to the rear extremity **29** of the deeper notch **26** the cutting edge portions defining the rear notch **26** perform the latter portion of the cutting operation. Although the edge portions of the rear notch **26** converge toward the rear extremity **29**, the lines of cutting on the fin are substantially elliptical, or correspond to the inner curved line of Fig. 3.

The curvature of the cutter wall in which the cutter edge is formed and the configuration of the notch cause the cut out portion of the piece **35**, before complete severance, to be forced or bent rearwardly until the action of complete severance at the extremity **29** of the deeper notch is accomplished. Hence, each piece **35** cut from the fin is disposed inside the tubular cutter and is urged away from the cutter mouth until completion of the cutting action. The disposition of the notches in the manner specified causes this action and prevents the pieces **35** from clogging in the mouth of the cutter or in the space between the notches **24** and **26**.

Since the internal bore of the tubular cutter tapers or increases in size inwardly, the pieces of waste material **35** can be disposed loosely in a chamber **36** which is closed at one end by the end of the adapter **22** during the cutting operations. Since the several pieces of waste material are loosely disposed in the chamber there is no danger of interference with the incoming pieces at the forward entrance of the cutter. Upon completion of the passage of the cutter through the several fins the adapter can be withdrawn from the pipe sections, as well as from the cutter, while the pipe sections remain assembled with the fins, and the waste material will then fall, or can be shaken from the cutter chamber.

As the cutter **20** is forced through the openings in the jig the flange **34** is progressively formed and forced to a position substantially at right angles to the surface of the fin. Since the configuration of the opening cut by the edge **25** is substantially elliptical the flange **34** is formed wider at diametrically opposite portions than at other portions thereof. In order to compensate for space required for the flanges **34**, annular recesses **38** are formed in the jig plates and one of these recesses is in communicating relation between the opening **19** and recess **16** of each jig plate.

It will be noted that rearwardly of the tapered and cutting portion of the tubular cutter, the circumference of the latter is substantially uniform both interiorly and exteriorly, and the exterior circumferences or diameters of each pipe section **10** and annular abutment **23** also corresponds in circumference substantially to the adjacent portion of the cutter.

Since the cutter is forced through the blank fins concurrently with forcing of the pipe section and adapter assembled therewith, the natural resiliency of the metal fins insures slight contraction of the marginal portions of the flanges **34** after the cutter has passed therethrough, and hence, these flanges will contract about the pipe sections to grip and maintain the latter and fins in assembled relation until they can be dipped in proper conventionally used solution, such as solder, or the like, for permanent assembly of these parts.

It is to be understood that the pipe sections are forced, together with the assembled adapter **22** and cutter **20**, through the fins until they assume the relationship illustrated in Fig. 1, and in such relationhip the adapter and cutter can be removed from the pipe sections. Thus the assembly of the pipe sections and fins is accomplished in the same operation that forms openings and flanges in the fins for receiving the pipe sections.

Although only one form of the invention has been shown and described in detail, it will be apparent to those skilled in the art that the invention is not so limited, but that various changes can be made therein without departing from the spirit of the invention or from the scope of the appended claims.

I claim:

1. In a device for making heat transfer units of the type in which fluid circulating pipe sections are disposed transversely through a series of substantially parallel sheet metal fins, means for holding a plurality of sheet metal blank fins in substantially parallel spaced relation, said means having an opening therethrough registering with locations on the blank fins corresponding to locations of the pipe sections in the fins of the finished unit, and a cutting member having means for mounting a pipe section therewith and movable concurrently with said pipe section through said opening to cut openings through the fins and to thread the pipe section therethrough, said cutting member having an opening therein for receiving metal cut from the fins.

2. In a device for making heat transfer units of the type in which fluid circulating pipe sections are disposed transversely through a series of substantially parallel sheet metal fins, means for holding a plurality of sheet metal blank fins in substantially parallel relation, said means having an opening therethrough registering with locations on the blank fins corresponding to locations of the pipe sections in the fins of the

finished unit, and a cutting member having means for assembling it with a pipe section and movable concurrently with a pipe section through said opening to cut openings through the fins and to thread the pipe section therethrough, said cutting member having an internal chamber increasing in size inwardly from its cutting portion for receiving cut out portions of the fin metal in passing through said fins.

3. In a device for making heat transfer units of the type in which fluid circulating pipe sections are disposed transversely through a series of substantially parallel sheet metal fins, means for holding a plurality of sheet metal blank fins in substantially parallel spaced relation, said means having an opening therethrough registering with locations on the blank fins corresponding to locations of the pipe sections in the finished unit, and a substantially cylindrical cutting member having means for assembling it with a pipe section and being movable concurrently with said pipe section through said opening to cut openings through the blank fins and to thread the pipe section therethrough, said cutting member having an end cutting edge and having a substantially axial chamber leading therefrom for receiving waste metal cut from the fins in passing through the latter.

4. In a device for making heat transfer units of the type in which fluid circulating pipe sections are disposed transversely through a series of substantially parallel sheet metal fins, means for holding a plurality of sheet metal blank fins in substantially parallel spaced relation, said means having an opening therethrough registering with the locations on the blank fins corresponding to locations of the pipe sections in the fins of the finished unit, and an elongate cutting member having means for assembling it with a pipe section and being movable concurrently with a pipe section through said opening to cut openings through the fins and to thread the pipe section therethrough, said cutting member having a cutting edge at one end thereof and having an axial opening adjacent said cutting edge for receiving waste metal cut from the fins.

5. In a device for making heat transfer units of the type in which fluid circulating pipe sections are disposed transversely through a series of substantially parallel sheet metal fins, means for holding a plurality of sheet metal blank fins in substantially parallel spaced relation, said means having an opening therethrough registering with locations on the blank fins corresponding to locations of the pipe sections in the fins of the finished unit; and a substantially cylindrical cutting member having means for assembling it with a pipe section and being movable concurrently with said pipe section through said opening to cut openings through the blank fins and to thread the pipe section therethrough, said cutting member having a cutting end portion tapering toward its extremity for cutting out a section of the blank fin and forming a flange portion on the fin about the opening so cut, said cutting member having a substantially axially disposed chamber for receiving and carrying away cut out waste metal from the fins.

6. In a device for making heat transfer units of the type in which fluid circulating pipe sections are disposed transversely through a series of substantially parallel sheet metal fins, means for holding a plurality of sheet metal blank fins in substantially parallel spaced relation, said means having an opening therethrough registering with locations on the blank fins corresponding to locations of the pipe sections in the fins of the finished unit, and a substantially tubular cutting member having means for assembling it with a pipe section and being movable concurrently with said pipe section through said opening to cut openings through the blank fins and to thread the pipe section therethrough, said tubular member including an end portion pointed and formed with a cutting edge obliquely disposed with reference to the length of the tubular member.

7. In a device for making heat transfer units of the type in which fluid circulating pipe sections are disposed transversely through a series of substantially parallel sheet metal fins, means for holding a plurality of sheet metal blank fins in substantially parallel relation, said means having an opening therethrough registering with locations on the blank fins corresponding to locations of the pipe sections in the finished unit, and a substantially tubular cutting member having means for assembling it with a pipe section and being movable concurrently with said pipe section through said opening to cut openings through the blank fins and to thread the pipe section therethrough, said tubular member having a tapering end portion, said tubular member including a cutting edge disposed substantially obliquely with reference to and in said tapering end portion.

8. In a device for making heat transfer units of the type in which fluid circulating pipe sections are disposed transversely through a series of substantially parallel sheet metal fins, means for holding a plurality of sheet metal blank fins in substantially parallel spaced relation, said means having an opening therethrough registering with locations on the blank fins corresponding to locations of the pipe sections in the fins of the finished unit, and a substantially tubular cutting member having means for assembling it with a pipe section and being movable concurrently with said pipe section through said opening to cut openings through the blank fins and to thread the pipe section therethrough, said tubular member having a cutting edge at one end thereof, the internal circumferential wall of the tubular member tapering adjacent the cutting edge.

9. In a device for making heat transfer units of the type in which fluid circulating pipe sections are disposed transversely through a series of substantially parallel sheet metal fins, means for holding a plurality of sheet metal blank fins in substantially parallel spaced relation, said means having an opening therethrough registering with locations on the blank fins corresponding to locations of the pipe sections in the fins of the finished unit, and a substantially tubular cutting member having means for assembling it with a pipe section and being movable together with said pipe section through said opening to cut openings through the blank fins and to thread the pipe section therethrough, said tubular member having an end portion formed into a cutting edge, the internal diameter of the tubular member increasing inwardly from said cutting edge.

10. In a device for making heat transfer units of the type in which fluid circulation pipe sections are disposed transversely through a series of substantially parallel sheet metal fins, mechanism for holding a plurality of sheet metal blank fins in substantially parallel spaced relation, said mechanism having an opening therethrough registering with locations on the blank

fins corresponding to the locations of the pipe sections in the fins of the finished unit, a tubular cutter having means for assembling a pipe section therewith and being movable concurrently with said pipe section through said opening to cut openings through the blank fins and to thread the pipe section therethrough, said means including a member for telescopically engaging both the tubular cutter and the pipe section.

11. A device for cutting openings through sheet material comprising a tubular member having a tapering end portion and having a cutting edge formed on the tapering end portion, said cutting edge being disposed obliquely with respect to the length of the tubular member and being formed with notches of different depths.

12. A device for cutting openings through sheet material comprising a tubular member having a notched end portion formed into a cutting edge, the internal diameter of the tubular member progressively increasing inwardly a predetermined distance from the cutting edge.

13. A device for cutting openings through sheet material comprising a tubular member having an end portion formed into a cutting edge, and an adapter for telescopically engaging with the tubular member and with a pipe section to be assembled with the sheet material.

14. A device for cutting openings through sheet material comprising a tubular member having an end portion formed into a cutting edge, and an adapter having an intermediate shouldered portion and telescopically engageable with the tubular member and with a pipe section to be disposed through the sheet material.

15. A device for cutting openings through sheet material comprising a tubular member having an end portion formed into a cutting edge and being movable through the sheet material incidentally to the formation of an opening therethrough, said cutting edge being notched to form cutting edge portions disposed substantially obliquely with reference to the length of the tubular member, the internal circumferential wall of said end portion of the tubular member having a tapering contour.

16. A device for cutting openings through sheet material comprising a tubular member having an end portion formed into a cutting edge and being movable through the sheet material incidentally to the formation of an opening therethrough, said cutting edge being notched and externally tapered to force a flange from the material during the cutting action, the internal bore of the tubular member increasing in size inwardly from the location of the cutting edge for a predetermined distance to receive waste material cut from the sheet material.

17. A device for cutting openings through sheet material comprising a tubular member having an end portion formed into a cutting edge and the latter defining notches of different depths.

18. A device for cutting openings through sheet material comprising a tubular member having notches formed in one end edge thereof, the end portion of the member in which the notches are formed tapering to provide progressively decreasing overall diameter toward the notched end, the length of the tapering portion being at least as great as the depth of the notches.

19. A device for cutting openings through sheet material comprising a tubular member having notches formed in one end edge thereof, the end portion of the member in which the notches are formed tapering outwardly to provide progressively decreasing exterior and interior diameters toward the member end, the length of the tapering portion of the member being at least as great as the depth of the notches.

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