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(54) **BURNER NOZZLE FIELD COMPRISING INTEGRATED HEAT EXCHANGERS**

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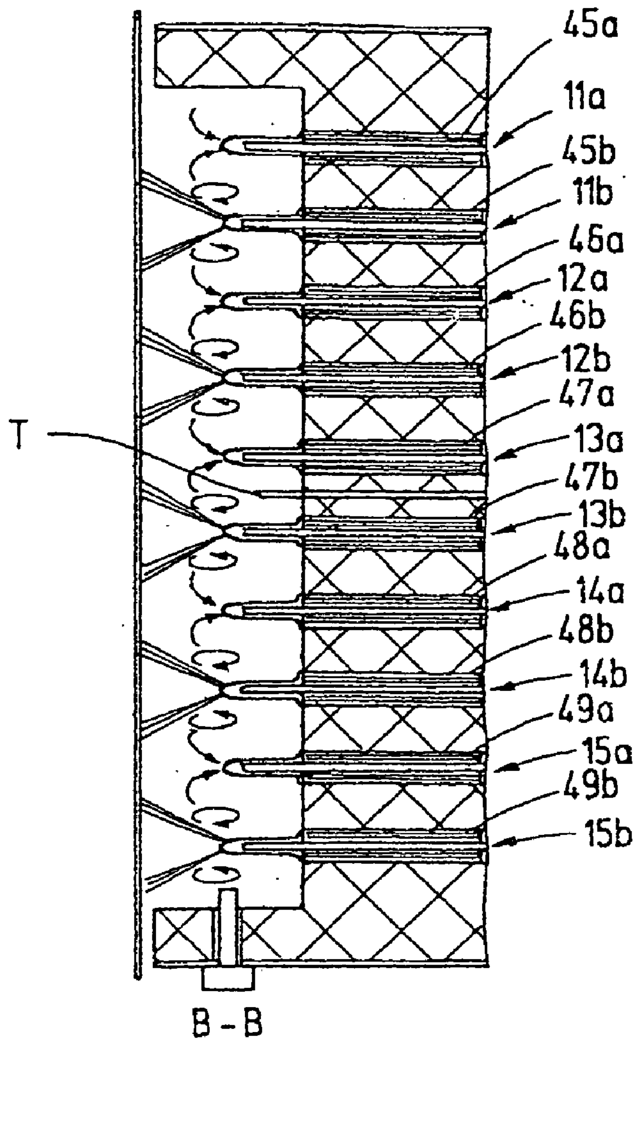
(57) **ABSTRACT**

The invention relates to a novel burner nozzle field consisting of nozzle field modules which work with an intensive air pre-heating system and which produce gas impact spots on the material which is to be warmed, which have an average distance of, preferably, less than 150 mm and, in the best case, less than 100 mm. The burners work with a deignited gas outlet and an individual air pre-heating system. The individual nozzle field modules can work in any particular spatial orientation. Burner nozzle fields can be arranged behind each other in order to increase efficiency.



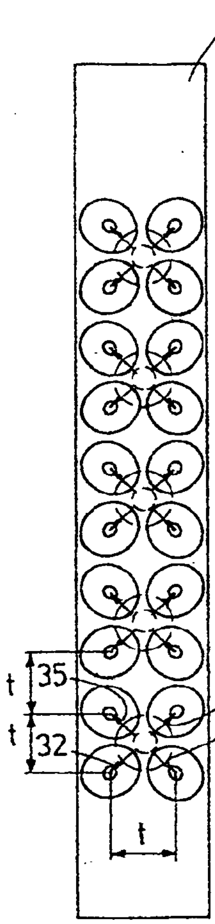


Fig.4

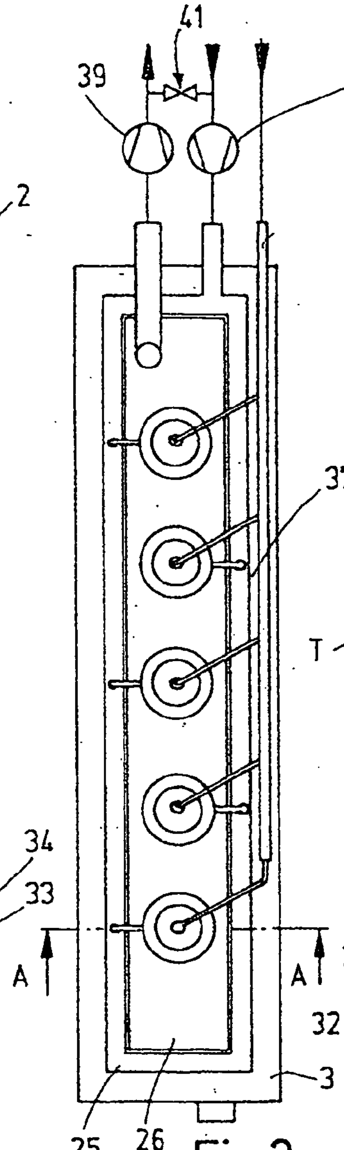


Fig.3

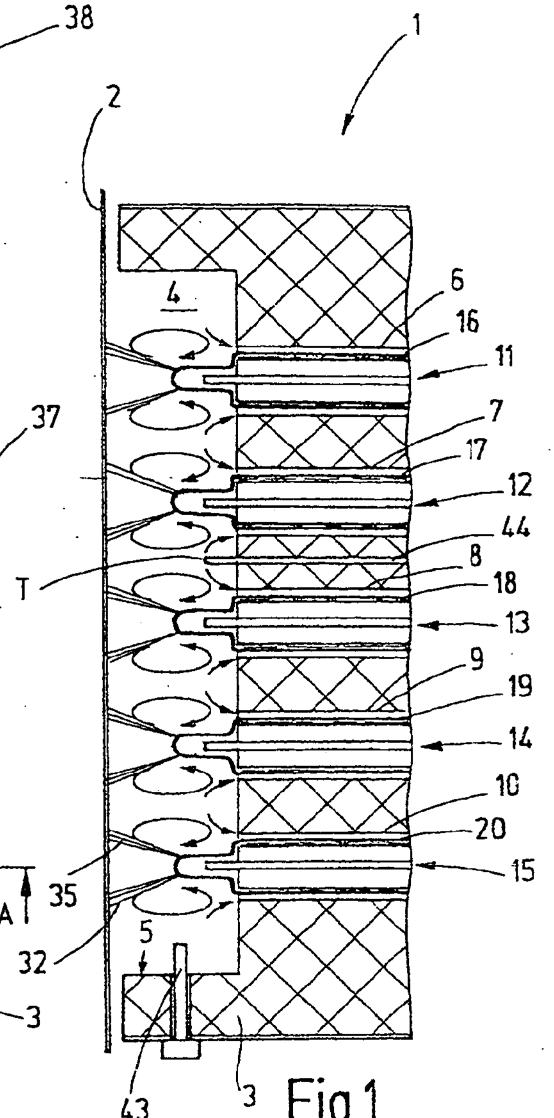


Fig.1

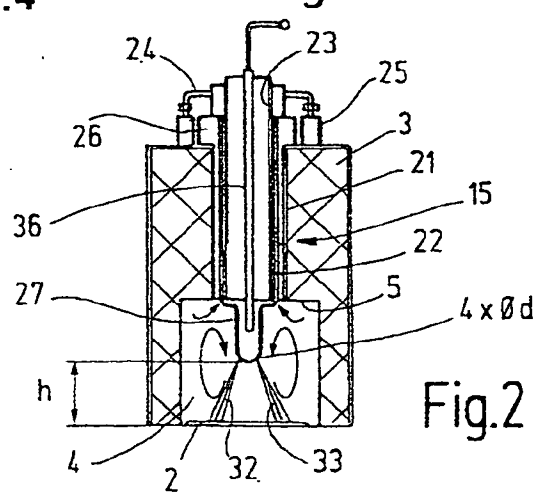


Fig.2

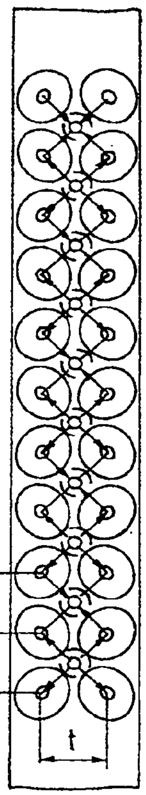


Fig.9

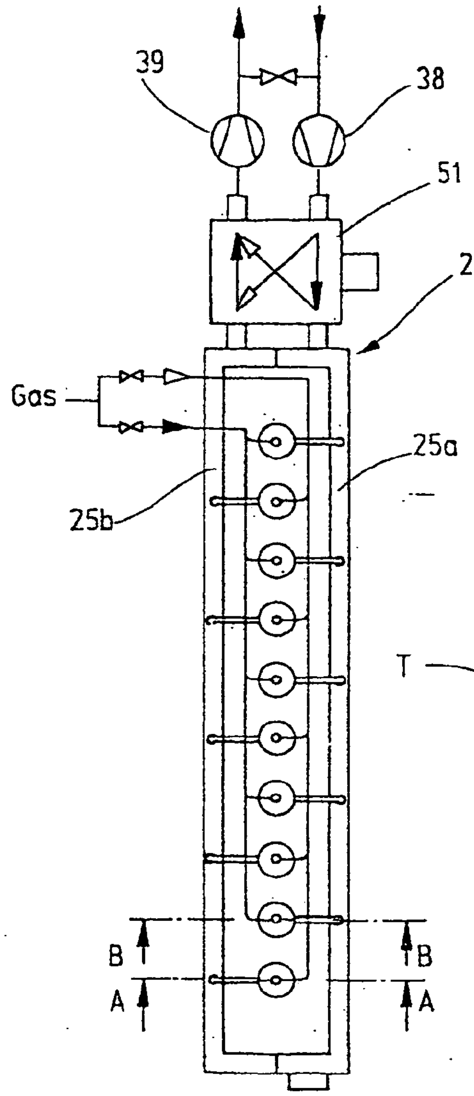
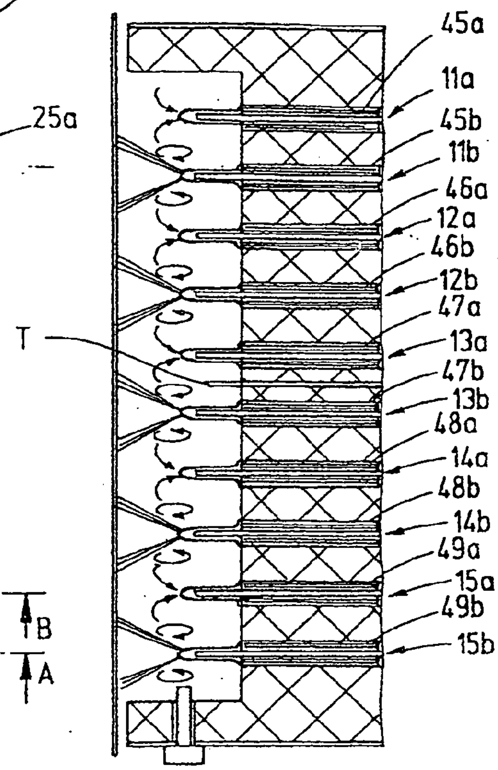


Fig.8 A - A



B - B Fig.5

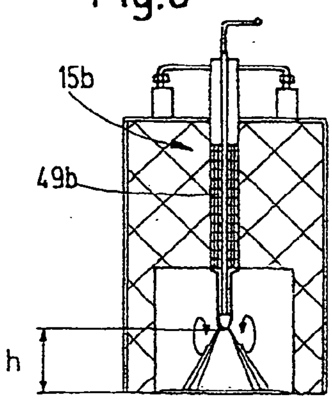


Fig.7

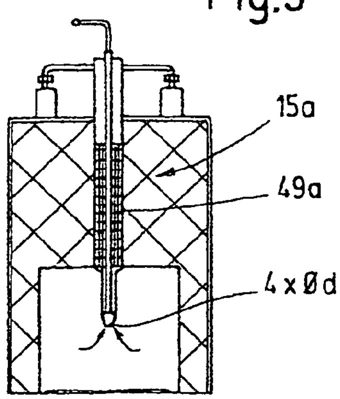


Fig.6

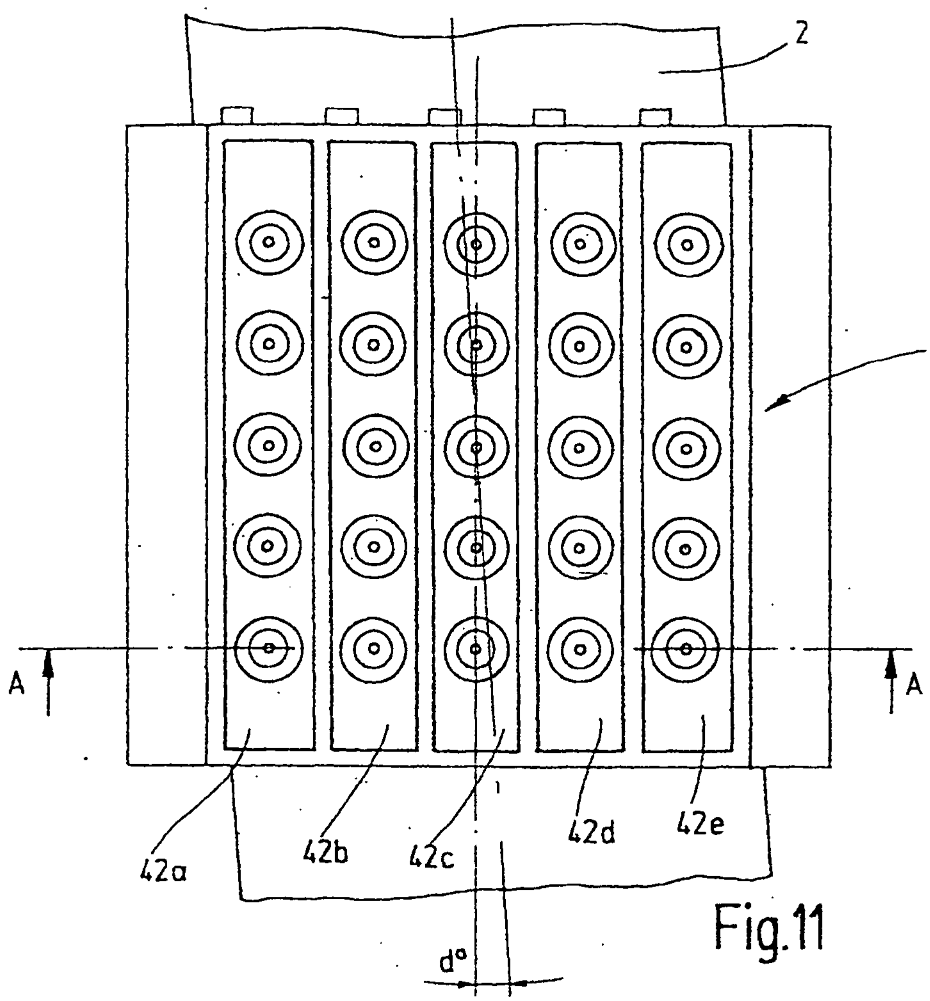


Fig.11

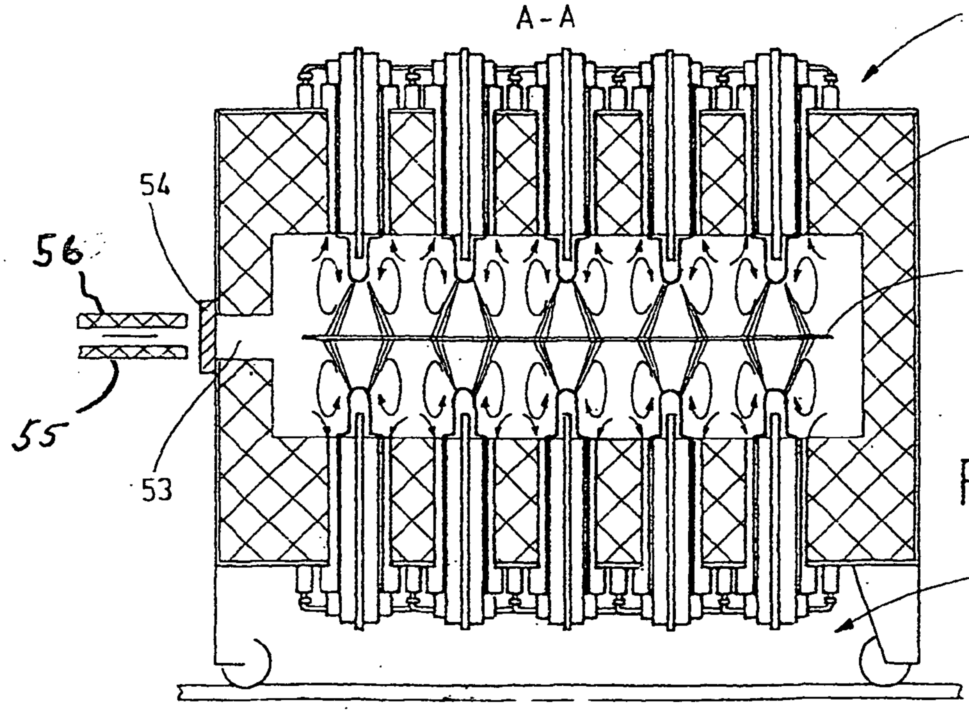


Fig.10

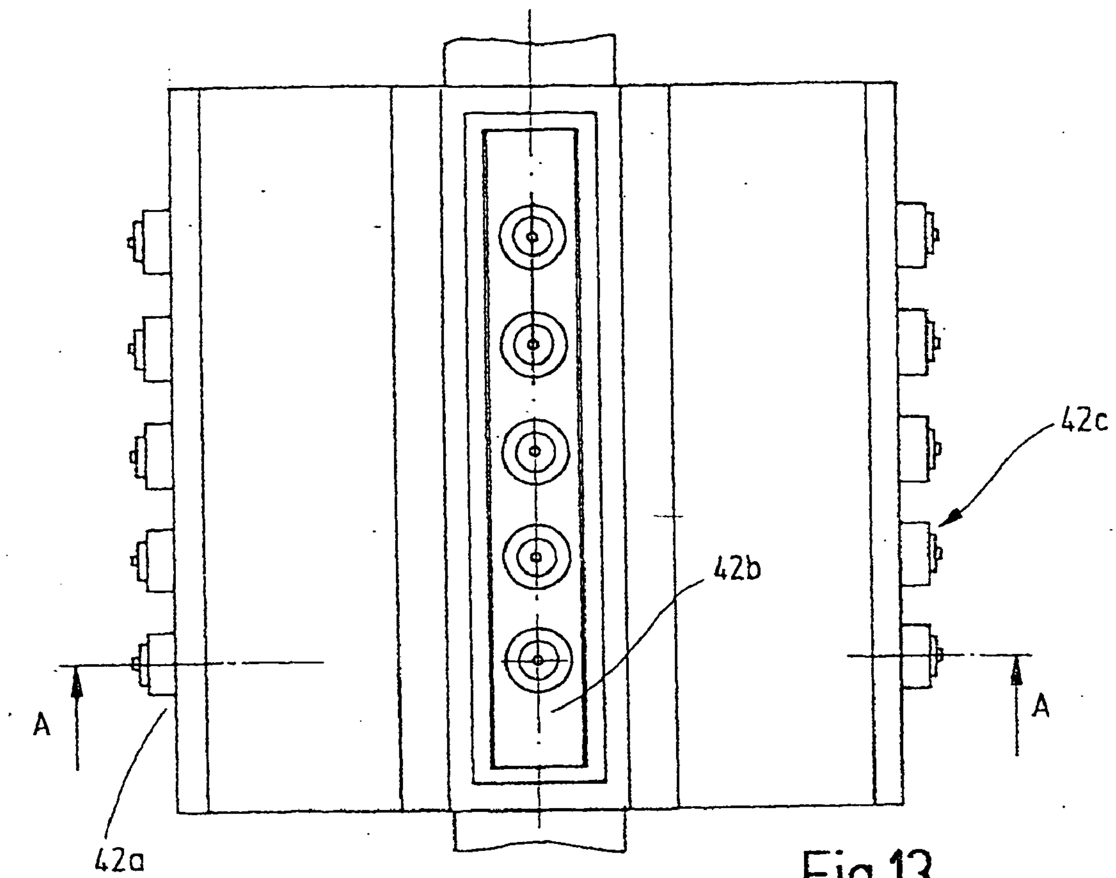


Fig.13

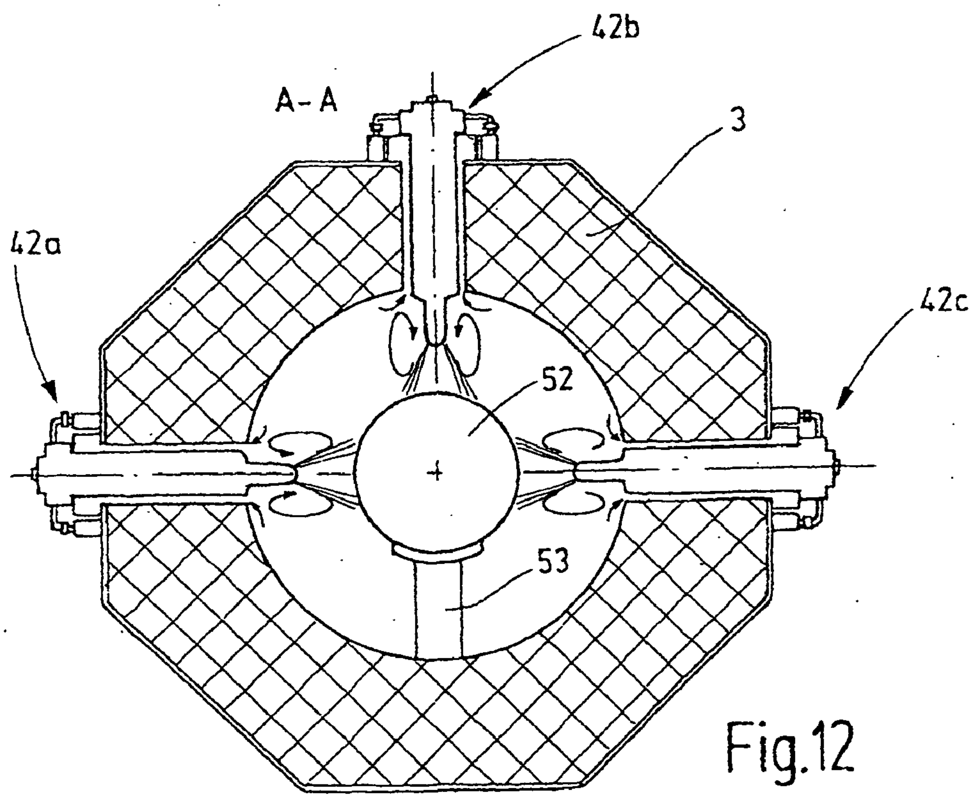


Fig.12

BURNER NOZZLE FIELD COMPRISING INTEGRATED HEAT EXCHANGERS

[0001] This is a continuation-in-part application of international application PCT/EP2005/007985 filed Jul. 21, 2005 and claiming the priority of German application 10 2004 035 276.3 filed Jul. 21, 2004.

BACKGROUND OF THE INVENTION

[0002] The invention relates to a burner nozzle field comprising a plurality of nozzles, each provided with an air preheating structure (**22**) and each having at least one nozzle opening for directing a jet (**32**) of a mixture of fuel and heated air onto a target surface of a material to be heated by impact jet flames at a target spacing of less than 150 mm upon ignition of the fuel/air mixture in the jet (**32**).

[0003] Burner nozzle fields which are used for heating industrial goods such as, for example, steel strips, steel rods, tubes or similar goods are generally called heated nozzle fields. They produce a relatively large number of impact jet flames disposed at small distances from one another that is in a tight pitch. By the combustion of a high convective heat transfer and a high temperature obtained with the combustion in the nozzle field, high heat flow densities of several hundred hole walls per square meter are obtained which substantially exceeds radiation heating capabilities. This effect is used in industry for the rapid heating of surfaces, particularly in the metal working industry, but also in other industrial areas.

[0004] The main objects for optimizing the heated nozzle fields are:

[0005] obtaining the highest possible heat flow density at the surface;

[0006] providing for a highly uniform heat transfer particularly in connection with a thin-walled good, where a temperature compensation in the surface area is inhibited; and,

[0007] providing for the highest possible efficiency.

[0008] Particularly, the requirement of high heat flow density, that is a high specific performance is counter to the requirement of good uniformity and high efficiency.

[0009] Particularly, the requirement for high heat flow density that is high specific performance in a certain way is contradictory to the requirement of high uniformity and high efficiency.

[0010] It is, therefore, the object of the present invention to provide a high-performance burner nozzle field which has a high power output, a uniform heat transfer and high efficiency and which operates highly economically.

SUMMARY OF THE INVENTION

[0011] The invention relates to a novel burner nozzle field consisting of nozzle field modules which work with an intensive air pre-heating system and which produce gas impact spots on the material which is to be warmed, which have an average distance of, preferably, less than 150 mm and, in the best case, less than 100 mm. The burners work with a deignited gas outlet and an individual air pre-heating system. The individual nozzle field modules can work in any particular spatial orientation. Burner nozzle fields can be arranged behind each other in order to increase efficiency.

[0012] In an accordance with this invention the burner nozzle field includes a plurality of nozzles, each with an air heating structure which is formed by regeneration or a recuperation arrangement for individually heating the air supplied to the individual nozzles up to over 500° C. in order to increase not only the efficiency, but also the heat transfer as, with the pre-heating of the air the volume flow increases.

[0013] The nozzles are arranged in spaced relationship at a distance from one another which is less than 200 mm. Preferably the lateral distance is less than 150 mm. Ideally, it does not exceed 100 mm. With this tight spacing a highly uniform heat transfer is achieved. Furthermore, the nozzle openings are oriented essentially axially. If several nozzle openings are present, they define, for example, a narrow cone, wherein the discharge directions of the nozzle openings of adjacent nozzles are oriented relative to one another in such a way that the impact areas of all jets on the goods to be heated form an equidistant pattern. If a nozzle has, for example, four individual nozzle openings, the pitch spacing of the impact center points on the good to be heated is half the spacing defined by this lateral distance between the nozzles. The angle formed between the individual nozzle jets and the longitudinal axis of the nozzle body is preferably less than 45°. Preferably it is only 30° (corresponding to a cone angle of 60°). This can be achieved by arranging the nozzle openings in a circle evenly spaced on a cylindrical nozzle body with curved end face. With this steep impact angle on one hand, a good heat transfer and, on the other hand, a uniform flow pattern with large-volume recirculation in the available reaction or, respectively re-circulation space can be obtained. The large-volume recirculation increases on one hand the mass flow of the hot gas impacting the goods to be heated and, on the other hand, facilitates the formation of a flameless oxidation. This, again, prevents the formation of local temperature peaks and, consequently, enhances a uniform heating of the goods to be heated. The uniform heating is further enhanced by the pre-heating of the air to temperatures of over 500° C. and by a nozzle design which causes the fuel/air mixture jet to leave the nozzle in an unburned state, that is, at the point of leaving the nozzles, the fuel and air are still present as such and have essentially not yet reacted with each other.

[0014] The heat transfer is mainly caused by the impact of the hot gas jets, that is the "parallel jets" on the goods to be heated (forced convection). With the high flow speed of at least 50 m/s and even better 100 m/s the gas jets impacting the goods to be heated transfer a very large amount of heat to the goods to be heated. This heat transfer is substantially higher than a heat transfer obtainable by radiation at the same burner temperature. In addition the heat transfer is independent of the reflection properties of the goods to be heated. It does essentially not matter whether the goods to be heated are metallic, shiny or black (for example by scale). To obtain the same heat transfer by radiation a substantially higher burner temperature would be required with the known inherent disadvantages regarding NO_x generation. Furthermore, with such high radiation heat outputs, radiation heating is critical with regard to the transport speed of the goods to be heated. If the goods stop or move too slowly, it can easily be overheated. This is not a danger with parallel jet heating. In addition, with the large reaction chambers, a large-area recirculation and a flameless oxidation with low formation of contaminants are facilitated.

[0015] The nozzle body and the air preheating arrangement (regenerator or recuperator) are preferably combined in a burner, that is a design unit, wherein several such burners jointly form a nozzle field module. The nozzle field module has a common air supply and a common exhaust gas discharge for example in the form of an exhaust gas collection box. With this proposed design combination of several burners in a burner module, the small pitch, that is the tight spacing between the burners is facilitated.

[0016] Preferably in the burner module, the burners are arranged so that they extend at a right angle from the air and exhaust gas guide structure. They therefore extend through a corresponding wall provided with openings. By the combination of the burners in a module, the desired tight pitch is achieved.

[0017] The nozzle bodies extend beyond the combustion chamber wall so that the nozzle openings are disposed at a distance from the combustion chamber wall. The nozzle openings of the nozzle bodies are preferably disposed at a distance of at least 50 mm, preferably at least 100 mm from the combustion chamber wall. As a result a reaction volume is formed between the individual nozzle bodies which can accommodate a large-volume examination. In this way, the residence time of the gases in the combustion chamber can be increased particularly in view of the desired small distances between the nozzle openings and the goods to be heated. These distances are preferably below 200 mm. Preferably they are below 150 mm and optimally below 100 mm. The recirculation volume required with such small distances between the nozzle opening and the goods to be heated which facilitates particularly a flameless oxidation is generated by the extension of the nozzle bodies beyond the combustion chamber wall.

[0018] Each nozzle body includes one, preferably several, nozzle openings whose discharge directions define a narrow cone. This cone is so narrow that the nozzle jets impact the surfaces of the goods almost at a right angle.

[0019] For an increase of this mass flow and, consequently, a more homogenous heat input, exhaust gas can be added to the fuel air mixture. Furthermore, the burner nozzle field may be operated with excess air, stoichiometrically or under-stoichiometrically.

[0020] Furthermore, the burner nozzle field may be arranged above, as well as, below the goods to be heated. If the goods to be heated have a large flat surface area, such as metal sheets, it is possible to transport them floating on a gas cushion build up by the burner nozzle field.

[0021] Furthermore, the goods to be heated by burner nozzle fields are heated at the same time from both sides. Consequently the burner nozzle field according to the invention provides for rapid heating of the goods to be heated. Preferably, the individual nozzles are arranged in rows which are oriented, that is, inclined with respect to the transport direction of the material to be heated. In this way the formation of heat strips is prevented.

[0022] The invention will become more readily apparent from the following description of particular embodiments thereof on the basis of the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] FIG. **1** shows a burner nozzle field with a work piece in a longitudinal cross-sectional view.

[0024] FIG. **2** shows the burner nozzle field of FIG. **1** in a transverse cross-sectional view.

[0025] FIG. **3** shows a rear view of the burner nozzle field.

[0026] FIG. **4** shows schematically a heated work piece indicating the impact areas of the nozzle jets.

[0027] FIG. **5** shows a modified embodiment of the burner nozzle field in a longitudinal cross-sectional view.

[0028] FIGS. **6** and **7** show the burner nozzle field of FIG. **5** in different cross-sections.

[0029] FIG. **8** shows the burner nozzle field according to FIG. **5** in a rear view.

[0030] FIG. **9** shows schematically the work piece indicating thereon the impact areas of the nozzle jets in a tops view.

[0031] FIG. **10** shows a burner nozzle field arrangement for heating both sides of a work piece at the same time.

[0032] FIG. **11** is a top view of the arrangement of FIG. **10**.

[0033] FIG. **12** shows a burner nozzle field arrangement for heating round work pieces in a longitudinal cross-sectional view; and,

[0034] FIG. **13** is a transverse cross sectional view of the arrangement of FIG. **12**.

DESCRIPTION OF THE ADVANTAGEOUS EMBODIMENTS

[0035] FIG. **1** shows a burner nozzle field **1** for heating a moving flat work piece such as a metal strip **2**. The metal strip **2** is shown separately in FIG. **4**. The metal strip is representative of any good to be heated by the burner nozzle field **1**.

[0036] Part of the burner nozzle field **1** is a heat insulated base body **3**, which includes at the side facing the metal strip **2** a tub-like opening **4** as shown in FIG. **2**. The surface area **5** delimiting the opening **4** forms the combustion chamber wall of a combustion chamber which is closed by the metal strip **2**.

[0037] The base body **3** includes a series of openings **6**, **7**, **8**, **9**, **10** through which the burners **11**, **12**, **13**, **14**, **15** extend. Between the inner wall of the respective openings **6** to **10** and the outer cylindrical wall of each burner **11** to **15** in each case an circular exhaust gas channel **16**, **17**, **18**, **19**, **20** is formed. As apparent from the example of burner **15**, as shown in FIG. **2** the exhaust gas channel **20** is formed between an outer tube **21** lining the opening **10** and an inner tube **22**, in which an additional tube **23** is supported so as to form an annular concentric gap. The additional tube **23** defines with the inner tube **22** an annular air supply channel which is in communication, via a feed line **24** with a corresponding air distribution frame **25** in the form of a closed ring. The exhaust gas channel **20** on the other hand is connected to an exhaust gas manifold **26**.

[0038] The inner tube **22** forms a recuperator tube along which exhaust gas flows on this outside and fresh air on the inside in counter-current heat exchange relationship. At the entrance to the combustion chamber, the inner tube **22** is narrowed down and carries a ceramic nozzle body **27**. The nozzle body **27** is provided at its end with at least one, if needed more than one, in the exemplary embodiment shown herein, four nozzle openings **28**, **29**, **30**, **31**. In FIGS. **1**, **2** and **4** the nozzle openings are only indicated by the origin of the burner jets **32**, **33**, **34**, and **35**. A fuel supply line **36** extends centrally into the nozzle body **27**. The fuel supply line **36** is connected to a distribution line **37** as shown in FIG. **3**. The air distribution frame **25** is connected to an air feed pump **38** whereas the exhaust gas manifold **26** may be connected to an exhaust gas pump **39**.

[0039] By turning the pump volumes of the air feed pump **38** and the exhaust gas pump **39**, defined mass flow conditions and, consequently, certain pressure relationships can be established in the half way open combustion chamber. Between the lines leading to or extending from the pumps **38**, **39** a connecting line including a valve **41** may be provided in order to make, for example, an external exhaust gas recirculation possible.

[0040] The burners **11** to **15** are arranged in spaced relationship at distances of, for example, only 150 mm between the longitudinal burner axes, and form with the air distribution frame **25** and the exhaust gas manifold **26**, a nozzle field module **42**. The nozzle jets **32** to **35** as well as the respective nozzle jets of the adjacent burners **11** to **14** impact the metal strip **2** at distances t (see FIG. **4**), which are less than 150 mm , and preferably smaller than 100 mm. The nozzle jets **32** to **35** reach the metal strip **2**, at an angle of 60°. The distance between the front surface of the respective nozzle body **27** and the metal strip (see FIG. **2**) is preferably of about the same size as the distance of the front surface of the nozzle body **27** from the part of the combustion chamber wall (area **5**) which extends parallel to the metal strip **2**.

[0041] Part of the burner nozzle field **1** are, furthermore, a pilot burner **43** and a temperature sensor **44**, which are arranged at suitable locations of the base body **3**.

[0042] The burner nozzle field described above operates as follows: For start-up operation the nozzle bodies of all burners **11** to **15** are first thermally isolated from the cold work piece. This can be done by removal of the work piece, by sideward displacement of the burner nozzle field **1** or by insertion of heat shields **55**, **56** (FIG. **10**) between the burners **11** to **15** and the work piece **2**. Using this heat-up burner **43**, the reaction chamber including the burners **11** to **15** is heated up to the desired temperature. Then, the burners **11** to **15** are activated. From the nozzle openings, the nozzle jets **32** to **35** consisting of a fuel/air mixture are then discharged as indicated in connection with burner **15** representatively for all the burners **11** to **15**. On the way from the nozzle body **27** to the work piece **2**, the fuel air mixture in the jets starts to react whereby it is heated. As indicated in FIG. **1** by the elliptical arrows, a large area gas recirculation is generated thereby which results in a uniform heat distribution in the opening **4** and, as a result, in a uniform heat transfer to the work piece, that is the metal sheet **2**. FIG. **4** shows the impact spots, that is the areas where the burner jets **32** to **35** impact the metal strip **2** and from where the recirculation flow originates. The reaction continues in the recirculatory part of the gas flow moving away from the metal sheet **2** so that hot gas from the combustion chamber is carried to the burner jets **32** to **35**. As a result, the whole recirculation area is used as reaction zone.

[0043] The hot exhaust gases are discharged via the exhaust channels **16** to **20** in counter-current heat transfer relation with the incoming fresh air which is heated thereby. The incoming air may be heated in the process to over 500° C. which results in a high operating efficiency.

[0044] As apparent from FIG. **4**, the impact areas of adjacent burners **11** to **15** are spaced from one another. They form groups of four (for example **32** to **35**) with center points arranged at the corners of a square. The groups of four do not overlap.

[0045] The set-up is different for the embodiments shown in FIGS. **5** to **9** which include regenerative burners. They differ from the arrangement described above by the use of a larger number of regenerative burners **11***a*, **11***b*, **12***a*, **12***b*, **13***a*, **13***b*, **14***a*, **14***b*, **15***a*, **15***b* which are arranged at smaller distances from one another, that is with a smaller pitch t. The burners are correspondingly slimmer and include in their interior a recuperation regeneration structure **45***a*, **45***b*, **46***a*, **46***b*, **47***a*, **47***b*, **48***a*, **48***b*, **49***a*, **49***b*. The burners **11***a* to **15***b* include a common connection for air and, respectively exhaust gas. The connection is in communication with an air distribution frame **25** which is divided into two sections. The half section **25***a* of the air distribution frame **25** is connected to all burners indexed with "a" that is the burners **11***a* to **15***a*. The half section **25***b* is connected to all burners indexed with "b" that is the burners **11***b* to **16***b*. The "a" and "b" indexed burners alternate and are arranged in a straight line. The pattern of the impact spots generated by the burner jets is shown in FIG. **9**. It has a pitch or spacing t of preferably less than 150 mm to less than 100 mm. The impact spots of the "a" indexed burners overlap with those of the "b" indexed burners or are identical. The burners are displaced with respect to the burner impact spots by t/2. In this way the whole pattern of jet impact spots is covered by the burners **11***a* to **15***a* as well as by the burners **11***b* to **15***b*. They are operated alternately. The switch over is initiated by the switch-over device **51** for example every ten seconds. In this way, for example, the flow pattern as shown in FIG. **5** with large-area re-circulations is established. FIG. **7** shows the flow conditions in a burner **15***b* when it is activated and its recuperation regeneration structure **49***b* transfers heat to the fresh air. FIG. **6** shows the burner **15***a* which is momentarily in a passive state in which it serves as exhaust line whereby its recuperation regeneration structure **49***a* is heated up.

[0046] FIGS. **10** and **11** illustrate an embodiment wherein metal strip **2** which, for example, extends horizontally is heated from its top side as well as from its bottom side. To this end, corresponding burner nozzle fields 1*a*, 1*b* are provided which, as described above, comprise individual modules. FIG. **11** shows the upper burner nozzle field 1*a*, which comprises five nozzle field modules **42***a*, **42***b*, **42***c*, **42***d*, **42***e* arranged side-by-side. The lower burner nozzle field **1***b* is of corresponding design. The longitudinal axes of the nozzle field groups **42***a* to **42***e* are displaced from the moving direction of the metal sheet **2**, so as to extend at an acute angle of, for example, 10° or 15° with respect to the travel direction of the metal sheet **2** in order to avoid the formation of heat stripes. In the arrangement as shown in FIG. **10**, the metal strip **2** can be supported on the gas cushion established by the lower burner nozzle field **1***b*. This can be achieved particularly by an adjustment of the pumping volume produced by the air feed pump **38** and the exhaust gas pump **39**. With appropriate tuning of the pumping volumes (the air feed pump volume exceeding somewhat the exhaust pump volume) below the metal sheet **2** an air cushion is formed which carries the metal strip. In order to prevent a discharge of gases from the combustion chamber, the air feed pump **38** and the exhaust gas pump **39** of the upper burner nozzle field **1***a* may be turned with respect to each other so that the far upper nozzle field the suction volume of the exhaust gas pump **39** exceeds that of the respective air feed pump **38**.

[**0047**] The base body **3** which in the present arrangement is in the form of a furnace chamber may be provided at the side thereof with a slot **53** which can be closed by a cover **54**. This permits sideward movement of the heating device away from the metal strip **2** when heating of the metal strip is not desired during heating up of the oven chamber or when repair work needs to be performed. Also heat shields **55**, **56** can be inserted into the heating chamber which shield the cold metal strip **2** thermally during the burner start-up procedure. After the burners and the heating chamber have reached operating temperature, the heat shields **55** and **56** are again removed from the heating chamber. In the testing phase an arrangement as shown in FIG. **3** has provided the following values:

Heating of strip steel, width 1.3 m, thickness 0.5 mm

[**0048**] strip speed 39 m/min

[**0049**] through put rate 12t/h

[**0050**] heating 380° K

[**0051**] effective heat output 338 kw

[**0052**] specific actual heat output 246 kw/min

The nozzle field with recuperation burners has the following data:

[**0053**] length 1 m

[**0054**] width 1.4 m

[**0055**] number of modules (top and bottom): 14

[**0056**] pitch t (spacing) of the nozzle jets: 100 mm

[**0057**] distance h of the nozzles from the surface: 100 mm

[**0058**] distance of the nozzle openings from combustion chamber wall: >100 mm

[**0059**] diameter D of the nozzles: 7 mm

[**0060**] temperature in the nozzle field: 1,100° C.

[**0061**] air preheating temperature 750° C.

[**0062**] energy input (Hu) 840 kw

[**0063**] discharge speed at nozzle opening: >50 m/s, preferably >100 m/s heating

[**0064**] efficiency 76%.

[**0065**] The FIGS. **12** and **13** show the use of nozzle field modules **42***a* **42***b*, **42***c*, to which the description provided in connection with FIGS. **1** to **4** applies, for heating an elongated body **52** for example with a circular cross-section. The burners of the nozzle field module **42** may, in this application, be oriented radially with regard to the body **52** and from rows extending about in the direction of movement of the body **52**. The combustion chamber may include a support structure **53** for supporting the body **52**.

[**0066**] A novel burner nozzle field **1** comprises nozzle field modules **42** which operate with high air preheating and generate on the material to be heated gas impact spots which have a center spacing of preferably less than 150 mm and optimally less than 100 mm. The burners operate with gas which is not ignited at the point of leaving the burners and have individual air preheating arrangements. The individual nozzle field modules **42** can operate at any spatial orientation. Burner nozzle fields may also be arranged in series for increasing the power output.

What is claimed is:

1. A burner nozzle field, particularly for heating moving goods to be heated, comprising:

A number of nozzle bodies (**27**), each including an individual air pre-heating structure (**22**, **45**) and each of said nozzle bodies (**27**) having at least one nozzle opening for generating fuel air jets (**32**) which are directed toward the goods to be heated, but are not ignited at the point of discharge from the respective nozzle opening so as to form an un-ignited fuel-air jet (**32**), said nozzle bodies (**27**) are arranged in spaced relationship that the distance between the centers of the impact spots on the good to be heated is less than 200 mm, and wherein the nozzle openings of the nozzle bodies (**27**) are disposed at a distance from the combustion chamber wall (**5**) so as to provide for a recirculation volume between the nozzle opening and the combustion chamber wall (**5**), wherein the air preheating arrangement (**22**, **45**) is so designed that it heats the air supplied to the nozzle bodies to above 500° C., and wherein the discharge speed of the fuel air jet (**32**) which leaves the nozzle opening in an un-ignited state is at least 50 m/s.

2. A burner nozzle field according to claim 1, wherein in each case, air nozzle body (**27**) is combined with one air preheating arrangement (**22**, **45**) to form a burner (**15**) which forms a design unit and wherein several such burners (**11** to **15**) are combined to form a nozzle field module (**42**).

3. A burner nozzle field according to claim 2, wherein each nozzle field module (**42**) includes an exhaust gas collection box (**26**) an air supply line (**25**) and a fuel supply line (**36**).

4. A burner nozzle field according to claim 3, wherein the individual burners (**11** to **15**) of the nozzle field module (**42**) extend from the exhaust gas collection box (**26**) and from the air supply line (**25**) at a right angle.

5. A burner nozzle field according to claim 1, wherein the discharge speed of the still unburned fuel/air jet (**32**) out of the nozzle opening is at least 100 m/s.

6. A burner nozzle field according to claim 1, wherein the nozzle openings of the nozzle body (**27**) for forming the recirculation space are disposed at a distance of at least 50 mm from the combustion chamber wall (**5**) and preferably at least 100 mm.

7. A burner nozzle field according to claim 1, wherein each nozzle body (**27**) has several nozzle openings whose discharge directions define a cone.

8. A burner nozzle field according to claim 1, wherein the nozzle body (**27**) consists of a ceramic material.

9. A burner nozzle field according to claim 1, wherein a fuel/air mixture with excess air is supplied to said at least one nozzle opening.

10. A burner nozzle field according to claim 1, wherein exhaust gas is supplied which is admixed to the air and/or the fuel to said at least one nozzle opening.

11. A burner nozzle field according to claim 1, wherein a stoichiometric fuel/air mixture is supplied to said at least one nozzle opening.

12. A burner nozzle field according to claim 1, wherein the burner nozzle field includes a heat-up burner (**43**).

13. A burner nozzle field according to claim 1, wherein the distance between the nozzle opening and the good to be heated is less than 200 mm.

14. A burner nozzle field according to claim 1, wherein the burner nozzle field is provided with a removal arrangement for the removal of the heated good (**2**).

15. A burner nozzle field according to claim 1, wherein the burner nozzle field is arranged below the good (**2**) to be heated.

16. A burner nozzle field according to claim 1, wherein the good (**2**) to be heated is supported by the gas cushion formed by the fuel/air jet discharged from the nozzle openings.

17. A burner nozzle field according to claim 1, wherein the nozzle bodies (**27**) are arranged in rows which are inclined with respect to the transport direction of the good to be heated.

18. A burner nozzle field according to claim 1, wherein two burner nozzle field modules (**42**) are arranged opposite each other.

19. A burner nozzle field according to claim 2, wherein nozzle field module (**42**) includes a plurality of pairs of burners (**11***a*, **11***b* to **15***a*, **15***b*), said pairs of burners are in air communication with said air distribution frame (**25**), said air distribution frame (**25**) includes two half sections (**25***a*), (**25***b*), half section (**25***a*) is in communication with said burners (**11***a* to **15***a*) indexed with 'a' and half section (**25***b*) is in communication with burners (**11***b* to **15***b*) indexed with 'b'.

20. A burner nozzle field according to claim 19, further including a switch over device (**51**) connected to said half sections (**25***a*), (**25***b*), said switch over device (**51**) for alternately providing air exhaust or air feed to said half sections (**25***a*), (**25***b*), whereby said burners indexed with 'a' and said burners indexed with 'b' alternate between actuated burner and recuperative regenerative heat transfer by operation of switchover device (**51**).

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