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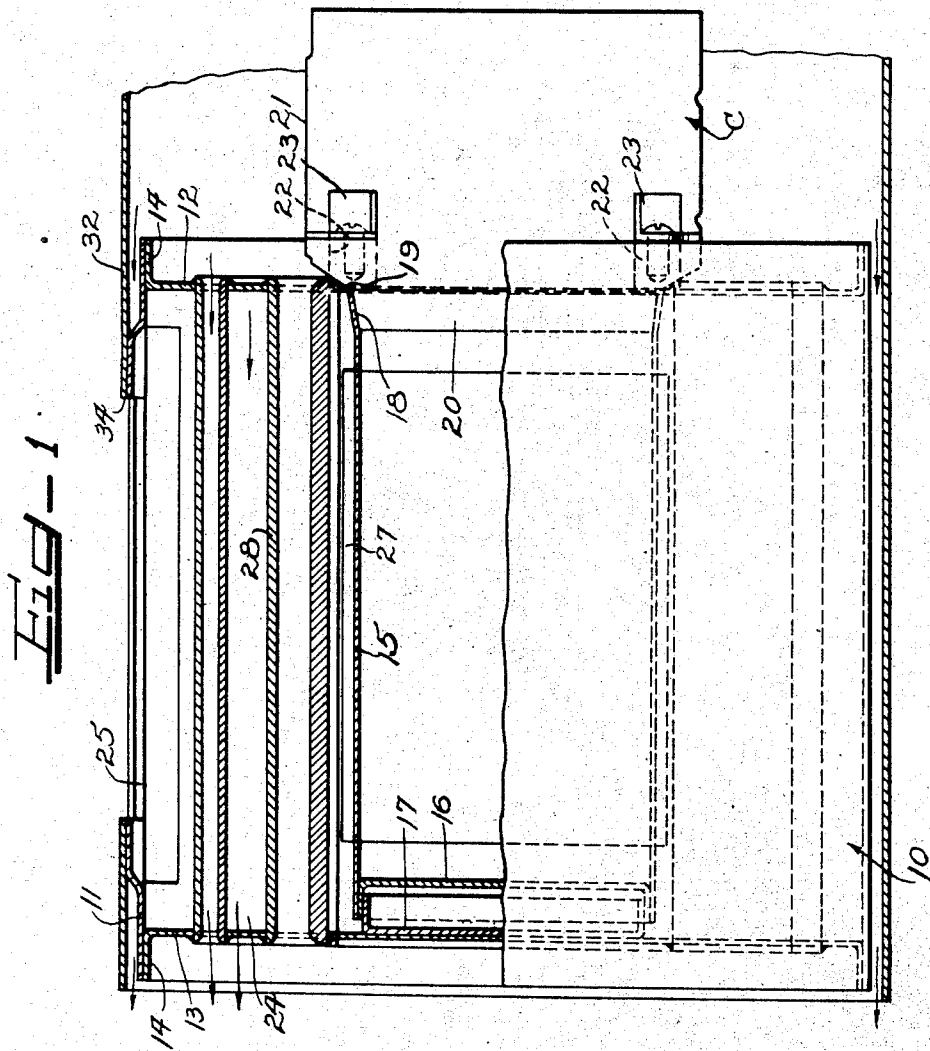
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HEAT EXCHANGER

Filed April 29, 1944

2 Sheets-Sheet 1



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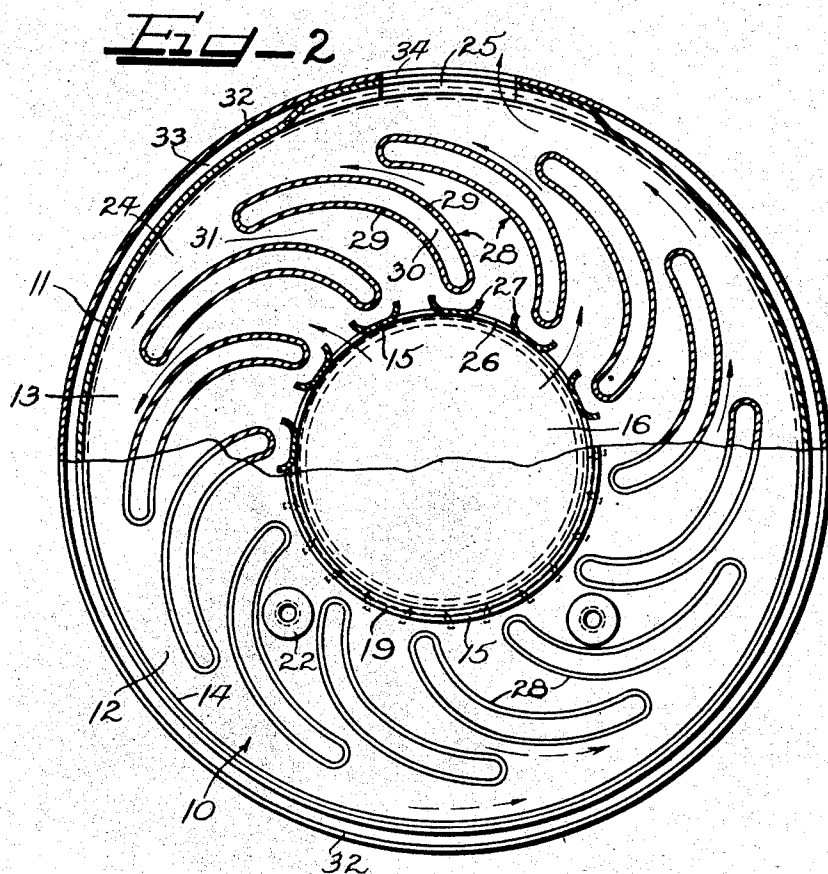
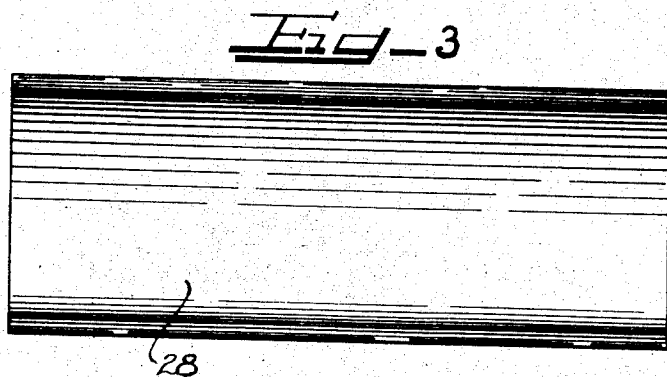
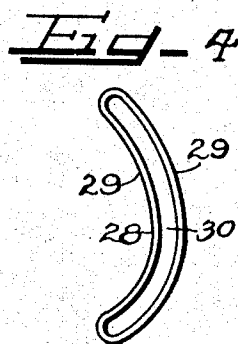
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2,421,371

HEAT EXCHANGER

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Application April 29, 1944, Serial No. 533,295

7 Claims. (Cl. 257-241)

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This invention relates to heat inter-changers adapted generally for the inter-change of temperature between fluids flowing in separate paths therethrough, but designed more particularly for use in heater structures for vehicles such as busses, for transfer of heat from products of combustion to air flowing through air ducts for delivery to space to be heated.

An important object of the invention is to produce a compact efficient exchanger of cylindrical form into which products of combustion, as from a hydrocarbon combustion chamber, may be delivered thereinto in axial direction to be directed radially outwardly for flow between and transversely of air ducts which are shaped and relatively located to form passageways for directing the flow in spiral streams toward an exhaust outlet.

Another object is to provide an arrangement in which a core shell defines, with a cylindrical surrounding shell, an annular flow chamber into which the heat products are directed radially from the interior of the core shell, with air flow ducts extending in axial direction through the flow chamber and with the air ducts in the form of narrow flat tubes curved transversely into substantially involute or spiral shape and so arranged within the flow chamber as to cooperate to define convergent spiral paths for flow of the heat products towards the surrounding wall of the outer shell for flow in rotary direction to an outlet in said outer wall.

Another object of this invention is to provide a heat exchanger embodying a plurality of converging parallel passages which are so arranged that the velocity of heated gases flowing past the tubes defining such passages is gradually increased as the temperature of the gases decreases.

Other objects and features will become apparent from the following specification in connection with the accompanying drawings, in which drawings:

Figure 1 is a side elevation of the heat exchanger partly in diametral section and showing a combustion structure from which products of combustion may be directed into this exchanger;

Figure 2 is an end view of the exchanger partly in transverse section;

Figure 3 is a side view of one of the air ducts; and

Figure 4 is an end view of the air duct.

The exchanger shown comprises a cylinder shell structure 10 having an annular wall 11 whose ends receive the inner and outer end walls 12 and 13, these end walls having preferably out-

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wardly directed peripheral flanges 14 for seating in the ends of the wall 11 to be secured thereto as by welding. Within the cylinder shell and concentric therewith is the core shell or tube 15 whose inner end is closed by a flanged wall 16 which telescopes the flanged wall 17 secured to the inner side of the outer end wall 13.

The outer end portion 18 of the core tube 15 is flared outwardly and terminates in the inlet opening 19 in the end wall 12. This flared end portion is adapted to receive the funnel shaped end wall 20 of a suitable heat producing source such as a combustion structure C disclosed in my co-pending application Serial No. 533,294, filed April 29, 1944, through whose inlet 21 combustion mixture, such as air and hydrocarbon fuel, is received for combustion within the combustion structure and delivery of the products of combustion under pressure into the core tube 15 of the exchanger.

The end wall 12 is shown provided with threaded studs 22 on which the combustion structure to be employed may be mounted. The combustion structure C shown has brackets 23 thereon through which screws may extend into the studs to support the combustion structure in axial alignment with the exchanger and with its outlet end 20 snugly seated in the flared end of the core shell 15.

The cylinder shell 10 and the core shell 15 therein define the annular chamber 24. A portion of the wall 11 is deflected radially outwardly and cut out to provide a longitudinally extending exhaust outlet 25 from the chamber 24. The heat products which flow axially into the core tube 15 are directed outwardly through longitudinally extending openings 26 in the core tube, these openings being provided by deflecting and extruding the metal to leave the outwardly directed guide wings 27 along the side edges of the openings.

Extending longitudinally through the annular chamber 24 between the end walls 12 and 13 are the air ducts 28 whose ends project through openings in the end walls and are secured thereto as by welding. The air ducts are comparatively narrow but of extended transverse width and of substantially spiral or involute cross-section. The ducts may readily be formed by transversely bending comparatively narrow flat tubing into the spiral or involute shape shown. The ducts are equally spaced apart in a circular row within the chamber 24 with their inner edges adjacent to the core shell between the passages 26,

while the ducts terminate at their outer edges a distance inwardly from the shell 11.

In the form of duct shown, the wide side walls 29 are parallel, the flow passageway 30 therebetween being comparatively narrow. As shown, the ducts are so relatively positioned and inclined that they will overhang the outlets 26 and the outer portion of each duct will overhang the inner portion of the next duct so that the ducts will act as baffles and will define outwardly converging spiral passageways 31 between the ducts. The heat producing medium delivered to the exchanger flows radially outwardly from the core shell 15 through the outlets 26 into the passageways 31 for flow therethrough in spiral direction into the outer part of the chamber 24 between the outer edges of the ducts and the shell 11 where the flow will be in circular direction toward and out through the exhaust outlet 25. The wings or tongues 27 along the sides of the outlet openings 26 serve to direct the flow into the passageways 31. The wide side walls of the ducts present extensive area to be contacted by the heat medium for corresponding absorption of heat by air flowing through the duct passageways 30, and the converging passageways 31 will cause the velocity of flow of the heat medium to gradually increase as the temperature thereof decreases whereby the metal of the tubes and the air flow therethrough will be uniformly heated.

As shown, the exchanger could be mounted in the outlet end of a tubular housing 32 into whose inlet end air under suitable pressure is directed as by a blower (not shown). A combustible mixture under pressure would then enter the fuel inlet 21 of the combustion structure C for flow of the products of combustion under pressure into and through the exchanger and out of the exchanger outlet 25, and air under pressure will flow outwardly through the exchanger air ducts for delivery to the space to be heated. Clearance space 33 could be left between the exchanger shell 11 and the housing 32 for outflow of air which would receive heat from the shell 11 to be delivered into the space to be heated. The deflected portion at the top of the shell 11 through which the exhaust opening 25 from chamber 24 extends could be welded to the wall of the housing 32 which would be cut out to provide the opening 34 in alignment with the exhaust outlet 25.

All the parts of the heat exchanger disclosed may be readily formed from comparatively light gauge sheet metal, such as steel, and the various parts may be readily assembled and secured, as by welding. The shape of the air ducts and their arrangement and cooperation within the exchanger will result in maximum temperature exchange and maximum efficiency.

I have shown a practical and efficient embodiment of the features of my invention but I do not desire to be limited to the exact construction, arrangement and operation shown and described, as changes and modifications may be made without departing from the scope of the invention.

I claim as my invention:

1. A heat exchanger comprising a cylinder wall having inner and outer end walls and a core tube therein to define an annular chamber, said inner end wall having an inlet opening therethrough to said core tube, ducts extending through said chamber, said cylinder wall having an outlet to the exterior from said chamber, there being openings in said core tube to connect the interior thereof with said chamber whereby medium directed into said core tube through said end wall

inlet opening will flow into and through said chamber into contact with said ducts and out of said outlet and the medium flowing through said ducts will be subjected to the temperature of the medium flowing through said chamber, said ducts being equally spaced in an annular row around said core tube and said ducts being in the form of flat tubes curved transversely to extend substantially in involute or spiral direction from said core tube and terminating short of said cylinder wall to leave an annular space between their outer edges and said cylinder wall whereby the medium flowing through the passageways between said ducts will be directed spirally into said annular space for flow through said space in circular direction to said outlet, said passageways converging to cause the velocity of flow therethrough to gradually increase as the temperature thereof decreases whereby the metal of the ducts and air flow therethrough will be uniformly heated.

2. A temperature exchanger comprising a cylinder shell having a core shell therein concentric therewith to define an annular chamber, said cylinder shell having a side outlet for outflow from said chamber, said core shell being open to the exterior of said cylinder shell at one end thereof for reception of medium under pressure at one temperature, said core shell having longitudinally extending outlet openings for flow of the medium radially into said chamber, ducts extending longitudinally through said chamber for flow therethrough of medium at another temperature, said ducts being comparatively narrow but of extended transverse width and being transversely curved, said ducts being arranged in a circular row around said core shell in spaced relation to define converging passageways therebetween for flow of the medium from said core shell outlets to said side outlet and for causing the velocity of the flow of the medium to gradually increase as the temperature thereof decreases whereby the metal of said ducts and the air flow therethrough will be uniformly heated.

3. A temperature exchanger comprising a cylinder shell having a core shell therein defining therewith an annular chamber, a side outlet in said cylinder shell for said chamber, said core shell being open at one end to the exterior of the cylinder shell for reception of medium flow under pressure, said core shell having longitudinally extending outlets in its wall for flow of the medium radially therefrom into said chamber for flow therethrough to said outlet, ducts extending longitudinally through said chamber and arranged in spaced relationship around said core shell with the spaces therebetween aligned with said core shell outlets, said ducts being comparatively narrow but of extended transverse width and being curved transversely to substantially spiral cross-section and with the passageways between the ducts converging outwardly to gradually increase the velocity of the medium flow as the temperature of the medium decreases whereby to effect efficient inter-change of temperature between said medium and the medium flowing through the ducts.

4. A temperature exchanger comprising a cylinder shell having a core shell therein defining therewith an annular chamber, a side outlet in said cylinder shell for said chamber, said core shell being open at one end to the exterior of the cylinder shell for reception of medium flow under one pressure under one temperature, said core shell having longitudinally extending outlets in its wall for flow of the medium radially there-

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from into said chamber for flow therethrough to said outlet, ducts extending longitudinally through said chamber and arranged in spaced relationship around said core shell with the spaces therebetween aligned with said core shell outlets, said ducts being comparatively narrow but of extended transverse width and being transversely curved, the transverse width and curvature being such that the passageways between the ducts will converge outwardly for gradual increase in velocity of the flow medium therethrough to compensate for decreasing temperature of the flow medium to thereby effect uniform temperature interchange between said medium and the medium flowing through said ducts.

5. A heat exchanger comprising a cylinder shell having a core shell therein defining therewith an annular chamber, said core shell being open at one end for the reception of products of combustion from a combustion source, air ducts extending longitudinally through said chamber and open at their ends to the exterior of said cylinder shell for flow therethrough of air to be heated, said core shell having longitudinally extending outlet openings for radial outflow of the products of combustion from said core shell into the spaces between said air ducts, said cylinder shell having a side outlet for flow of the products of combustion from said chamber, said air ducts being in the form of comparatively wide flat tubes curved transversely and so arranged relatively as to overhang the outlets from said core shell and to define outwardly convergent passageways through which the products of combustion are directed in tangential direction toward the outer wall of the cylinder shell for flow to said outlet and whereby the velocity of the hot products of combustion is gradually increased as the temperature thereof decreases and the air flow through said tubes will be uniformly heated.

6. A heat exchanger comprising a cylinder shell and a core shell therein defining therewith an annular chamber having an outlet in the side wall of the cylinder shell, a circular row of narrow but comparatively wide air ducts extending into said chamber around said core shell, said core shell being open at one end for reception of products of combustion under pressure, said core shell having longitudinally extending outlet openings for flow of the products of combustion radially

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into the spaces between said air ducts, and guide tongues along the sides of said outlets for directing the flow into said spaces, said air ducts being inclined to overhang said outlets whereby to baffle the flow of the products of combustion through said spaces for prolonged contact thereof with the walls of the ducts for efficient heating of the air flow through the ducts.

7. A heat exchanger comprising an outer cylindrical shell having a side outlet, a core shell mounted within said outer shell and defining therewith an annular chamber, said core shell being open at one end for the admission of a fluid flow and closed at the other end and having longitudinally extending outlets for radially outward flow of said fluid into said annular chamber, and open-ended ducts extending through said chamber the full length thereof for the passage therethrough of a second fluid for indirect heat exchange with said first fluid, said ducts being arranged in spaced relationship around said core shell with the spaces therebetween aligned with said core outlets and being comparatively narrow but of extended transverse width and transversely curved, the transverse width and curvature being such as to provide full length spiral passageways between said ducts that converge outwardly for gradually increasing the flow velocity of said first fluid therethrough, the outer ends of said ducts terminating in spaced relationship to said outer shell, whereby said first fluid is caused to flow spirally through said passageways and circularly between the outer ends of said ducts and the inside surface of said outer shell before passing out through said outlet.

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