March 15, 1938. J. KARMAZIN 2,111,534

HEAT TRANSFER DEVICE AND METHOD OF MAKING SAME

Original Filed Dec. 21, 1933 2 Sheets-Sheet 1

Fig. 1.

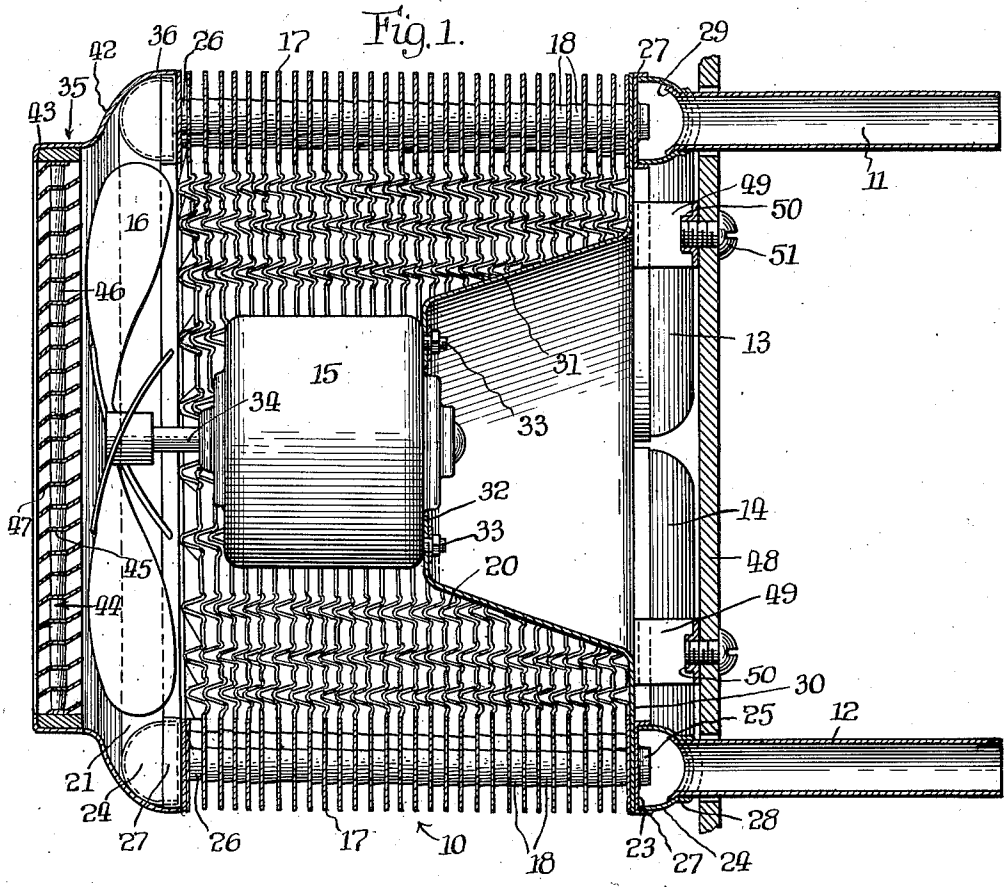


Fig. 2.

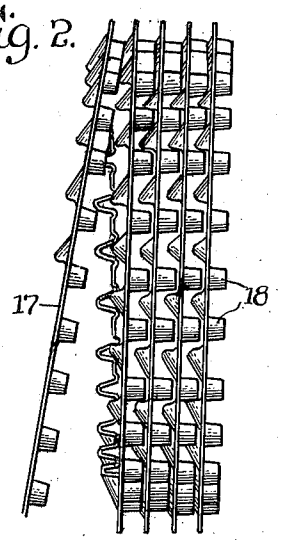
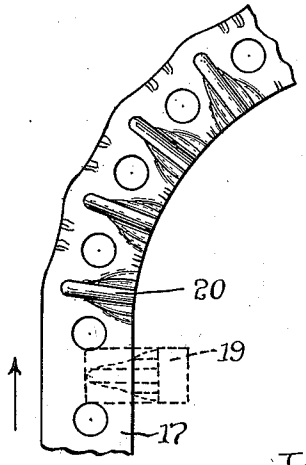


Fig. 3.



Inventor:
John Karmazin,
By Kleindorf, Parker & Carlson.
Attys.

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Fig. 4.

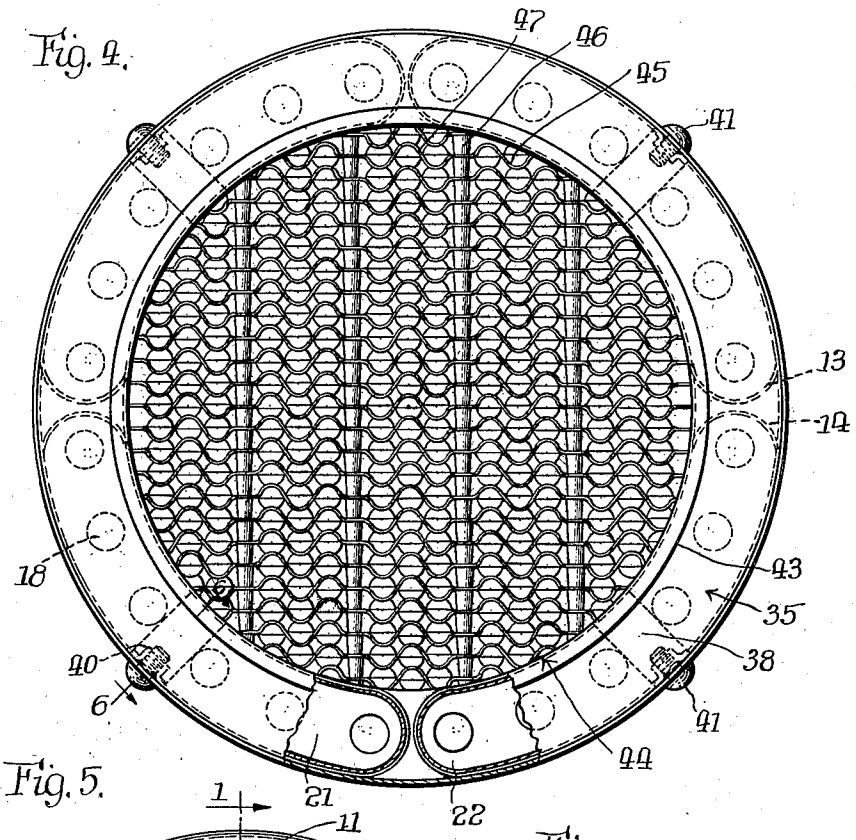


Fig. 5.

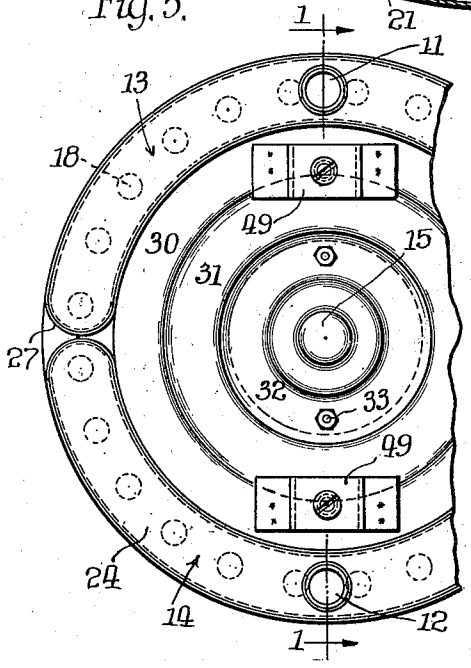


Fig. 6.

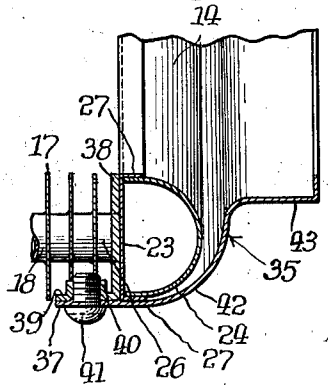
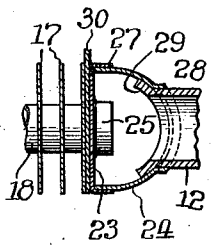


Fig. 7.



Inventor:
John Karmazin,
By Schmidt, Parker & Carlson.
Attys.

Patented Mar. 15, 1938 2,111,534

UNITED STATES PATENT OFFICE

2,111,534

HEAT TRANSFER DEVICE AND METHOD OF MAKING SAME

John Karmazin, Huntington, Ind.

Application December 21, 1933, Serial No. 703,343
Renewed March 11, 1937

30 Claims. (Cl. 29—157.3)

The invention relates to heat transfer devices and to a method of making such devices and has as its general aim the provision of a new and improved device of this character which is simplified in construction, efficient in operation and may be cheaply produced by a novel method for sale at a relatively low cost.

Another object of the invention is to provide a novel method of producing heat transfer means of the so-called "fin and tube" type wherein integral tubes and fins are fashioned from an endless strip of material which is turned upon itself to bring the tube elements in one portion of the strip into registration with the elements in another portion whereby the tube elements may be telescoped together to form a completed unit from a single strip of material.

In conjunction with the foregoing, another object is to provide such a method wherein the strip is turned in the plane of its surface to produce a helicoidal winding resulting in a heat transfer device of annular form.

A further object is to provide a new and improved heat transfer device of cylindrical shape embodying fluid conducting tubes paralleling the axis of the device and heat transfer fins located in substantially radial planes, and having means centrally located within the device for causing a circulating flow across the heat transferring structure.

Another object resides in the provision of an improved device of high efficiency wherein a unit which is small and compact embodies a heat transfer means of large area and has means located centrally of the heat transfer means for inducing an unobstructed circulating flow across the transfer means.

Devices possessing these characteristics are eminently suitable for use as heaters for motor vehicles wherein the heating medium is water from the cooling system of the motor and another object is to provide novel structure in which the flow of heating medium through the device is through passageways of substantial dimensions fashioned to eliminate all pockets, obstructions and "dead" areas which would impede the flow and wherein sediment would accumulate.

Another object of the invention is to provide simplified arrangements of structure facilitating manufacture and assembly of the component parts of the device.

Other objects and advantages will become apparent in the following description and from the accompanying drawings, in which:

Figure 1 is an axial section through a device embodying the features of the invention.

Fig. 2 is a side view of the heat transfer means during one step in the process of its production.

Fig. 3 is a plan view of a strip of material in the process of being fashioned into the heat transfer means.

Fig. 4 is a front elevation of a heat transfer device.

Fig. 5 is a fragmentary rear view of said device.

Figs. 6 and 7 are fragmentary views showing details of construction and assembly.

While the invention is susceptible of various modifications and alternative constructions, I have shown in the drawings and will herein describe in detail the preferred embodiment, but it is to be understood that I do not thereby intend to limit the invention to the specific form disclosed, but intend to cover all modifications and alternative constructions falling within the spirit and scope of the invention as expressed in the appended claims.

One form of device embodying the features of the invention is highly suitable as a heater for motor vehicles and the like and such a device has, for illustrative purposes, been shown in the drawings. It is to be understood, however, that certain features of the invention may be utilized in devices other than automobile heaters.

With reference to the drawings, 10 (Fig. 1) indicates generally a heat transfer core or body which is preferably of the fin and tube type of construction. The core 10 is fashioned to provide an internal chamber and may, therefore, be considered as being annular or tubular in form. An inlet duct 11 and an outlet duct 12 communicate, respectively, with headers 13 and 14 on one end of the core and are arranged for connection in the usual manner with the cooling system of the motor. The headers 13 and 14, as will be presently explained, are arranged to cooperate with the tubular passageways of the heat transfer body and with other headers 21, 22 at the other end of the core in directing a flow of heating medium through the device. A motor 15 driving a fan 16 is mounted within the chamber defined by the heat transfer core for producing a circulating flow of air through the device.

The body 10 is preferably formed in a novel manner whereby the body may be manufactured rapidly, efficiently and inexpensively. Briefly stated, the method comprises forming a series of tubular elements from a flat and continuous strip of material by a stamping or comparable operation so that the tubular elements extend transversely of the surface of the strip. The tubular elements are fashioned to be assembled in nested or telescopic relation with other and similarly formed tubular elements to build up a heat transfer structure wherein the registering tubular elements form continuous passageways for a heating medium while the remaining integral portions of the strip of material constitute the heat transfer or heat radiating fins. Heretofore

it has been customary to sever the continuous strips, thereby to provide a number of sections each of which included a series of tubular elements, after which the sections were stacked with the tubular elements in registration and the assembly suitably secured together. According to the present invention, the continuous strip, after the tubular elements have been properly fashioned, is turned or bent upon itself a number of times in such manner that the tubular elements in one portion of the strip are caused to register with tubular elements in another portion of the strip, after which the tubular elements are connected to complete the device. Thus a heat transfer device may be constructed from a continuous strip of matrial.

With reference to Figs. 2 and 3, 17 designates the flat strip of material having tubular elements 18 integrally formed therefrom. As this strip passes from the mechanism or means by which the tubular elements are formed, it is led through suitable means, such as the die mechanism diagrammatically illustrated at 19, wherein one side edge of the strip is stamped or crimped, as at 20, out of the plane of the surface of the strip. In this manner the strip is turned or bent laterally in the plane of its surface with the result that the strip assumes the form of a helicoidal winding. By properly correlating the spacing between the tubular elements and the radius on which the strip is turned, the tubular elements in one circular section of the winding may be caused to register exactly with the tubular elements in an adjacent section. The continuous strip is severed after a desired number of turns have been formed, and the loose winding pressed together to produce a telescopic and closely interfitting relationship of the registering tubular elements. The structure may then be subjected to a soldering, hydrogen brazing or other suitable operation for perfecting a fluid tight seal of the joints between the tubular elements. This method produces a cylindrical heat transfer core or body in which the heat radiating fins are located in substantial radial planes, while the integral tubular fluid passageways extend transversely of the fins, and parallel the axis of the core in evenly spaced circular series.

The tubular elements carried by the end turns of the body may be pressed further into or onto the adjacent cooperating tubular elements in order to locate the end faces of the core in planes which are substantially perpendicular to the axis.

The heat transfer core illustrated in the drawings has been formed by this method. In order to produce an efficient circulation of the heating medium through the tubular passageways, headers are provided for directing the flow of said medium through said passageways, this flow being preferably back and forth through groups of passageways. In the present instance, a pair of headers is provided at each end of the core, the headers 13 and 14 being located as shown at the rear end of the core, while the pair of headers 21, 22 are mounted on the opposite or front end. Each of the headers 13, 14, 21, 22 is longitudinally arcuate and extends through substantially 180° so that when placed end to end they form a substantially complete circle of approximately the same diameter as that of the end of the core. Each header is formed in two sections comprising a flat bottom or adapter plate 23 (Fig. 7) and a cover 24 of arcuate cross section.

The plates 23 for one end of the core have a series of inturned tubular elements 25 (Fig. 1) to receive the projecting tubular elements at that end of the core, while the plates for the opposite end of the core are formed with a series of outwardly extending tubular elements 26 for telescopic entry into the ends of the tubes at this end of the core. Peripherally the bottom plates have outstanding flanges 27 to receive therebetween the peripheral edges of the cover 24 whereby the flanges may be pressed inwardly against the cover and suitably sealed by a soldering or similar operation.

The headers are thus formed as separate units capable of being quickly secured to the core in any suitable manner, as by soldering, it only being necessary to apply the proper headers to the corresponding end of the core. In order to effect a flow of the heating medium in one direction and a return flow in the other direction, the headers at one end of the core are staggered or offset with respect to the headers at the other end of the core. In the present instance, as may be clearly seen in Fig. 4, the ends of the headers at the opposite ends of the core are located a quarter of a circumference or 90° apart. Consequently, the flow of heating medium, as seen in Fig. 1, is from rear to front through the upper half of the tubular pasageways and return from front to rear through the lower half of the passageways.

The inlet and outlet ducts 11 and 12 may be secured to their respective headers in any suitable manner such as that shown in Fig. 7 wherein the cover 24 is apertured and the margin thereof turned outwardly, as at 28, to provide a flange which fits snugly about an end portion of the duct. The inner end of the duct may be flared outwardly, as at 29, to engage the inner surface of the cover, and the parts are rigidly connected, as by soldering.

The preferred means by which the motor and fan assembly is mounted in place may best be seen in Fig. 1. A plate 30 of substantially the external diameter of the heat transfer core is arranged to be secured between the rear end face of the core and the cooperating headers. The plate has a series of apertures therein to permit of the interfitting connection between the tubular elements on the core and the corresponding parts on the adapter 23. The plate 30 extends radially inwardly a short distance beyond the inner side of the core, is then forwardly and axially offset, as at 31, and terminates in a flat portion 32 extending transversely of the axis of the core. The motor 15 is suitably secured to this flat portion 32, as by screws 33.

Thus, the motor is positioned within and substantially upon the axis of the heat transfer core with its armature shaft 34 extending forwardly to support the fan 16 at the front end of the core. Since the rear end face of the core is closed by the plate 30, operation of the fan in one direction results in an inflow of air into the internal chamber from all directions across the heat radiating fins and the tubes and thence outwardly from the front end of the core. In consequence, an exceedingly large heat transferring area is traversed by the air or whatever other fluid is being circulated and the heat transferring capacity of the structure is exceedingly large. If the fan is driven in an opposite direction, the circulating flow is reversed but the efficiency of the device remains the same.

Where the device is being used as an automobile heater, or in a comparable capacity, it

may be desirable to deflect the air as it passes from the front end of the device or to cause the heated air to flow uniformly in all directions. In this embodiment, a hood member 35, generally in the form of an annular ring, has a flange-like edge 36 which fits rather snugly about the outer surfaces of the headers 21, 22. At spaced intervals this edge 36 is provided with nibs 37 (Fig. 6) which extend rearwardly beyond the headers. At corresponding points, the headers have small brackets 38 secured to the outer face of the adapter plate, which brackets have end portions 39 bent for facing abutment with the nibs. The nibs are apertured and the end portions 39 have inwardly extruded and screw threaded portions 40 to receive screws 41 for securing the parts together.

The ring 35 tapers inwardly as at 42 from the edge portion 36 to overlie the headers 21, 22 and ends in a substantially cylindrical end portion 43 having approximately the same diameter as the internal diameter of the core. Secured within the cylindrical end 43 is a flow deflecting member 44. While any suitable grille or grille-like structure may be employed as the flow deflecting member, that which is shown herein comprises the following structure. A number of sections each embodying a fin 45 and one or more tube elements 46 are formed in the manner which has been previously described. Preferably during the process of forming the tube elements, the edge portions of the fins are suitably bent or turned out of the surface plane thereof to provide deflecting vanes 47. As shown, one edge of each fin between adjacent tube elements is bent to provide two upwardly extending vanes separated by a downwardly extending vane, while the opposite edge of the fin is formed with two downwardly extending vanes separated by an upwardly extending vane. The vanes in this instance are semi-circular in cross section. The tubular elements in the grille materially strengthen the assembly without interfering to any great extent with the flow of fluid through the grille. While a grille of this type is highly efficient in dispersing a flow therethrough in all directions, types of grilles other than that shown may be employed to meet particular requirements.

Preferably means is provided for securing the device to a stationary part such as the bulkhead wall 48 of a vehicle body. Thus, as shown in Figs. 1 and 5, U-shaped brackets 49 are suitably secured, as by spot welding, through their ends to the motor supporting plate 30. The base of each bracket has an extruded and screw threaded boss 50 for engagement by a supporting screw 51 which passes through the wall 48.

It will be evident from the foregoing that an improved heat transfer device has been provided which has an exceedingly high heat transfer capacity for its size. The entire side periphery of the heat transfer unit is open to permit a forced circulation of air or other fluid across every part of the large heat transferring surface. The headers and tubes constituting the circulating system of the heat transferring medium are of large capacity and are substantially unimpeded so that there are no flow impeding pockets or spaces in which sediment may accumulate. Moreover there are no obstructions in the path of the flow which is produced by the fan whereby the full effect of a maximum air flow is obtained. The novel method of producing the heat transfer core or body, together with the simplified details of construction and assembly, provide a device which may be manufactured and sold at a relatively low cost. The heat transfer device may, of course, be used with fluids other than water and may also be employed as a heating or as a cooling device.

I claim as my invention:

1. The method of forming a heat transfer unit of the fin and tube type which comprises the steps of forming a succession of tubes on a strip of material, turning said strip upon itself to cause registration of the tubes in one part of the strip with those in another part thereof while said strip is intact, and connecting the registering tubes.

2. The method of making heat transfer devices of the fin and tube type which includes the steps of forming tubes in a strip of material, turning said strip upon itself to place spaced tubes in registration while said strip is intact, and telescopically joining the registering tubes.

3. The method of making heat transfer devices of the fin and tube type which includes the steps of placing certain tube elements formed on an endless strip of material in registration with other tube elements on said strip while said strip is intact, and connecting the registering tubes.

4. The method of making heat transfer devices of the fin and tube type which includes the steps of forming a series of tube elements on a continuous strip of material, and bending said strip to form a spiral structure in which a number of the tube elements are each in registration with a like number of tube elements to form continuous tubular passageways through the structure.

5. The method of making heat transfer devices of the fin and tube type which includes the steps of forming a series of tube elements on a continuous strip of material, and bending said strip laterally in the plane of its surface to produce a helicoidal winding, the extent of bending and the spacing of the tube elements being such that the tube elements in one turn are caused to register with the tube elements in an adjoining turn.

6. The method of making heat transfer devices of the fin and tube type which includes the steps of forming a series of tube elements on a continuous strip of material, and bending said strip laterally in the plane of its surface to produce a helicoidal winding of annular shape, the extent of bending and the spacing of the tube elements being such that the tube elements are caused to register with other tube elements, and connecting the registering tube elements to form fluid tight tubular passageways from one end of the structure to the other.

7. The method of making heat transfer devices of the fin and tube type which includes the steps of forming a series of tube elements on a continuous strip of material, and bending said strip laterally in the plane of its surface to produce a helicoidal winding of annular shape in which the tube elements in one turn of the strip register with corresponding elements in the adjacent turns to produce a number of tubular passageways, telescoping the registering tube elements together, and securing the parts in fluid tight relationship.

8. The method of making heat transfer devices of the fin and tube type which includes the steps of forming a series of tube elements on a continuous strip of material, and bending said strip laterally in the plane of its surface to produce a helicoidal winding in which the tube elements in one turn of the strip register with corresponding elements in the adjacent turns, and pressing

the registering tube elements together with the end turns disposed substantially in planes perpendicular to the axis of the device.

9. A heat transfer device comprising, in combination, heat transfer means of cylindrical form having radial fins and spaced tubes arranged concentrically about and paralleling the axis of said means, said tubes and said fins being integral with one another and formed from a single strip of material wound continuously in one direction upon itself, a pair of headers at each end of said means, each of said headers being semi-circular to cooperate with half of the tubes and the headers at one end being staggered substantially a quarter circumference with respect to the headers at the opposite end, inlet and outlet ducts connected respectively to the two headers at one end of the heat transfer means, and means mounted centrally within the heat transfer means for inducing a circulating flow across the fins and tubes.

10. A heat transfer device comprising, in combination, heat transfer means of annular form having radially extending fins and spaced tubes arranged substantially concentrically about and parallel with the axis of said means, said tubes and said fins being integral with one another and formed from a single strip of material wound continuously in one direction upon itself, headers at each end of said heat transfer means for directing the course of heat transfer medium through said tubes, and means enclosed by the body of said heat transfer means for producing a circulating flow across said fins and tubes.

11. A heat transfer device comprising, in combination, an annular core having heat transfer fins and passageways for fluid flow, said fins and passageways being integral with one another and formed from a single strip of metal wound continuously in one direction upon itself, means on the opposite ends of said core for directing such fluid flow through the passageways, means for creating circulation of air across said fins and tubes, and a grille traversing one end of said core.

12. A heat transfer device comprising, in combination, an annular core formed of spaced fin elements having tubes traversing said elements, said fin elements and said tubes being integral with one another and formed from a single strip of metal wound continuously in one direction upon itself, headers secured at each end of said core for directing a fluid flow back and forth through said tubes, an inlet and an outlet connected with the headers at one end of said core, a hood member overlying the headers at the other end of said core and defining an annular opening, and a grille mounted on said hood member and traversing said opening.

13. A heat transfer device comprising, in combination, an annular core formed of spaced fin elements having tubes traversing said elements, a series of longitudinally arcuate headers cooperating with the tubes at each end of said core to direct a flow of fluid back and forth through said tubes, a plate secured at one end of said core between said headers and the core proper and having a central and inwardly offset portion, and a fan and motor assembly carried by said offset portion.

14. A heat transfer device comprising, in combination, an annular core formed of spaced fin elements having tubes traversing said elements, said fin elements and said tubes being integral with one another and formed from a single strip of metal wound continuously in one direction upon itself, a series of longitudinally arcuate headers cooperating with the tubes at each end of said core to direct a flow of fluid back and forth through said tubes, an annular member secured to one end of said core in overlying relation to the headers at that end, said member being centrally apertured, and grille-like means traversing the aperture.

15. A heat transfer device comprising, in combination, an annular core having spaced fin elements and tubes traversing said elements, a series of longitudinally arcuate headers cooperating with the tubes at each end of said core to direct a flow of fluid back and forth through said tubes, a plate secured at one end of said core between said headers and the core proper and having a central and inwardly offset portion, and a fan and motor assembly carried by said offset portion, an annular member secured to the other end of said core over the headers at that end, and flow directing means carried centrally by said annular member.

16. A heater for a motor vehicle or the like comprising a relatively small and compact heat transferring member having radiating fins and heating medium conducting tubes traversing said fins, said tubes and said fins being integral with one another and formed from a single strip of material wound continuously in one direction upon itself, said member defining an internal chamber, means for conducting heating medium to, through, and from said tubes, and means located within said chamber for forcing a current of air across said heat radiating fins.

17. A heater for a motor vehicle or the like comprising a relatively small and compact heat transferring member having radiating fins and heating medium conducting tubes traversing said fins, said tubes and said fins being integral with one another and formed from a single strip of material wound continuously in one direction upon itself, said member defining an internal chamber, means for circulating a heating medium through said tubes, means in said chamber for forcing a current of air across the radiating fins, and a support for said last mentioned means traversing and closing one end of said member.

18. A heater for a motor vehicle or the like comprising a relatively small and compact heat transferring core having heat radiating fins and heating medium conducting tubes traversing said fins, said tubes and said fins being integral with one another and formed from a single strip of material wound continuously in one direction upon itself, said core defining an internal chamber, means for conducting heating medium to, through, and from said tubes, a power driven fan mounted within said chamber to produce an air flow across said fins into said chamber and thence outwardly from one end of the core, and flow directing means traversing said last mentioned end.

19. A heat transfer device, comprising a heat transfer means of cylindrical form including a helicoidal winding consisting of a continuous strip of material bent laterally in the plane of its surface, and a series of tube elements formed on said strip and arranged in registering axial relation, said tube elements being joined together to form continuous fluid tight tubes passing through the device.

20. In a device of the character indicated, a unit comprising a continuous strip of material bent laterally in the plane of its surface to form

a spiral structure, means for maintaining a uniform spacing between the adjacent turns of said structure, and means forming a plurality of spaced apart conduits extending through the spiral structure.

21. The method of making heat transfer devices of the fin and tube type which includes the steps of forming a series of tube elements on a continuous strip of material, bending said strip laterally in the plane of its surface to produce a helicoidal winding of annular shape, the extent of bending and the spacing of the tube elements being such that the tube elements are caused to register with other tube elements, connecting the registering tube elements to form fluid tight tubular passageways from one end of the structure to the other, and attaching headers to the opposite ends of the structure to provide for fluid circulation through certain of said passageways in one direction and through the remaining passageways in the opposite direction.

22. The method of making heat transfer devices of the fin and tube type which includes the steps of forming a series of tube elements on a continuous strip of material, bending said strip laterally in the plane of its surface to produce a helicoidal winding of annular shape, the extent of bending and the spacing of the tube elements being such that the tube elements are caused to register with other tube elements, connecting the registering tube elements to form fluid tight tubular passageways from one end of the structure to the other, attaching headers to the opposite ends of the structure to provide for fluid circulation through certain of said passageways in one direction and through the remaining passageways in the opposite direction, and securing means to said structure for creating a circulation of air through said helicoidal winding and about said tubes.

23. A heat transfer device comprising a core structure including superimposed portions of a continuous strip of material, said portions having a plurality of spaced apart openings therein and being crimped to bend them laterally in the plane of their surface, and means connecting certain openings of one of said portions with certain openings of another of said portions to form a plurality of closed fluid passages in said structure.

24. A heat transfer device comprising a core structure including superimposed portions of a continuous strip of material, said portions having a plurality of spaced apart openings therein and being crimped to bend them laterally in the plane of their surface, and means connecting certain openings of one of said portions with certain openings of another of said portions to form a plurality of closed fluid passages in said structure, and headers at the ends of said core structure communicating with a plurality of said closed fluid passages.

25. A heat transfer device comprising a core structure including superimposed portions of a continuous strip of material, said portions having a plurality of spaced apart integral tubular elements therein and being crimped to bend them laterally in the plane of their surface, said tubular elements of one portion being telescoped into tubular elements of another portion to form a plurality of tubular passages in said structure.

26. A heat transfer deviec comprising a core structure including superimposed portions of a continuous strip of material, said portions having a plurality of spaced apart integral tubular elements therein and being crimped to bend them laterally in the plane of their surface said tubular elements of one portion being telescoped into tubular elements of another portion to form a plurality of tubular passages in said structure, and headers at the ends of said core structure communicating with a plurality of said tubular passages.

27. The method of making a core for a heat transfer device which comprises, forming a succession of tube elements in portions of strip material, crimping the strip material to cause bending thereof laterally in the plane of its surface, and superimposing similarly formed portions upon the first portion to form a curved structure in which a number of tube elements are each in registration with a like number of tube elements to form tubular passageways through the structure.

28. The method of making a core for a heat transfer device which comprises, forming a succession of tube elements in portions of strip material, crimping the strip material along one of its longitudinal edges to cause bending thereof laterally in the plane of its surface, and superimposing similarly formed portions upon the first portion to form a curved structure in which a number of tube elements are each in registration with a like number of tube elements to form tubular passageways through the structure.

29. A heat transfer device comprising in combination an annular core having heat transfer fins and tubes forming passageways for fluid flow, said fins and tubes being integral with one another and formed from a single strip of metal wound continuously in one direction upon itself, headers on one end of the core communicating with certain of the fluid passageways, headers on the opposite end of the core communicating with said certain of the fluid passageways and with other passageways, said headers being arranged to cause flow of fluid in one direction through said certain of the passageways of said core and in the opposite direction through said other passageways thereof, and means for creating circulation of air across said fins and tubes.

30. A heat transfer device comprising in combination, an annular core having heat transfer fins and tubes forming passageways for fluid flow, said fins and tubes being integral with one another and formed from a single strip of metal wound continuously in one direction upon itself, headers on one end of the core communicating with certain of the fluid passageways, headers on the opposite end of the core communicating with said certain of the fluid passageways and with other passageways, said headers being arranged to cause flow of fluid from a header at one end of said device through said certain of the passageways of said core to a header at the opposite end of the device and thence from the header at the opposite end of said device through said other passageway of said core to a header at said one end of the device, and means for creating circulation of air across said fins and tubes.

JOHN KARMAZIN.