June 5, 1956 W. HARTWIG 2,749,110

RECUPERATOR

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Fig. 1

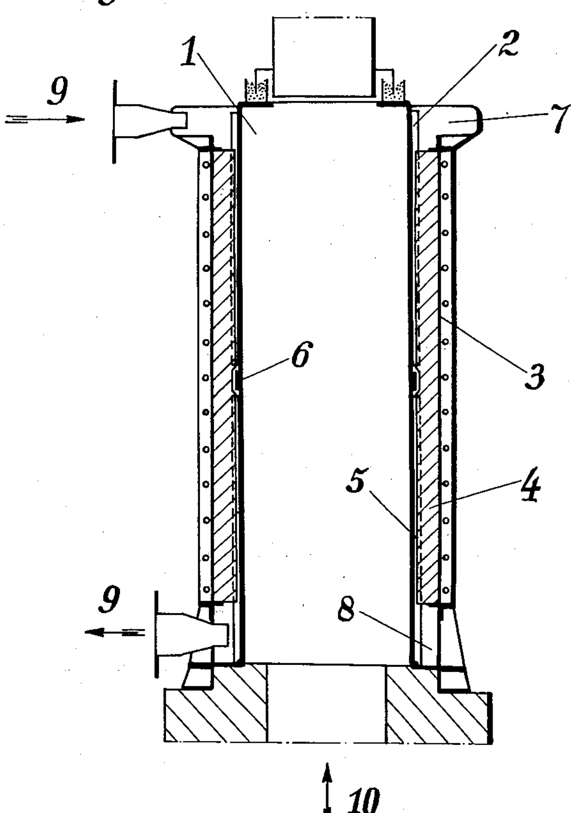
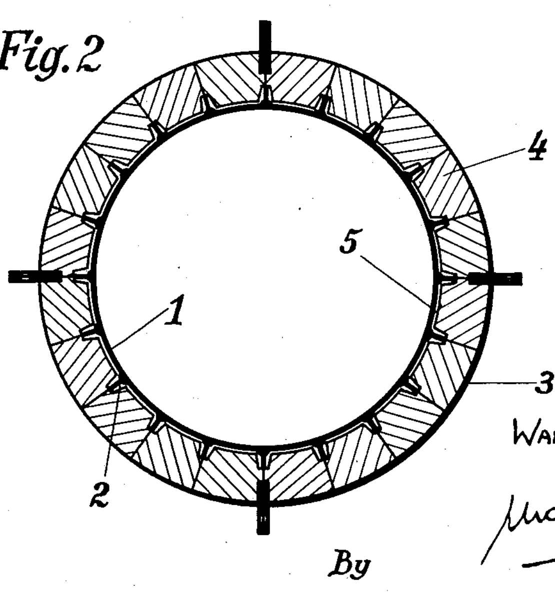


Fig. 2



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RECUPERATOR

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7 Claims. (Cl. 263—20)

The present invention relates to a recuperator for heating air, vapors or other gaseous media. Such recuperators are used in industry in connection with such apparatus such as smelting furnaces, combustion chambers, and the like, for heating by means of otherwise useless, highly heated combustion or waste gases discharged therefrom air, vapor, or other gaseous media. Of particular significance is the use of such recuperators as air heaters.

In particular, the invention concerns a recuperator, consisting of an outer wall and an inner steel tube having ribs for spacing the tube from the wall. The heat transmitting medium then passes through the tube and the heat absorbing medium flows through the annular gap between the tube and the wall. In the case of these recuperators, the heat radiation of the hot flue or fuel gases has an important effect in the heating of the medium flowing between the tube and the wall. Known recuperators of this kind are only suitable for small outputs and comparatively low flue gas temperatures with a correspondingly low heat output, since such recuperators become distorted and useless in a short time with higher temperatures.

The invention aims at providing a recuperator of the afore-mentioned kind which, with a high output and dimensions of any desired size also can operate satisfactory at flue gas temperatures of 1300–1350° C. with a preheating of the medium to 800–900° C.

According to the present invention this is obtained by the fact that the outer wall, which is preferably fitted on the outside with a jacket of metal sheet or plate, consists of shaped insulating bricks with recesses for housing the ribs the depth of the recesses corresponding to the length of the rib minus the width of the gap. These bricks are so formed that the gap for the medium to be heated between the tube and the shaped bricks may be maintained at the actual width necessary for a high velocity of the air to be heated and consequently a good heat transmission. The ribs apart from keeping the shaped bricks at a distance from the internal tube, also serve for heat transmission as well as for stiffening the tube. The gap provided, even if it is ever so slight, is always guaranteed by the distancing. The shaped bricks are also comparatively rough, so that a strong whirling action is effected at the same time, which assists the heat exchange considerably. For this purpose the ribbed tube may also be provided with irregularities or the like.

The invention will be described further, by way of example, with reference to the accompanying drawings, in which:

Fig. 1 is a longitudinal section; and

Fig. 2 is a cross section on a larger scale.

The recuperator consists of an internal tube **1** of suitable heat resistant material such as steel, on which are mounted ribs **2** for strengthening and to improve the heat exchange characteristics. A removable outer jacket **3** is lined with specially shaped bricks **4**. These bricks are so formed that a gap **5** of the desired width is created between the tube **1** and the bricks **4**. As the bricks **4** abut on the ribs **2**, the desired spacing of the bricks from the tube is accurately maintained. In the case of larger recuperators the internal tube **1** is reinforced by strengthening bands **6**. For the inlet and outlet **9** of air, annular spaces **7** and **8** are provided, through which the medium to be heated is equally distributed over the cross sectional area of the gap **5**. The medium enters the annular chamber **7** under pressure, which space is at the same time adapted as an expansion member for absorbing the difference in expansion between the tube **1** and the jacket **3**, flows through the gap **5** and leaves the recuperator through the annular space **8**. The heat absorbing medium in this arrangement flows in countercurrent relation to the flue gas i. e. in the direction of the arrow **10**.

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I claim:

1. A heat exchange apparatus comprising, in combination, an inner tubular wall member having axially extending longitudinal rib portions circumferentially spaced on its outer surface; an outer tubular wall member surrounding said inner wall member and radially spaced therefrom to provide an elongated annular space therebetween into which said longitudinal rib portions of said inner wall member project; and an intermediate tubular insulating lining means arranged in said annular space between said inner and outer wall members, the inner surface of said insulating lining means being spaced from the outer surface of said inner wall member by a gap having a radial width amounting to a minor fraction of the distance between said inner and outer wall members, said inner surface of said insulating lining means being formed with axially extending grooves respectively receiving said longitudinal rib portions of said inner wall member, the depth of each axially extending groove being substantially equal to the radial width of the longitudinal rib portion projecting therein minus the radial width of said gap, whereby a fluid medium to be heated is forced to pass at relatively high speed through said gap for absorbing heat from a fluid medium passing through said inner wall member.

2. A heat exchange apparatus comprising, in combination, an inner tubular wall member having axially extending longtiudinal rib portions circumferentially spaced on its surface; an outer tubular wall member surrounding said inner wall member and radially spaced therefrom to provide an elongated annular space therebetween into which said longitudinal rib portions of said inner wall member project; inlet means at one end of said annular space; outlet means at the other end of said annular space; and an intermediate tubular insulating lining means arranged in said annular space between said inner and outer wall members, the inner surface of said insulating lining means being spaced from the outer surface of said inner wall member by a gap having a radial width amounting to a minor fraction of the distance between said inner and outer wall members, said inner surface of said insulating lining means being formed with axially extending grooves respectively receiving said longitudinal rib portions of said inner wall member, the depth of each axially extending groove being substantially equal to the radial width of the longitudinal rib portion projecting therein minus the radial width of said gap, said gap communicating at opposite ends with said inlet and outlet means, whereby a fluid medium to be heated is forced to pass at relatively high speed through said gap from said inlet to said outlet means for absorbing heat from a fluid medium passing through said inner wall member.

3. A heat exchange apparatus comprising, in combination, an inner tubular wall member having axially extending longitudinal rib portions circumferentially spaced on its outer surface; an outer tubular wall member sur-

rounding said inner wall member and radially spaced therefrom to provide an elongated annular space therebetween into which said longitudinal rib portions of said inner wall member project; and an intermediate tubular insulating lining means formed of segments composed of insulation bricks arranged in said annular space between said inner and outer wall members, the inner surface of said insulating lining means being spaced from the outer surface of said inner wall member by a gap having a radial width amounting to a minor fraction of the distance between said inner and outer wall members, the adjacent portions of the inner surfaces of adjoining bricks being recessed to form axially extending grooves respectively receiving said longitudinal rib portions of said inner wall member, the depth of each axially extending groove being substantially equal to the radial width of the longitudinal rib portion projecting therein minus the radial width of said gap, whereby a fluid medium to be heated is forced to pass at relatively high speed through said gap for absorbing heat from a fluid medium passing through said inner wall member.

4. A heat exchange apparatus comprising, in combination, an inner metallic tubular wall member having axially extending longitudinal rib portions circumferentially spaced on its outer surface; an outer metallic tubular wall member surrounding said inner wall member and radially spaced therefrom to provide an elongated annular space therebetween into which said longitudinal rib portions of said inner wall member project; and an intermediate tubular heat insulating lining means arranged in said annular space between said inner and outer wall members, the inner surface of said insulating lining means being spaced from the outer surface of said inner wall member by a gap having a radial width amounting to a minor fraction of the distance between said inner and outer wall members, said inner surface of said insulating lining means being formed with axially extending grooves respectively receiving said longitudinal rib portions of said inner wall member, the depth of each axially extending groove being substantially equal to the radial width of the longitudinal rib portion projecting therein minus the radial width of said gap, whereby a fluid medium to be heated is forced to pass at relatively high speed through said gap for absorbing heat from a fluid medium passing through said inner wall member.

5. A heat exchange apparatus comprising, in combination, an inner steel tubular wall member having axially extending longitudinal rib portions circumferentially spaced on its outer surface; an outer tubular wall member surrounding said inner wall member and radially spaced therefrom to provide an elongated annular space therebetween into which said longitudinal rib portions of said inner wall member project; and an intermediate tubular insulating lining means formed of segments composed of insulation bricks having rough surfaces arranged in said annular space between said inner and outer wall members, the inner surface of said insulating lining means being spaced from the outer surface of said inner wall member by a gap having a radial width amounting to a minor fraction of the distance between said inner and outer wall members, the adjacent portions of the inner surfaces of adjoining bricks being recessed to form axially extending grooves respectively receiving said longitudinal rib portions of said inner wall member, the depth of each axially extending groove being substantially equal to the radial width of the longitudinal rib portion projecting therein minus the radial width of said gap, whereby a fluid medium to be heated is forced to pass at relatively high speed through said gap for absorbing heat from a fluid medium passing through said inner wall member.

6. A heat exchange apparatus comprising, in combination, an inner steel tubular wall member having axially extending longitudinal rib portions circumferentially spaced on its outer surface; an outer tubular wall member surrounding said inner wall member and radially spaced therefrom to provide an elongated annular space therebetween into which said longitudinal rib portions of said inner wall member project; inlet means at one end of said annular space; outlet means at the other end of said annular space, said inlet and outlet means each including an annular conduit extending around said inner wall member at opposite ends thereof; and an intermediate tubular insulating lining means formed of segments composed of insulation bricks having rough surfaces arranged in said annular space between said inner and outer wall members, the inner surface of said insulating lining means being spaced from the outer surface of said inner wall member by a gap having a radial width amounting to a minor fraction of the distance between said inner and outer wall members, the adjacent portions of the inner surfaces of adjoining bricks being recessed to form axially extending grooves respectively receiving said longitudinal rib portions of said inner wall member, the depth of each axially extending groove being substantially equal to the radial width of the longitudinal rib portion projecting therein minus the radial width of said gap, said gap communicating at opposite ends with said annular conduits of inlet and outlet means, whereby a fluid medium to be heated is forced to pass at relatively high speed through said gap from said inlet to said outlet means for absorbing heat from a fluid medium passing through said inner wall member.

7. A heat exchange apparatus comprising, in combination, an inner tubular wall member having axially extending longitudinal rib portions circumferentially spaced on its outer surface; annular reinforcing means extending around said inner wall member; an outer tubular wall member surrounding said inner wall member and radially spaced therefrom to provide an elongated annular space therebetween into which said longitudinal rib portions of said inner wall member project; and an intermediate tubular insulating lining means arranged in said annular space between said inner and outer wall members, the inner surface of said insulating lining means being spaced from the outer surface of said inner wall member by a gap having a radial width amounting to a minor fraction of the distance between said inner and outer wall members, said inner surface of said insulating lining means being formed with axially extending grooves respectively receiving said longitudinal rib portions of said inner wall member, the depth of each axially extending groove being substantially equal to the radial width of the longitudinal rib portion projecting therein minus the radial width of said gap, whereby a fluid medium to be heated is forced to pass at relatively high speed through said gap for absorbing heat from a fluid medium passing through said inner wall member.

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