July 20, 1965 F. DRUSEIKIS ETAL 3,195,626

HEAT EXCHANGER

Filed July 9, 1962

3 Sheets-Sheet 1

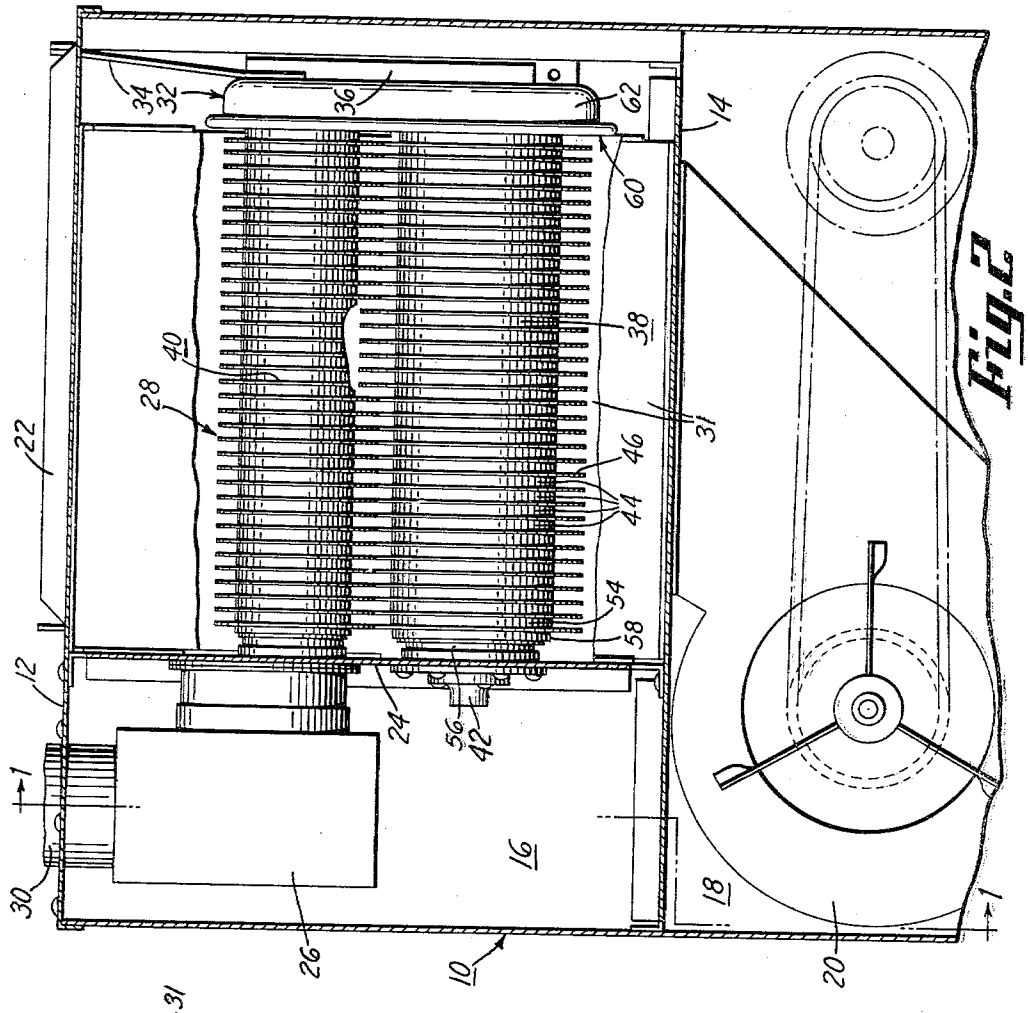


Fig. 2

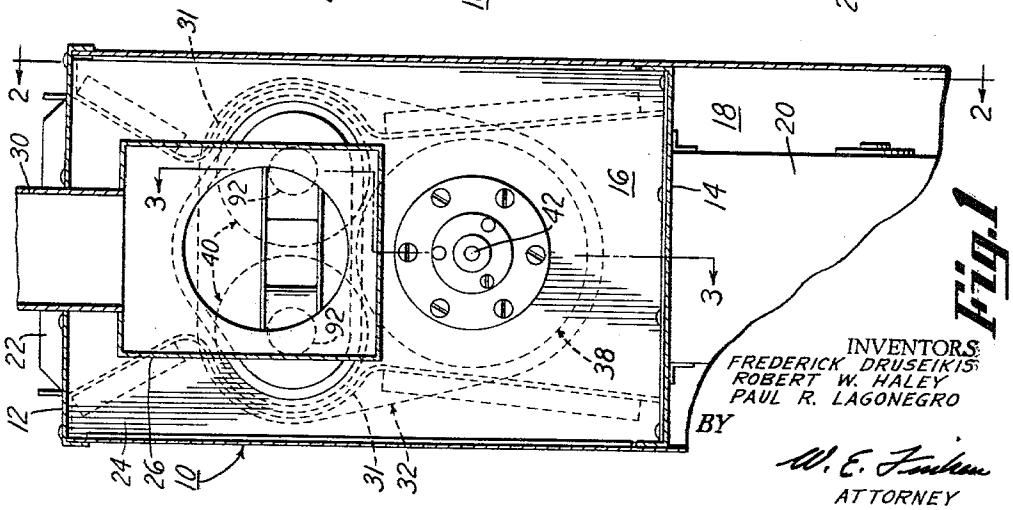


Fig. 1

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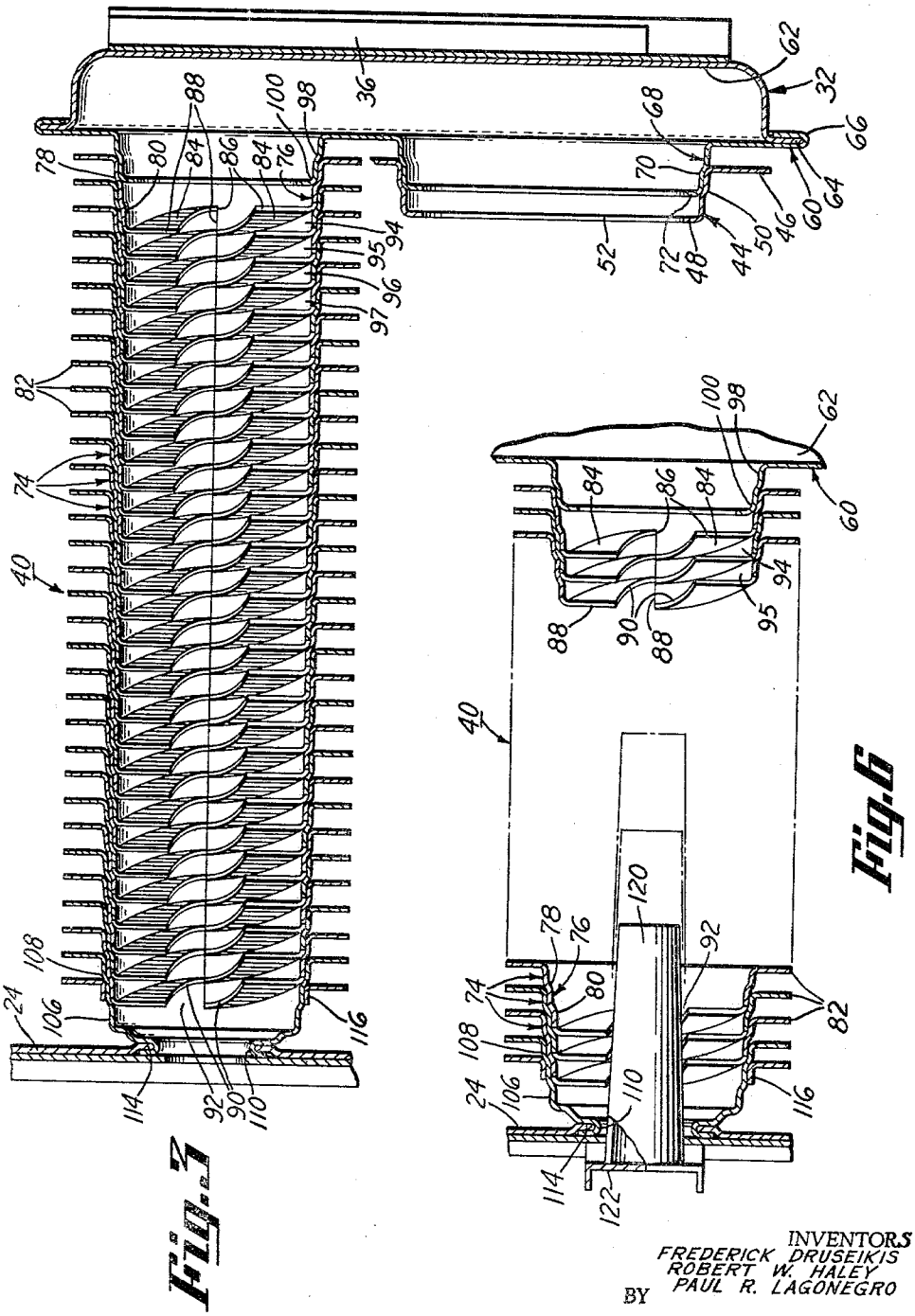


Fig. 7

Fig. 6

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Fig. 4.

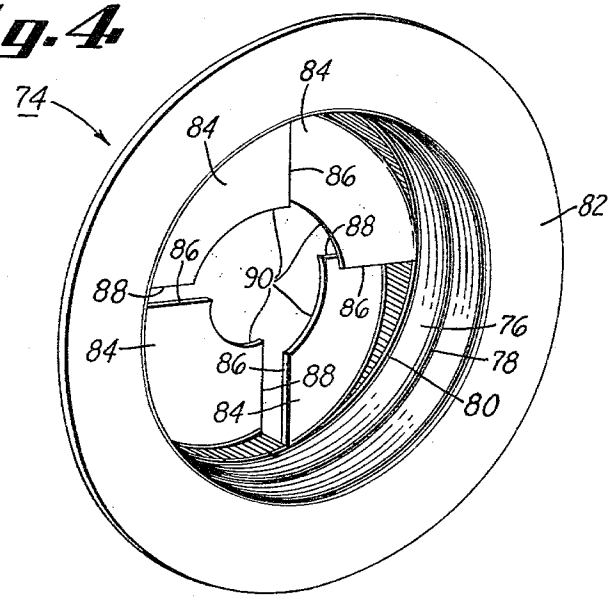
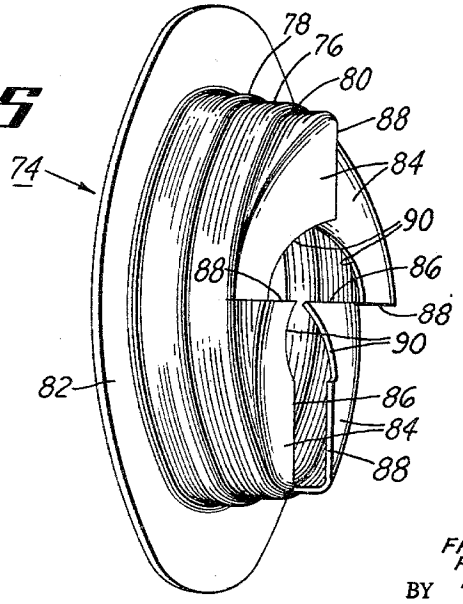


Fig. 5.



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United States Patent Office 3,195,626 Patented July 20, 1965

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HEAT EXCHANGER

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Filed July 9, 1962, Ser. No. 208,316
7 Claims. (Cl. 165—179)

This invention pertains to heat exchangers, and particularly to a heat exchanger having internal and external extended surfaces.

Heretofore, sheet metal heat exchangers having internal and external extended surface portions, in the form of fins, have been made from strip stock having laterally offset edges, which strip stock is spirally wound with adjacent convolutions overlapping and rigidly united to form a tube. This type of heat exchanger tube has spiral internal and external fins which facilitate the exchange of heat between fluids inside and outside thereof. The present invention relates to a heat exchanger comprising a plurality of rings arranged in stacked relation, each ring having an external annular fin and a plurality of spiral, or helical internal fin segments. When the rings are assembled in stacked relation and rigidly secured together, they form a tube having spaced, external annular fins and internal spiral fins which define a plurality of helical passages therethrough.

Accordingly, among our objects are the provision of an improved extended surface tubular heat exchanger; the further provision of a tubular heat exchanger having equidistantly spaced, parallel, external annular fins and segmental helical internal fins which define a plurality of helical internal passages therebetween with a central opening therethrough; the further provision of a heat exchanger of the aforesaid type having core means for the central opening defined by the inner edges of the segmental internal helical fins; and the still further provision of an improved heat exchanger section, or ring, having an annular external fin, an annular body with multiple offset portions, and a plurality of internal helical fin segments.

The aforementioned and other objects are accomplished in the present invention by nesting, or interfitting, the annular body portions of a plurality of heat exchanger sections to form a tubular stack with the radial ends of the internal helical segmental fin portions of adjacent sections abutting, and thereafter rigidly securing the plurality of sections together by copper brazing or welding. Specifically, as disclosed, the annular body of each heat exchanger section is formed with multiple offset portions between its ends to provide spaced, intermediate annular stop shoulders. One edge of each section is outwardly flanged at right angles to the annular body to form an annular external fin, and the other edge is formed with four inwardly extending helical fin segments, the inner peripheral edges of which define a circular central hole. The internal helical fin segments of the stacked heat exchanger sections define four spiral passages therethrough. The tubular heat exchanger can be used with or without a central core which, if used, completely closes the central hole through the stacked sections.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein preferred embodiments of the present invention are clearly shown, and wherein similar numerals depict similar parts throughout the several views.

FIGURE 1 is a fragmentary view, partly in section and partly in elevation, of a forced warm air furnace

embodying the heat exchanger of the present invention, taken generally along line 1—1 of FIGURE 2.

FIGURE 2 is a fragmentary view, partly in section and partly in elevation, with certain parts broken away, taken along line 2—2 of FIGURE 1.

FIGURE 3 is an enlarged fragmentary sectional view taken along line 3—3 of FIGURE 1.

FIGURE 4 is an enlarged perspective view of one end of the improved heat exchanger section.

FIGURE 5 is an enlarged perspective view of the other end of the improved heat exchanger section.

FIGURE 6 is a fragmentary view, partly in section and partly in elevation, of a modified form of the heat exchanger.

With reference to FIGURES 1 and 2, the improved heat exchanger is shown in combination with a forced warm air furnace having a casing 10 comprising front, rear and side walls, with a top wall 12 suitably secured thereto and a bottom wall, not shown. In addition, the casing 10 has an intermediate substantially horizontal partition wall 14 dividing the casing into an upper compartment 16 and a lower compartment 18. A conventional motor driven blower 20 is located in the lower compartment 18, the blower, when operating, discharging air to be heated into the upper compartment 16 for delivery through an opening 22 in the top wall 12. The upper chamber 16 has a vertical partition 24 attached to the top wall 12 and the horizontal partition 14, the partition 24 constituting a mounting plate for a flue gas collector box 26 and an integral combustion shell and heat exchanger assembly 28, the collector box 26 and the assembly 28 being disposed on opposite sides of the partition panel 24. The interior of the flue gas collector box communicates with a stack 30 through an opening in the top wall 12 of the casing.

The integral heat exchanger and combustion shell assembly 28 is shrouded by a pair of side baffles 31 which confine air flow from the blower to a path contiguous to the extended surface portions of the heat exchanger. The assembly 28 comprises a header 32 which is supported by a bracket 34, and has a plurality of substantially vertically extending, laterally spaced U-shaped fins 36 welded, or brazed, to its end wall. The integral combustion shell and heat exchanger assembly 28 also comprises a multiple section, externally finned combustion shell 38, and a pair of multiple section, externally finned heat exchanger tubes 40. A fuel burner 42 is supported by the partition panel 24 and extends into the tubular combustion shell 38.

Referring to FIGURE 3, the combustion shell 38 comprises a plurality of nested, or interfitting, rings 44. Each ring 44 has an annular body with an outwardly extending annular flange 46 along one edge and an inwardly extending annular flange 48 at its other edge, with an offset in its annular body intermediate its edges to form an annular stop shoulder 50. The stop shoulders 50 on the rings 44 enable the plurality of rings 44 to be assembled in stacked, nested relation to form a double thickness wall, which nested, or interfitted, rings are rigidly secured together such as by welding, or brazing. The inwardly extending annular flanges 48 define a central circular opening 52 for accommodating the burner 42. A combustion shell mounting ring 54 has a neck portion 56 suitably secured to the periphery of an opening in the partition panel 24, and supports a transfer ring 58. Both the mounting ring 54 and the transfer ring 58 have outwardly extending annular flanges 46, the flanges 46 on the several sections constituting integral extended surface portions, or fins.

The header 32, as seen in FIGURE 3, comprises a junction plate 60 and a dish-shaped cover 62, the cover 62 having a flanged edge 64 over which the edge 66 of the

junction plate 60 is clinched to obtain a gas tight joint. The junction plate 60 is formed with an integral ring portion 68 adapted to interfit with the end ring 44 of the combustion shell. Thus, the ring portion 68 is offset intermediate its edges to form an annular stop shoulder 70 for the end ring 44, and likewise has an inwardly extending annular flange portion 72 at its outer edge. It is to be understood that the end ring 44 is welded or otherwise suitably connected to the ring portion 68.

Referring to FIGURES 4 and 5, each heat exchanger tube 40 comprises a plurality of nested, or interfitted, ring, or cup, sections 74. The rings 74 are preferably formed of sheet metal which is stamped and drawn to the desired form. Each ring 74 has an annular body 76 with a pair of offsets between its ends to provide axially spaced annular shoulders 78 and 80 of different diameter. In the assembly of the rings only one of the shoulders 78 or 80 is used as a stop. One end of each ring 74 is formed with an outwardly extending annular flange 82, and the other end of each ring is formed with four inwardly extending segmental helical fins 84. Each segmental helical fin 84 has axially offset, substantially radial ends 86 and 88, with the ends adjacent the fins being in substantial alignment with each other although axially spaced apart. The inner peripheral edges 90 of the segmental fin 84 are arcuate such that when a plurality of rings 74 are interfitted with each other, the radial ends of the helical fin segments of adjacent rings abut each other, and the inner peripheral arcuate edges 90 define a substantially circular hole 92 through the tubular heat exchanger 40 as seen in FIGURES 1 and 3.

Each heat exchanger tube 40 comprises a stack of interfitted rings 74, each shoulder 80 forming a seat, or stop, for each adjacent ring so as to equidistantly space the annular external flanges, or fins, 82 which lie in spaced parallel planes. The offset portions of the annular bodies 76 of adjacent rings form a continuous double thickness side wall for each heat exchanger tube 40, adjacent rings being rigidly secured together such as by welding, or brazing, the offset annular body portions thereof. In addition, during assembly of the rings 74 to form the heat exchanger tube 40, the axially outward offset radial ends 88 of the four segmental helical fins 84 of each ring 74 are arranged to abut the axially inward offset radial ends 86 of the segmental helical fins of the next succeeding ring 74 from the header 32 to the partition panel 24. By so interfitting the rings 74 four separate and distinct spiral, or helical, passages 94, 95, 96 and 97 are formed by the segmental internal helical fins of the several rings 74 throughout the length of each heat exchanger tube 40. Each helical passage 94, 95, 96 and 97 makes a complete turn through the axial distance of four rings 74. Moreover, as alluded to hereinbefore, the interfitted rings 74 define a substantially circular central through passage 92.

The junction plate 60 is formed with a pair of integral ring portions 98 adapted to interfit with the end ring 74 of each tubular heat exchanger 40. Each ring portion 98 has two intermediate offsets forming an annular stop shoulder 100, the end ring 74 being welded or otherwise suitably connected to the ring portion 98.

At the other end of each heat exchanger tube, the shoulder 80 of end ring 74 seats against a complementary offset portion of a mounting ring 106 having a shoulder 108. The mounting ring 106 has its inner edge 110 clinched over the peripheral edge 114 defining an opening in the partition panel 24. A transfer ring 116 seats against the shoulder 108 of the mounting ring 106, both the transfer ring 116 and the mounting ring 106 having outwardly extending annular fins 82.

In a modified embodiment as shown in FIGURE 6, the heat exchanger tube 40 has a central tapered core 120 with an imperforate end cap 122, the core 120 extending through the circular opening 92 formed through the nested ring sections 74 so as to substantially close the same. In this embodiment the flow of fluid internally of the heat exchanger tube 40 is substantially confined to the four helical passages 94, 95, 96 and 97 formed by the internal segmental helical fins of the ring sections 74. While the core 120 increases the restriction to flow through the heat exchanger tube, it also increases the efficiency of heat transfer between the internal and external fluids, be they gaseous or liquids, since substantially all of the internal fluid must flow in multiple spiral paths and is thus in intimate contact with the internal extended surface portions of the heat exchanger tube throughout its length. The core 120 can be of different lengths, as shown in phantom in FIGURE 6, to obtain the desired heat transfer efficiency.

In both embodiments of the improved tubular heat exchangers disclosed herein, the number of internal helical passages formed by the segmental helical fins can be changed by varying the number of regimental helical fins on each ring section. The extent of the axial flow required for a complete turn, or revolution of the fluid through the helical passages is directly proportional to the number of segmental helical fins on each section. Thus, with the specifically disclosed ring sections, the fluid traverses an axial distance of four ring sections while making a complete turn. The multiple helical passages greatly increase the efficiency of heat transfer between the internal and external fluids.

While the embodiments of the invention as herein disclosed constitute preferred forms, it is to be understood that other forms might be adopted.

We claim:

1. A tubular heat exchanger including, a plurality of interfitting rings, each ring comprising an annular body having an outwardly extending, annular fin at one end and a plurality of inwardly extending, segmental helical fins at its other end, stop means on said annular body engageable with the adjacent ring to space the annular fins equidistantly apart, the ends of the segmental helical fins of adjacent rings abutting each other and defining a plurality of internal helical passages in the heat exchanger equal to the number of segmental helical fins on each ring.

2. A tubular heat exchanger including, a plurality of interfitting rings, each ring comprising an annular body having an external, annular fin at one end and a plurality of internal, segmental helical fins at its other end, means on said annular body defining a stop for the adjacent ring to space the external fins equidistantly apart, the internal segmental helical fins of each ring having arcuate inner peripheral edges with the internal segmental helical fins of adjacent rings abutting each other to define a plurality of internal helical passages in said heat exchanger equal to the number of internal segmental helical fins on each ring, the arcuate inner peripheral edges of the internal segmental fins on adjacent rings defining a substantially cylindrical passage through the heat exchanger.

3. The tubular heat exchanger set forth in claim 2 including a tubular core having a closed outer end disposed within said substantially cylindrical through passage so as to substantially close the central through passage.

4. A tubular heat exchanger including, a plurality of interfitting rings, each ring comprising an annular body having an external, annular fin at one end and a plurality of internal, segmental helical fins at its other end, means on said annular body constituting a stop for the adjacent ring to space the external fins equidistantly apart, adjacent internal segmental helical fins of each ring having axially offset, radially aligned ends, the axially outward offset ends of the segmental helical fins on each ring abutting the axially inward offset ends of the segmental helical fins on the next adjacent ring to define a plurality of internal helical passages in the heat exchanger equal to the number of segmental helical fins on each ring.

5. A tubular heat exchanger including, a plurality of interfitting rings, each ring comprising an annular body having an external, annular fin at one end and a plurality of internal, segmental helical fins at its other end,

means on said annular body constituting a stop for the adjacent ring to space the external fins equidistantly apart, adjacent internal segmental helical fins on each ring having axially offset aligned, substantially radial ends, the radial ends of the segmental helical fins of adjacent rings abutting each other and defining a plurality of internal helical passages in the heat exchanger equal to the number of segmental helical fins on each ring with each helical passage making a complete turn throughout the axial distance of the number of interfitting rings equal to the number of internal segmental helical fins on each ring.

6. The tubular heat exchanger set forth in claim 5 wherein the means on the annular body constituting a stop for the adjacent ring comprises an offset in said annular body intermediate its ends defining an annular stop shoulder.

7. The tubular heat exchanger set forth in claim 5

wherein the inner peripheral edge of each segmental helical fin on each ring is arcuate, and wherein adjacent arcuate inner peripheral edges of the internal segmental helical fins of said plurality of interfitting rings define a substantially cylindrical passage therethrough.

References Cited by the Examiner

UNITED STATES PATENTS

1,880,533	10/32	Thomas	165—179
2,703,701	3/55	Simpelaar	165—141
2,925,830	2/60	Kantrowitz	165—179
3,068,905	12/62	Millington et al.	165—179 X

FOREIGN PATENTS

514,015	11/20	France.

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