

April 28, 1964

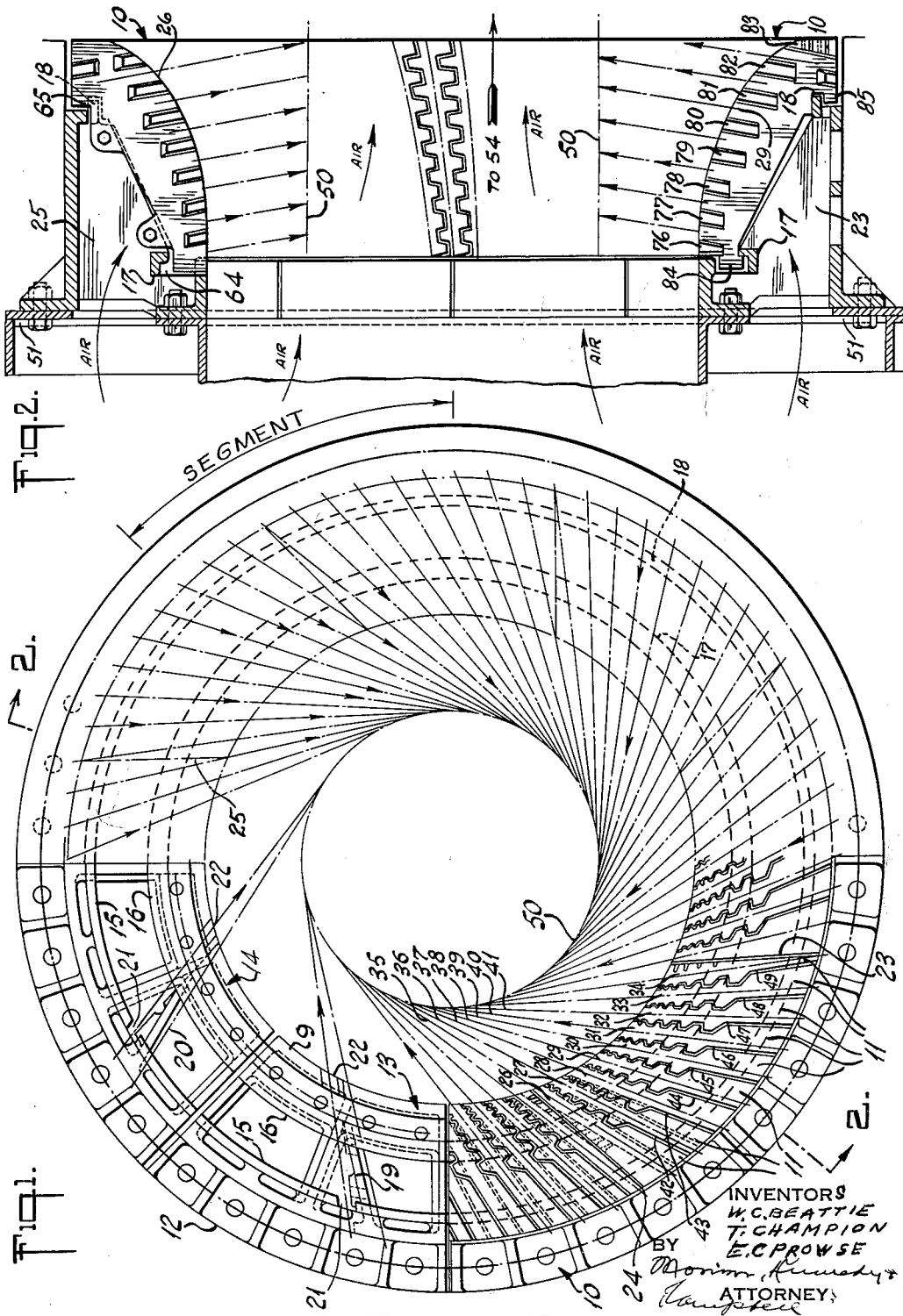
W. C. BEATTIE ETAL

3,130,773

AIR-COOLED BURNER RING

Filed May 4, 1959

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April 28, 1964

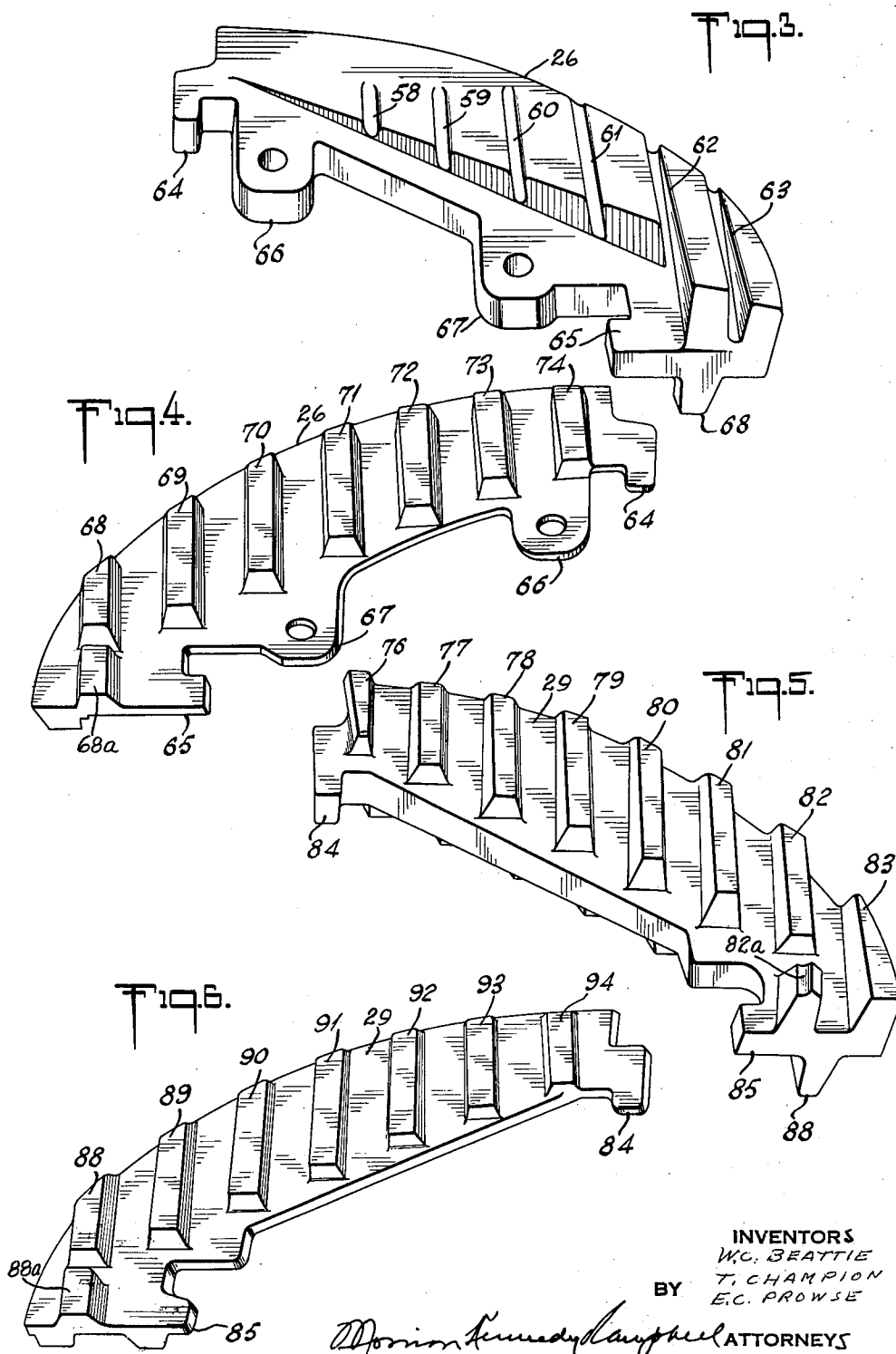
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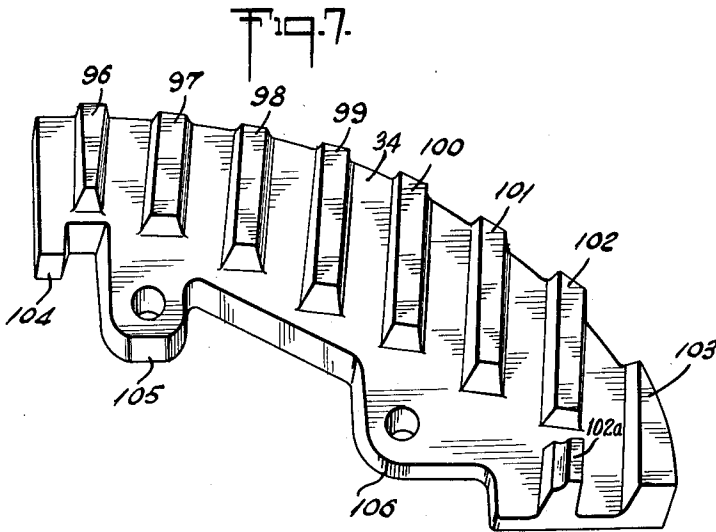
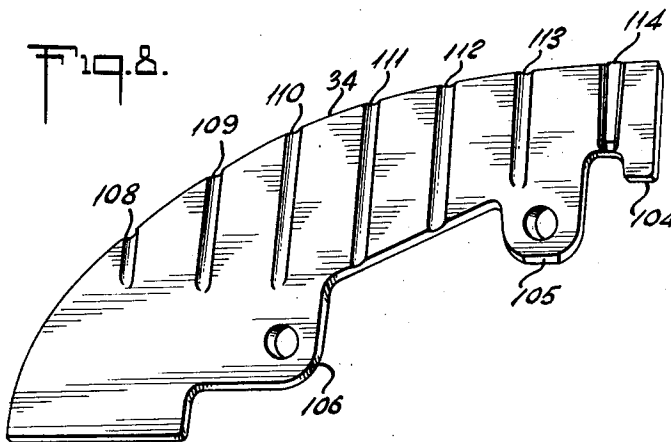
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6 Sheets-Sheet 3



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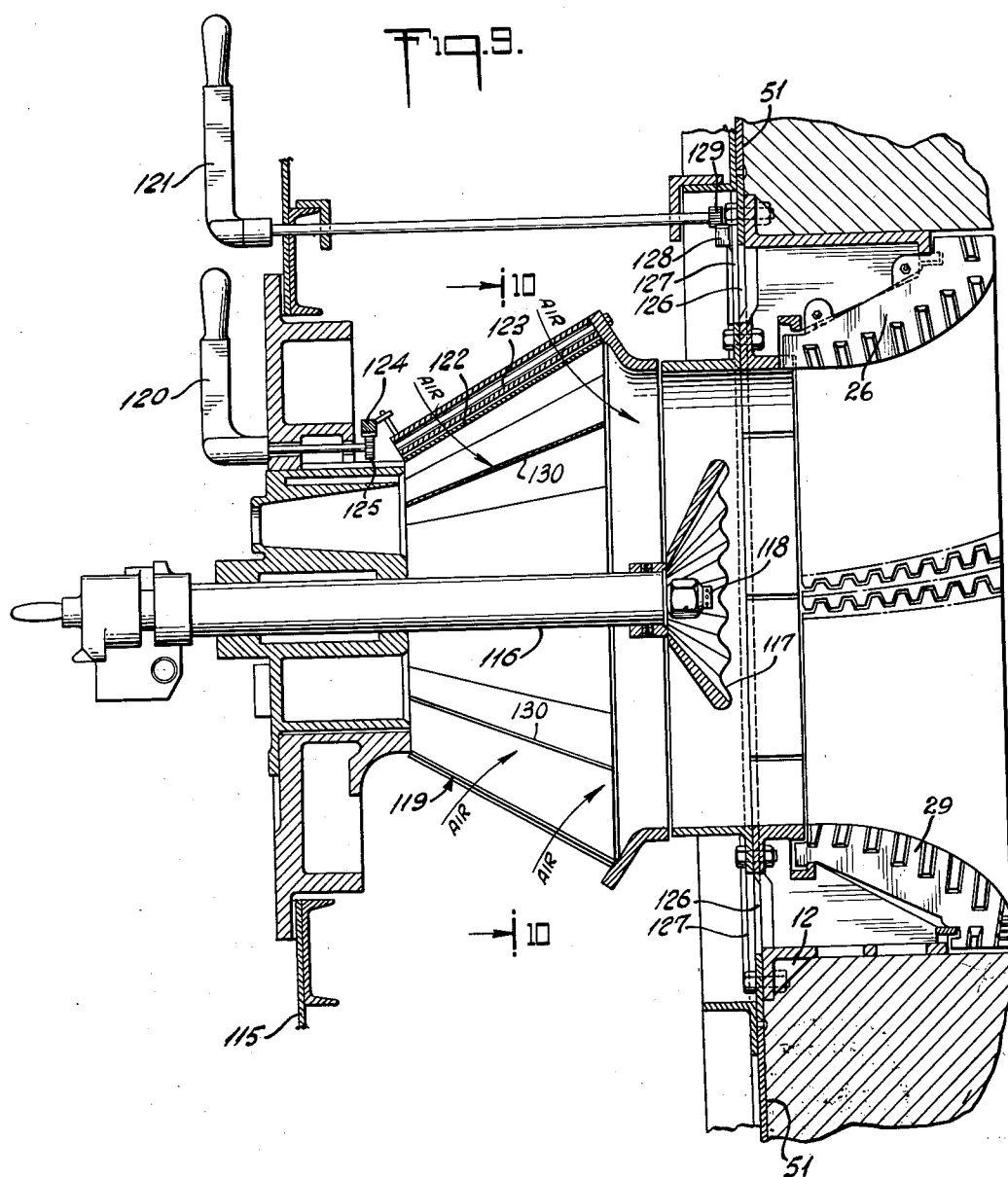
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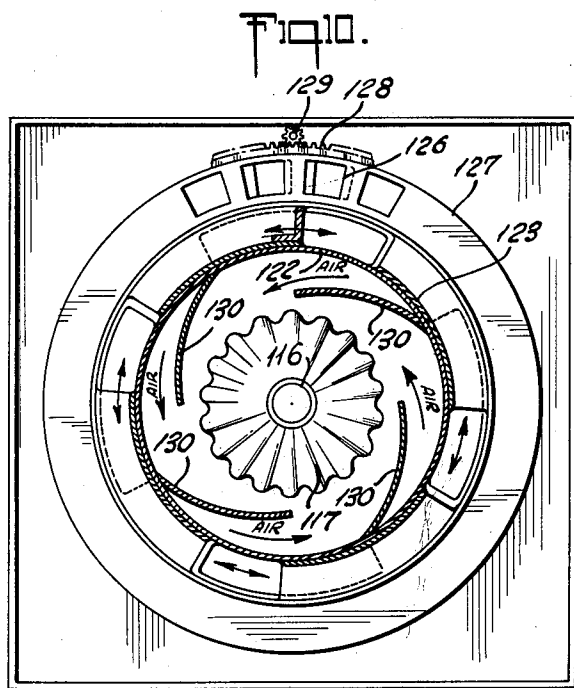
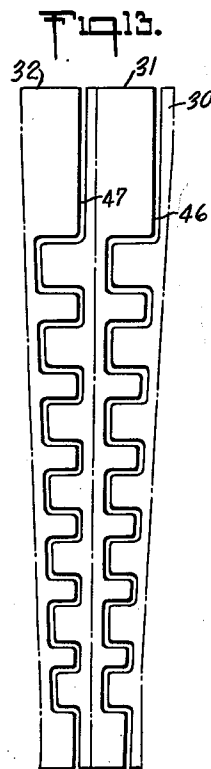
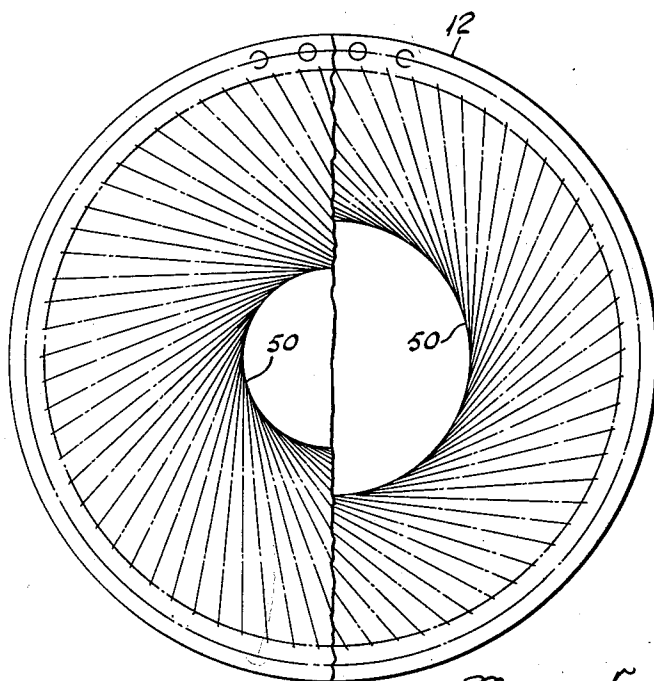
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6 Sheets-Sheet 5



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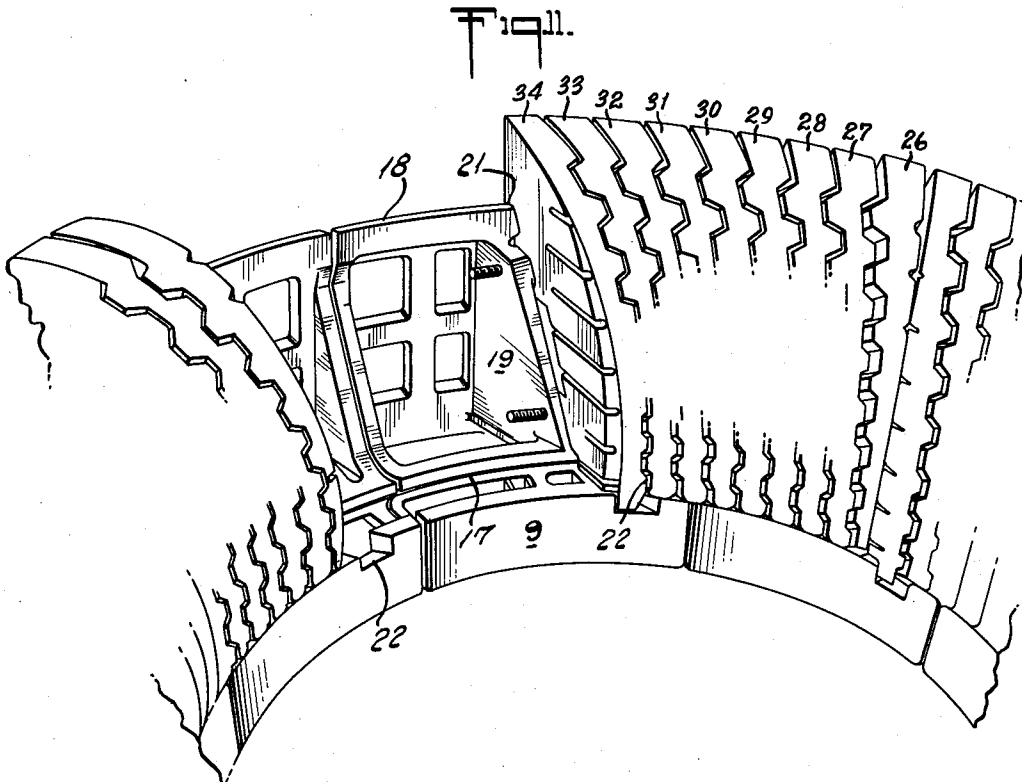
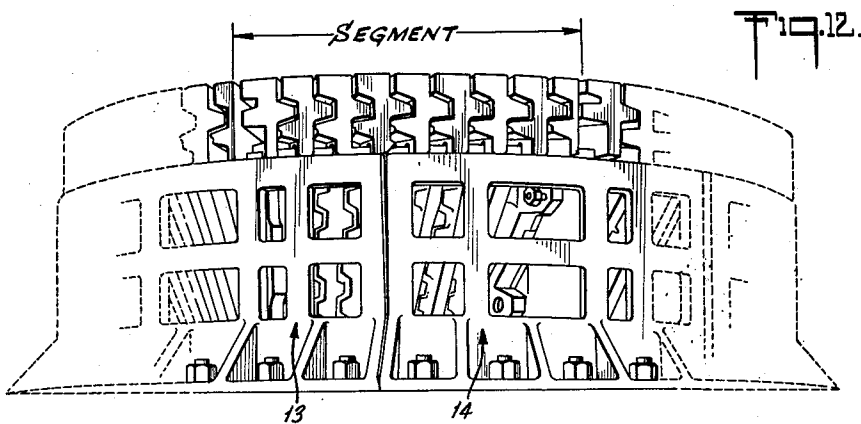
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6 Sheets-Sheet 6



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3,130,773

AIR-COOLED BURNER RING

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16 Claims. (Cl. 158—1.5)

This invention relates to burner rings for steam boilers and the like and more particularly to an air-cooled burner ring capable of supplying heated air to the burner.

The general objects of the invention are to provide a burner ring which will be air-cooled and which will therefore last for a long period of time, and which will also be capable of directing and supplying air to the burner in the combustion chamber and therefore result in better burner and boiler efficiency. The prime object is to give durability and long life to the ring predicated on low construction cost coupled together with ease of replacement of damaged parts.

A further object of the invention is to afford a burner ring which is especially adapted to be used with all types of fuels and burners and in addition provide a means for controlling combustion in the boiler by supplying secondary air at elevated temperatures to result in better combustion and boiler efficiency.

In the past, the burner rings have been made of various materials but primarily of so-called fire brick. These bricks have been made in the form of annular wedge inserts forming the burner ring and due to their being subjected to the intense heat generated in the firebox by the burning of the fuel have had to be replaced quite often. The construction of the new units disclosed herein is such that the temperatures of the components may be closely controlled and will therefore result in a much longer life than is possible with existing units.

In the specific embodiment illustrated, the air-cooled burner ring is made up of a series of individual bars having suitable air passages therebetween for cooling the ring and arranged to direct the heated air into the combustion chamber. The air may be primary air or secondary air, according to the boiler design. As herein shown, the burner ring air passages are utilized for supplying heated secondary air to the burner from the same wind box which is ordinarily employed for the supplying of primary air to the burner. The burner ring bars are preferably, but not necessarily, made of cast iron and are formed on their opposite side faces with grooves and ribs which space the bars apart and create the desired air passages therebetween. The ribs on one face of an individual bar are staggered with reference to the ribs on the abutting face of the adjoining individual bar, so that all of the bars will be supported in nested ring formation but the ribs do not contact with one another and thus leave a series of continuous air passages between each pair of adjoining bars. The actual spacing of the bars is accomplished by spacing lugs located at each end of the bars. The total area of these air passages may be regulated to control the volume of air (primary or secondary) required for complete combustion. The burner ring bars, instead of being arranged in a purely radial direction (as they could be in the broader aspects of the invention) are inclined from the radial so that the air discharged from them will be given a tangential swirl which assumes the formation of a cylinder of suitable diameter. This air swirl not only acts as an insulation blanket between the burner flame and the burner ring but also improves combustion by effecting a more thorough mixing of the air and fuel in the operation of the boiler. Preferably, too, the air passages are arranged to incline forwardly from the vertical in the direction of air flow to direct the air

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into the flame area of the firebox, there being a plurality of ring-like series of air passages extending across the entire curved or cone-like face of the burner ring.

The burner ring bars can be readily removed and replaced whenever necessary. They are arranged in segmental groups and are mounted in an annular frame which is made up of as many segmental sections as there are segmental groups of bars. One group of the bars may be readily removed without disturbing the other groups. In order to facilitate such replacement, the burner ring bars of each segmental group comprise one starting bar, a plurality of intermediate bars and one locking bar. In removing a group of bars, the starting bar is withdrawn, as may be readily done, then the remaining bars slid out through the same space. In replacing the bars, they are inserted one by one in reverse fashion and then locked in place by the locking bar.

Referring to the drawings:

FIG. 1 is a face view of the eight segments from the fire face side which make up the annular mounting frame upon which the inclined burner ring bars are mounted. The view is sectioned to first show 90° of the annular mounting ring with two segments thereof, then 90° of the burner ring bars, while the remaining 180° depicts the direction of flow of air emitted from the air passages between the inclined bars to result in a tangential swirl;

FIG. 2 is a section of FIG. 1 taken at 2—2 and shows the air-cooled burner ring mounted in the boiler wall as well as the individual bars at various locations and in addition shows the tangentially swirling cylinder of air produced by the cooling air;

FIG. 3 is a perspective view of the inclined starting bar looking at the front or starting side and showing air passages and mounting means;

FIG. 4 is a perspective view of the back side of the inclined starting bar and shows the face ribs and mounting means;

FIG. 5 is a perspective view of the front side of an inclined intermediate bar and showing the face ribs and mounting means;

FIG. 6 is a perspective view of the back side of an inclined intermediate bar and showing the face ribs and mounting means;

FIG. 7 is a perspective view of the front side of the inclined locking bar and showing the face ribs and mounting means;

FIG. 8 is a perspective view of the back or closing side of the inclined locking bar and showing air passages and mounting means;

FIG. 9 is a sectional view through a boiler wall showing the wind box, burner assembly and air-cooled burner ring in place and showing the air inlet dampers for primary and secondary air;

FIG. 10 is a section of FIG. 9 taken at 10—10 through the primary air inlet and shows the primary guide vanes for imparting the tangential flow to the primary air with its damper and also shows the damper for controlling the volume of secondary air into the air-cooled burner ring;

FIG. 11 is a partial perspective view of the annular mounting frame with the guide vanes and a segmental group of burner ring bars removed;

FIG. 12 is a partial perspective view of the annular mounting frame of the air-cooled burner ring and discloses the interlocking ends of the inclined bars and the segments that make up the annular mounting frame;

FIG. 13 is a developed view of the air outlet space between two inclined intermediate bars; and

FIG. 14 is a face view of two different air-cooled burner rings in which the inclined bars have been changed to give two other diameters to the swirling cylinder.

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In FIG. 1 there is shown a face view of the complete air-cooled burner ring 10 with the inclined individual bars 11 mounted on an annular supporting frame 12. The annular frame 12 is made up of eight segments, all alike, and of which 13 and 14 are typical examples, and contain the segments 15 of an outer circular bar mounting ring 18 (larger diameter) as well as the segments 16 of an inner circular bar mounting ring 17 (smaller diameter). When the frame segments are bolted in place, they form a complete annular supporting frame with two complete circular bar mounting rings upon which the inclined bars 11 are mounted. It will be noted that the segments 13 and 14 of the annular mounting frame are formed with guide vanes 19 and 20 which not only tend to direct the air into the passages between the inclined bars 11 but in addition form the means for starting and locking each segmental group of inclined bars in place. It will also be noted that the segments of the outer and inner circular bar mounting rings 18 and 17 on each of the segments 13 and 14 of the annular mounting frame 12 are milled at points 21 on the outer circular mounting ring and at points 22 on the inner face 9 of segments 13 and 14. The bars 11 are arranged in eight segmental groups and are of three different types, as will subsequently appear. It will be noted that each segmental group of bars starts and ends at the guide vanes 23, 24, and 25 located beneath the bars and directed in the same plane as the bars in order that they may be bolted thereto. The mounting of a segmental group of bars 11 (each group consisting of nine bars) is started by taking the starting bar 26 and inserting it into the slot 21 milled in the outer circular bar mounting ring segment 15 and at the same time mount its other end over the inner circular bar mounting ring segment 16 and then slide it on said mounting rings up to the guide vane 24, to which it is bolted. The same operation must again be gone through to insert and mount the seven intermediate bars 27 to 33 which are held entirely in place by the outer circular bar mounting ring 18 and the inner circular bar mounting ring 17. The inclined locking bar 34 is now placed in position in the milled slots 21 and 22 and bolted in place to the guide vane 23 and thereby complete the mounting of a complete segment of burner ring bars. The spacing of the bars is accomplished by small lugs on the sides which accurately space each bar from the succeeding one to give an accurate air emission area between bars. Thus, each starting bar 26 is formed at one end and at one side with a spacing lug 68a (FIG. 4); each intermediate bar 29 is formed at opposite ends and on opposite sides with spacing lugs 82a and 88a respectively (FIGS. 5 and 6); and each locking bar 34 is formed at one end and at one side with a spacing lug 102a (FIG. 7). The same procedure is carried out for all eight segments which go to make up the complete burner ring 10 and it is evident that any one of the eight segments may be readily removed for repair and inspection (or if necessary replacement) without disturbing any of the other segments. The lines 35, 36, 37, 38, 39, 40 and 41 indicate the tangential path of the air which is emitted by the air passages 42, 43, 44, 45, 46, 47, 48 and 49 between the bars and directly indicates how the cylinder of tangential swirling air 50 is formed where the air converges. The air inlet into the air-cooled burner ring is shown by the arrows marked air and it can readily be seen how the air could be used for either primary or secondary or tertiary air for normal burner use.

It is not deemed necessary to repeat the foregoing description for each of the eight segments contained in the air-cooled burner ring as they are all alike and all the elements that go to make them up are all interchangeable. It can now be seen how the complete cylinder 50 of tangentially swirling air is formed and how it may be used either for supplying primary or secondary air to the

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burner and thereby cause complete and controlled combustion.

It may also be noted that the diameter of the cylinder 50 can readily be changed simply by changing the angle of inclination of the inclined bars 11 by removing one series of bars and substituting another series with a suitable angle of inclination. In addition the bars may also be changed to vary the volume of air therethrough if necessary by varying the air space.

FIG. 2 is a sectional view of FIG. 1 taken along the line 2—2 and shows the air-cooled burner ring 10 mounted on the furnace wall 51 by means of bolts. The inclined intermediate bar 29 is mounted on the inner circular bar mounting ring 17 and outer circular bar mounting ring 18 by means of retaining lugs 84 and 85 located on the under side of said bar. The ribs 76, 77, 78, 79, 80, 81, 82 and 83 formed on the front side of the bar 29 indicate the means employed in directing the air slightly into the firebox area 54, while still maintaining the tangentially swirling air cylinder 50. It must be noted that the net result of the large volume of air which is being emitted through the plurality of passages between the burner ring bars will in reality form a cylindrical swirling blanket of tangentially flowing air between the face of the burner ring and the cylinder 50, which blanket will not only insulate the bars making up the burner ring from the direct heat of the burning fuel but will in addition supply heated air to induce more complete combustion. The secondary air cylindrical blanket directly causes the burning gases to swirl and mix with the secondary air and moreover imparts additional swirl to the primary air to give complete combustion control. In addition, the air blanket prevents the flame from impinging on the back wall of the boiler by causing the flame to ball out in response to the ever increasing tangential swirling motion and thereby fill the firebox and prevent damage to the brickwork on the back wall of the boiler.

The inclined starting bar 26 (still referring to FIG. 2) is shown mounted on the inner and outer circular bar mounting rings 17 and 18 by means of retaining sections 64 and 65 and bolted to the guide vane. In connection with this mounting and retaining means, it might be stated that the means is so designed as to anchor the burner ring bars on the inner circular bar mounting ring 17 and permit the bars to expand and contract on the outer circular bar mounting ring 18.

In FIG. 3 is shown a perspective view of the front side of an individual starting bar 26 same as bar 26 shown and used in FIG. 1. This bar is mounted on and bolted to the guide vane and serves as the starting bar for every segmental group of burner ring bars. The bar 26 is formed on its front or starting side with a plurality of air passages 58, 59, 60, 61, 62 and 63 which serve to cool the bars when the adjoining locking bar is in place. The retaining lugs 64 and 65 serve as the mounting and guide means and the perforated ears 66 and 67 serve as the anchoring means whereby the bar is bolted to the guide vane.

In FIG. 4 is shown a perspective view of the back side of the starting bar 26 shown in FIG. 3. The bar is formed on said back side with a plurality of cooling ribs 68, 69, 70, 71, 72, 73 and 74 which when placed in conjunction with an intermediate bar forms an air passage of given cross sectional area to permit the passage therethrough of a given volume of air for cooling of said bars and for combustion control. The mounting means 64, 65, 66 and 67 remain the same and are shown reversed.

In FIG. 5 is shown a perspective view of the front side of an individual intermediate bar 29 with a plurality of cooling ribs 76, 77, 78, 79, 80, 81, 82 and 83 formed on said front side and so arranged as to nest into and form air passages between it and the adjoining starting bar 26 disclosed in FIGS. 3 and 4. Retaining lugs 84 and 85 are utilized as hereinbefore described. There are

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seven of these intermediate bars in each segmental group, as before stated.

In FIG. 6 is shown a perspective view of the back side of the intermediate bar 29 shown in FIG. 5. The bar 29 is formed on said back side with a plurality of cooling ribs 88, 89, 90, 91, 92, 93 and 94 which are so arranged as to nest into the cooling ribs 76, 77, 78, 79, 80, 81, 82 and 83 formed on the back side of a like adjoining intermediate bar or of an adjoining locking bar as shown in FIGS. 7 and 8 in order to give the necessary air control. Retaining lugs 84 and 85 are formed on the opposite ends of the bar.

In FIG. 7 is shown a perspective view of the front side of an individual locking bar 34 with a plurality of cooling ribs 96, 97, 98, 99, 100, 101, 102 and 103 which are so arranged as to nest into the cooling ribs 88, 89, 90, 91, 92, 93 and 94 of an adjoining intermediate bar 29 as shown in FIG. 6. One retaining lug 104 is used here and is moved into place as the bar 34 is slid into position radially and then retaining lug 104 is moved circumferentially to hook over the outer circular bar mounting ring 18 and bolted in place by means of the perforated ears 105 and 106 onto the guide vanes. This bar 34 is placed in the milled slot 22 in the face of the frame segment 9 and in slot 21 in the annular outer circular bar mounting ring 18.

In FIG. 8 is shown a perspective view of the back or closing side of the locking bar 34 shown in FIG. 7. The bar 34 is formed on said back side with a number of air passages 108, 109, 110, 111, 112, 113 and 114 which allow the passage of air between it and an adjoining starting bar. The mounting means 104, 105 and 106 remains the same as above described.

The foregoing description of the burner ring bars easily makes it discernible how and why the bars may be removed in segments and are readily interchangeable. It also discloses how the volume of air can be controlled by controlling the size of the air passage area between said bars. The shape of the cooling ribs on the bars may be changed in order to give a pattern that will be suitable for the overall area necessary for cooling and combustion control. The various patterns that may be resorted to are square as shown herein but they could be of V-form or corrugated.

In FIG. 9 is shown a section through the air-cooled burner ring shown in FIGS. 1 and 2 but with the burner and primary air inlet and wind box added to disclose how one augments the other when used in series as shown. The wind box outside wall 115 together with the boiler wall 51 forms the two walls of said wind box and supports the burner 116 and the primary air control operating handle 120 and secondary air control operating handle 121. The primary air control cone 119 is formed of two truncated sections 122 and 123 arranged to nest one over the other with the under or lower cone section 122 being an integral part of the burner assembly and formed with a suitable plurality of air directing openings to impart an initial tangential swirl to the primary air. The adjustment and control of the primary air is accomplished by rotating cone 123, by means of rack 124 and pinion 125, over the cone section 122 and so open and close the plurality of openings and thereby control the ingress of primary air. The burner 116 with reflector 117 and nozzle 118 are ordinary burner parts designed and used for gas, oil or powdered coal as desired.

The control of the secondary air used to cool the burner ring and control combustion is accomplished by means of two flat circular plates 126 and 127 formed with a plurality of radially disposed openings therein, the plate 126 being affixed to the annular mounting frame for the burner ring and the plate 127 being rotatable over said plate 126 so that when plate 127 is moved back and forth, by means of rack 128, pinion 129 and operating handle 121, it opens and closes said plurality of openings and so controls the volume of secondary air. Under no

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circumstances should the secondary air openings be closed off entirely as this would cause the burner ring to heat up and melt; hence there is installed a stop which permits the operating handle 121 to be operated only so far and thereby insure a given minimum amount of air for cooling said burner ring. The two hand controlled operating handles 120 and 121 can actually be coupled together by suitable gearing if desired in order to control the primary and secondary air by a single operation.

FIG. 10 is a section through FIG. 9 at 10-10 and actually shows the means employed to impart the initial tangential swirl to the incoming primary air as well as control the volume thereof and in addition shows the means for controlling the secondary air. The inner cone section 122 is equipped with vanes 130 under openings in said section in order to impart the initial tangential swirl to the primary air supplied to the burner. The secondary air volume control above described is also shown in FIG. 10.

FIG. 11 is a partial perspective view of the annular burner ring mounting frame with a segmental group of the inclined bars removed and directly shows the milled slots 21 and 22 in the inside face 9 and the circular bar mounting ring 18. The locking bar of the adjoining section is shown in place and bolted to the guide vane 23. This view also discloses how the junctions of the segments of the annular mounting frame are offset circumferentially from the fastening means for the burner ring bars.

FIG. 12 is a partial perspective view of the outside of the completed air-cooled burner ring and shows the method of interlocking the inclined bars in order to allow them to be held in place while still permitting a small amount of air to pass therethrough for cooling. FIG. 12 also shows the inclined bars mounted on the annular frame as viewed through openings in the outside shell, which openings normally would be covered by brickwork of the boiler wall. One segmental group of inclined bars is shown complete. The method of fastening the annular mounting frame to the boiler wall is also disclosed.

FIG. 13 is a developed view of the air outlet space between two inclined intermediate bars and illustrates the actual air space being employed to furnish cooling air as well as combustion control air. From this view it can be seen how the area for volume control as well as the direction of the air can be changed and controlled.

FIG. 14 is a face view of two different air-cooled burner rings in which the inclined bars have been changed to give two other diameters to the swirling cylinder of air 50. One is shown larger and the other smaller.

It will thus be seen that we have described an air-cooled burner ring embodying the principles and attaining the objects and advantages of the present invention. Since many matters of arrangement, combination, design, and details may be variously modified without departing from the principles involved, it is not intended to limit the invention to such matters except insofar as specified in the appended claims.

While, as previously stated, the burner rings are preferably made of cast iron, in the broader aspects of the invention they could be composed of some other metal or metal alloy, whether cast or machined. The rings might also be composed of some high heat-resistant baked refractory material, such as chrome, magnesia, chrome magnesia or carborundum. Moreover, in other aspects of the invention, the elements which comprise the burner ring might be in the form of blocks or in the form of circular rings, so long as they are designed to give the requisite number of air passages for cooling and combustion. These and other modifications will readily suggest themselves to those skilled in the art.

What is claimed is:

1. In combination with a fuel burner adapted to be mounted at the entrance to a furnace and comprising a spray nozzle for the discharge of fuel under high pres-

sure into the furnace, an air-cooled burner ring disposed about said spray nozzle and adapted to be mounted in the furnace wall to protect it against the burner heat and defining a burner throat within which combustion of the fuel takes place, said burner ring comprising a circular series of thin individual independently supported one-piece elongated bars spaced apart to provide between them substantially throughout their length a series of closely spaced inwardly directed air passages open at the outer edges of the bars for the entrance of cooling air and open at the inner edges of the bars for the discharge of heated cooling air into the flame area of the burner throat, and mounting means for said bars permitting their individual expansion and contraction, said bars being formed with spacing lugs which space them apart at a definite uniform distance.

2. In combination with a fuel burner adapted to be mounted at the entrance to a furnace and comprising a spray nozzle for the discharge of fuel under high pressure into the furnace, an air-cooled burner ring disposed about said spray nozzle and adapted to be mounted in the furnace wall to protect it against the burner heat and defining a burner throat within which combustion of the fuel takes place, said burner ring comprising a circular series of individual elongated bars spaced apart to provide between them substantially throughout their length a series of inwardly directed air passages open at the outer edges of the bars for the entrance of cooling air for the burner throat and open at the inner edges of the bars for the discharge of heated cooling air into the flame area of the burner throat, and an annular mounting frame for said bars, said frame having two concentric rings on which the bars are individually supported at their opposite ends and adapted to be supported in an opening of the furnace wall.

3. A combination according to claim 2, wherein the individual bars of the burner ring are formed to be removably supported on the two concentric rings of the annular mounting frame so as to be replaceable by another set of individual bars of the same length and likewise formed to be removably supported on said concentric rings.

4. A combination according to claim 2, wherein said annular mounting frame of the burner ring is made up of a plurality of individual segments, each provided with its own individual fastening means for independent mounting.

5. An air-cooled burner ring according to claim 2, wherein the individual bars are divided into a plurality of segmental groups for independent mounting and dismounting, each said group comprising a starting bar, a plurality of intermediate bars, and a locking bar, and wherein the annular mounting frame is formed with a plurality of anchoring elements, one located between each pair of adjoining segmental groups of bars, both the starting bar and the locking bar of adjoining segmental groups being bolted to the corresponding anchoring element, and the intermediate bars of each group being individually supported by the two concentric rings on the annular mounting frame.

6. An air-cooled burner ring adapted to be mounted in a furnace wall opening and defining a burner throat, said ring comprising an annular mounting frame having an outer cylindrical shell and two concentric rings located inwardly of said cylindrical shell at the front and back thereof, and a circular series of individual elongated bars spaced apart to provide between them substantially throughout their length a series of inwardly directed air passages open at the outer edges of the bars for the entrance of cooling air and open at the inner edges of the bars for the discharge of heated cooling air into the flame area of the burner throat, said bars being individually supported at their opposite ends upon the two concentric rings of the annular mounting frame and spaced from the outer cylindrical shell of said frame to

provide therebetween an annular air supply chamber open for the entrance of air and communicating with the inlet openings of the air passages between the individual bars.

7. An air-cooled burner ring according to claim 6, wherein the individual bars are inclined from the radial so as to cause the heated cooling air discharged into the flame area of the burner throat to assume a tangential direction with reference to an imaginary cylinder of a given diameter located in said burner throat, and said burner ring being formed within the annular air supply chamber with air guide vanes having the same inclination as that of the individual bars.

8. An air-cooled burner ring according to claim 7, wherein the individual bars are divided into segmental groups for independent mounting and dismounting, and wherein the air guide vanes in the annular air supply chamber also act as anchoring elements between which adjoining segmental groups of bars are mounted.

9. An air-cooled burner ring according to claim 6, wherein the annular mounting frame is provided with an annular damper to control the amount of air entering the air supply chamber.

10. An air-cooled burner ring according to claim 6, wherein the outer cylindrical shell of the annular mounting frame is formed with a series of openings throughout its circumference leading radially outward from the annular air supply chamber.

11. An air-cooled burner ring adapted to be mounted in a furnace wall and defining a burner throat, said ring comprising an annular mounting frame having an outer cylindrical shell and two concentric rings of different diameters located inwardly of said shell at the front and back thereof, and a circular series of individual elongated bars spaced apart to provide between them substantially throughout their length a series of inwardly directed air passages open at the outer edges of the bars for the entrance of cooling air and open at the inner edges of the bars for the discharge of heated cooling air into the flame area of the burner throat, said bars being individually supported at their opposite ends upon the two concentric rings of the annular mounting frame for individual expansion and contraction, the outer edges of the bars being inclined outwardly from the supporting ring of smaller diameter to the supporting ring of greater diameter and spaced from the outer cylindrical shell to leave an annular air supply chamber open for the entrance of air and communicating with the inlet openings of the air passages between the individual bars, and the inner edges of the bars being of arcuate shape and flared in the direction of the length of the individual bars from the supporting ring of smaller diameter toward the supporting ring of greater diameter, and said arcuate and flared inner edges of the bars being flush with one another in all directions to provide a flame exposed surface which is interrupted only by the air passages formed between the bars and leading into the flame area of the burner throat.

12. An air-cooled burner ring according to claim 11, wherein the individual bars are inclined from the radial to cause the streams of heated cooling air discharged into the flame area of the burner throat to assume a tangential direction with reference to an imaginary cylinder of a given diameter located in said burner throat, and wherein the inwardly directed air passages between the individual bars are constituted by ribs and grooves formed on a great majority of individual bars and extending transversely of the length thereof, the ribs on one bar projecting into grooves on adjacent bars to control the direction of flow of the heated cooling air discharged into the flame area of the burner throat.

13. An air-cooled burner ring adapted to be mounted in a furnace wall and defining a burner throat, said ring comprising a circular series of individual elongated bars spaced apart to provide between them substantially throughout their length a series of inwardly directed air passages open at the outer edges of the bars for the en-

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trance of cooling air and open at the inner edges of the bars for the discharge of heated cooling air into the flame area of the burner throat, said individual bars on their adjacent side faces having a matching configuration which provides air passages of tortuous form in the direction of length of the bars, thereby providing increased cooling and heating area for the bars as well as increased volume of heated cooling air discharged into the flame area of the burner throat, and mounting means for said bars permitting their individual expansion and contraction.

14. An air-cooled burner ring adapted to be mounted in a furnace wall and defining a burner throat, said ring comprising a circular series of individual elongated bars spaced apart to provide between them substantially throughout their length a series of inwardly directed air passages open at the outer edges of the bars for the entrance of cooling air and open at the inner edges of the bars for the discharge of heated cooling air into the flame area of the burner throat, the air passages between a great majority of individual bars being constituted by a series of ribs and grooves formed on said bars and extending transversely of the length of the bar, and said bars being so arranged that the ribs of one bar project into the grooves of adjacent bars, whereby the heated cooling air is discharged into the flame area of the burner throat in the same transverse direction in which the ribs and grooves extend, and mounting means for said bars permitting their individual expansion and contraction.

15. An air-cooled burner ring according to claim 14, including an annular mounting frame for said bars, said frame having two concentric rings on which the bars are individually supported at their opposite ends, and wherein the individual bars are formed to be removably supported on the two concentric rings of the annular mounting frame so as to be replaceable by another series of individual bars of the same length and likewise formed to be removably supported on said concentric rings.

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16. An air-cooled burner ring adapted to be mounted in a furnace wall and defining a burner throat, said ring comprising a circular series of closely spaced individual elongated bars spaced apart at a distance less than the thickness of said bars to provide between them substantially throughout their length a series of narrow inwardly directed air passages open at the outer peripheral edges of the bars for the entrance of cooling air for the burner throat and open at the inner peripheral edges of the bars for the discharge of heated cooling air in a direction crosswise of said bars into the flame area of the burner throat, and an annular frame wherein the individual bars are mounted for free and independent expansion and contraction, said frame alone affording complete support for the entire series of bars and adapted to be supported in an opening of a furnace wall, and said bars being formed with spacing lugs which space them apart at a definite uniform distance in the mounting frame while permitting their free and independent expansion and contraction.

References Cited in the file of this patent

UNITED STATES PATENTS

1,532,041	Couch	Mar. 31, 1925
1,610,707	Rathgeb	Dec. 14, 1926
1,774,859	Wager	Sept. 2, 1930
1,843,000	Rich	Jan. 26, 1932
1,862,126	Ternau	June 7, 1932
2,015,756	Moir	Oct. 1, 1935
2,192,682	Anderson	Mar. 5, 1940
2,271,587	Haynes	Feb. 3, 1942
2,334,314	Campbell	Nov. 16, 1943
2,515,843	Te Nuyt	July 18, 1950
2,901,032	Brola	Aug. 25, 1959

FOREIGN PATENTS

649,843	France	Sept. 10, 1928
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