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3,615,082

FURNACE MUFFLE

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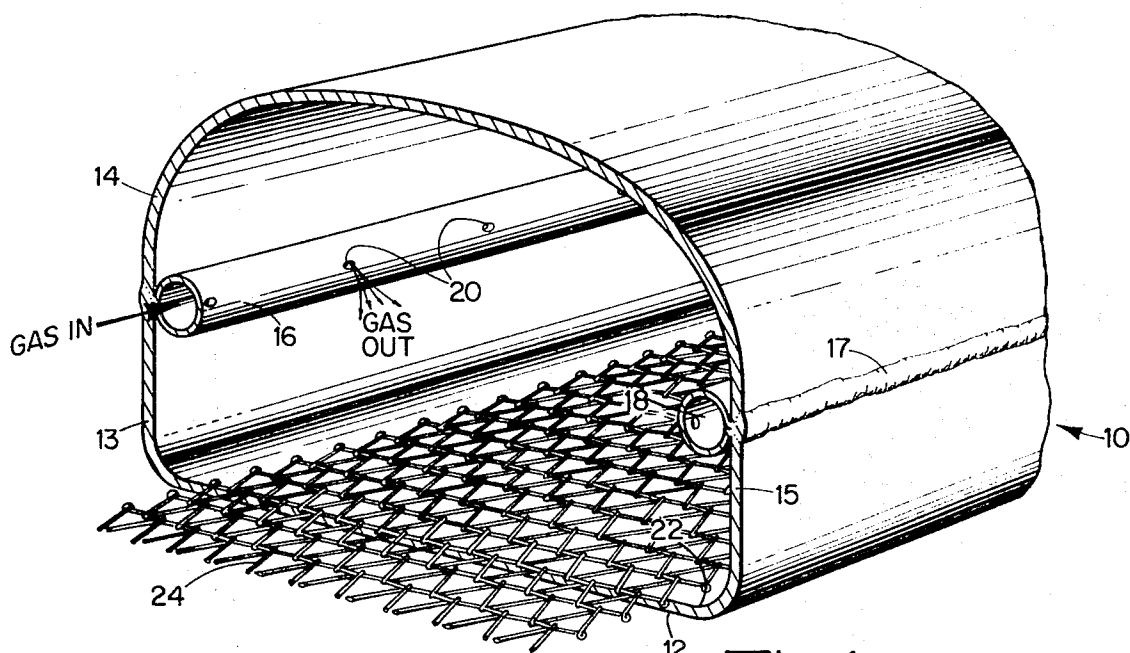


Fig. 1.

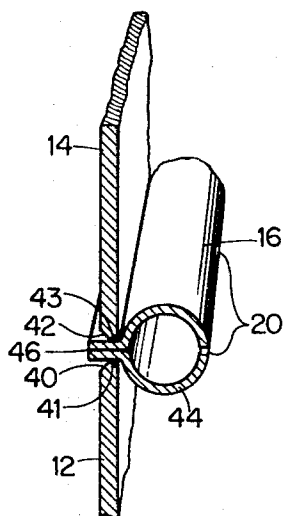


Fig. 2.

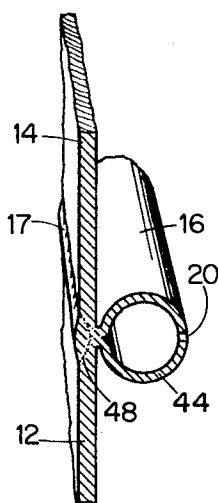


Fig. 3.

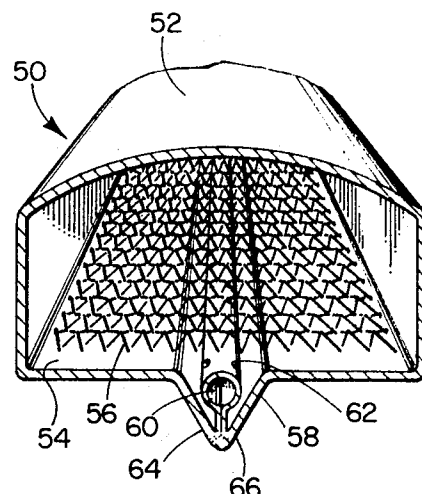


Fig. 4.

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FURNACE MUFFLE

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5 Claims

ABSTRACT OF THE DISCLOSURE

A furnace muffle of unique welded construction and especially adapted for operation at extreme operating temperatures. The muffle is formed as an elongated tubular member having one or more gas pipes integrally formed therein to introduce a gaseous atmosphere within the muffle. The entire muffle structure including the gas pipes is formed of a metal which has experienced the same work history during fabrication, and individual elements of the muffle structure are welded in a unique manner to provide a unitary muffle construction capable of superior operation at elevated temperatures.

FIELD OF THE INVENTION

This invention relates to furnace muffles and more particularly to a welded muffle construction capable of providing superior operation at extreme elevated temperatures.

BACKGROUND OF THE INVENTION

Moving conveyor muffle furnaces are widely employed in the heat processing of components and devices such as thick film circuits. The furnace muffle is formed as an elongated tubular member having a bottom wall which serves as a hearth for support of a moving conveyor thereon for transport of the work load through the furnace. The muffle may be divided into zones, each of which can be individually controlled to maintain separate temperatures and each of which may contain a different gaseous environment according to the particular heat processing being performed. In order to maintain uniform temperature within the muffle and in order to provide a sealed gaseous atmosphere, the muffle is formed as a closed tubular member and it is important that the integrity of the muffle structure be maintained over a wide range of operating temperatures without distortion in order not to detract from proper furnace operation.

The gaseous environment within the muffle is often provided by one or more gas pipes disposed along the length of the muffle and welded to the interior muffle wall. Such gas pipes, however, usually have different metallurgical characteristics and work history than the metal forming the muffle. As a result, the gas pipe has different thermal expansion characteristics than that of the muffle, as a consequence of which the pipe can physically distort during furnace operation. In an attempt to avoid such distortion, conventional furnace muffles have been constructed in which the gas pipe is supported within the muffle by means of brackets attached to the muffle wall. This latter approach, while lessening the problem of distortion to some extent, suffers the disadvantage of additional support structures within the muffle, which add to the cost of muffle fabrication, as well as giving rise to possible sources of contamination with the muffle at elevated temperatures.

SUMMARY OF THE INVENTION

In accordance with the present invention a furnace muffle of improved construction is provided which is especially adapted for superior operation at elevated temperatures. All elements of the muffle structure are formed of metal having identical metallurgical characteristics and having

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the same cold and hot metal working history, such that a muffle so constructed exhibits uniform thermal expansion and stress relieving over the operating temperature range. Typically, the muffle is formed of first and second elongated metal members of generally U-shaped cross section, arranged to be welded along their confronting edges to provide a closed tubular muffle structure. The confronting edges of the muffle sections are of predetermined beveled configuration and a gas pipe formed from a metal having the same work history as the sections of the muffle is disposed between the beveled confronting edges of the muffle sections. A portion of the gas pipes serves as a source of welding material and permits a mechanically strong unitary muffle to be provided capable of operation at extreme elevated temperatures without distortion.

DESCRIPTION OF THE DRAWINGS

The invention will be more fully understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a cutaway pictorial view of a furnace muffle constructed according to the invention;

FIG. 2 is an elevation view, partly in section, of the unique muffle construction prior to welding;

FIG. 3 is an elevation view, partly in section, of the muffle structure after welding; and

FIG. 4 is a cutaway pictorial view of an alternative embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

A furnace muffle of unique unitary construction and adapted for superior operation at elevated temperatures is illustrated in FIG. 1. The muffle 10 is of elongated tubular configuration and includes a first muffle section 12 of generally channel-shaped cross section intimately joined to a second muffle section 14 of generally U-shaped configuration. First and second gas pipes 16 and 18 are respectively joined to muffle sections 12 and 14 at their respective junctures. Gas pipes 16 and 18 each extend along the length of a respective side wall of muffle 10 and include a plurality of openings 20 therein spaced along the length of the gas pipes to transmit gas introduced within pipes 16 and 18 into the interior of the muffle 10. A predetermined gaseous environment can thus be maintained within the interior of the muffle.

Muffle section 12 includes a bottom wall 22 which serves as a hearth for the support of a movable conveyor belt 24 thereon. Conveyor belt 24 is typically formed of woven wire or chain link construction and is transported through the interior of muffle 10 by a suitable transport mechanism (not shown). A work load is thereby transportable through the muffle by means of moving conveyor 24. Muffle section 12 also includes side walls 13 and 15 formed at right angles to bottom wall 22 and joined to section 14 and respective gas pipes 16 and 18 by the unique continuous welds 17. The muffle section 14 is of a smoothly curved configuration and provides the arched roof of muffle 10.

The muffle elements described hereinabove are continuously and uniquely welded to provide the unitary muffle structure illustrated in FIG. 1 having a continuous weld 17 along each side wall thereof. The weld 17 is of large area and has substantially the same characteristics as the material forming the muffle elements. As a result, a muffle formed according to the invention, in a manner to be described, is operative over a wide temperature range and exhibits uniform stress relief and thermal expansion characteristics and maintains structural integrity even at extreme operating temperatures. It is a particular feature of the invention that all elements of the muffle are formed of metal which has experienced the same cold and hot work history such that

the entire unitary muffle structure exhibits the same thermal expansion characteristics and experiences substantially uniform stress relief over an operating temperature range. The muffle is formed of a high temperature alloy such as Inconel, the metal preferably being cross rolled to provide improved stress-relieved characteristics. Gas pipes 16 and 18 are formed in a configuration operative to assist in the achievement of a mechanically strong weld between the muffle sections 12 and 14 and gas pipe contained therebetween.

The confronting edges of muffle sections 12 and 14 and the portion of respective gas pipes 16 and 18 disposed therebetween and intimately bonded thereto are adapted according to the invention to provide a superior weld as a result of which a unique unitary muffle structure is provided which is capable of operation and which maintains its structural integrity over a wide range of operating temperatures.

Construction of the unitary muffle structure is accomplished by a unique welding technique which provides an extremely strong large area weld between the elements of the muffle being fabricated. Referring to FIG. 2, there is shown the confronting edges of muffle sections 12 and 14 with gas pipe 16 disposed therebetween, prior to welding of these elements into a unitary structure. Gas pipe 18 is identically fabricated on the other side wall of muffle 10. A bevel 40 is formed on the upper edge of section 12 and a similar bevel 42 is formed on the edge of muffle section 14. The bevels extend across approximately half the wall thickness of respective muffle sections 12 and 14 and are formed on the side of the muffle sections opposite to the location of gas pipe 16.

The confronting edges of muffle sections 12 and 14 also include non-beveled portions 41 and 43 which extend across the other half of the wall thickness of the muffle sections and are formed substantially orthogonal to the plane of the muffle side walls on which they are disposed. A V-shaped region is defined by the confronting beveled edges along the length of muffle sections 12 and 14 and this region is effective to permit the formation of a deep large area weld, which, in accordance with the invention, provides the improved unitary muffle structure.

As discussed hereinabove, the gas pipes 16 and 18 are formed into the desired shape from a metal having the same work history as the metal employed to fabricate sections 12 and 14 of the furnace muffle. As illustrated in FIG. 2, gas pipe 16 includes a tubular portion 44, and a flange portion 46 which is disposed between the confronting non-beveled edges 41 and 43 of respective muffle sections 12 and 14. The flange portion 46 extends into the V-shaped region defined by the beveled edges 40 and 42 and may extend beyond the plane of the substantially coplanar walls of muffle sections 12 and 14.

As a particular feature of the invention, the flange portion 46 of the gas pipes serves as a source of material for forming the unitary welded muffle structure. This flange portion is of the same metal and has the same work history as muffle sections 12 and 14, and the weld formed according to the invention has essentially the same metallurgical characteristics as the elements forming the muffle. A muffle thus constructed is capable of operation at extreme elevated temperatures without degradation or distortion of the weldments.

The confronting surfaces of muffle sections 12 and 14 and the associated gas pipe are continuously welded along the length of the muffle typically by Heliarc welding to form the welded structure depicted in FIG. 3. As discussed hereinabove, the metal of flange portion 46 serves as a source of welding material which flows into the V-shaped region defined by the bevel edges 40 and 42 of muffle sections 12 and 14, such that a relatively deep and large area weld of high physical strength is provided. The surfaces 41 and 43 are also welded to the confronting portions of flange portion 56. The boundary

of the weld is depicted in FIG. 3 by the dotted generally hemispherical line 48. The metal employed in muffle sections 12 and 14 and the associated gas pipe is identical and has the same work history, and exhibits substantially uniform stress relieving as temperature varies. The gas pipes and associated muffle sections expand and contract by the same amount with temperature variation and the welds have less tendency to deteriorate under temperature cycling which may be experienced in operation and at high elevated temperatures at which the furnace employing the muffle operates. The muffle constructed according to the invention therefor maintains its structural integrity even at extreme operating temperatures, with the result that reliable and controllable furnace operation is maintained.

An alternative embodiment of a muffle constructed according to the invention is illustrated in FIG. 4 and includes an elongated tubular structure 50 having an arched roof 52 and a substantially flat coplanar bottom wall 54 which serves as the muffle hearth for support of a movable conveyer belt 56 thereon. A generally V-shaped slot 58 is formed in bottom wall 54 of the muffle and extends longitudinally along the length thereof. A gas pipe 60, formed of a metal having the same metallurgical characteristics and work history as the metal forming the muffle itself is disposed within the V-shaped slot 58 and is welded, in accordance with the invention, to the lowermost confronting edges of the slot to provide the superior unitary muffle structure. The uppermost surface of gas pipe 60 lies substantially within or below the plane of the muffle hearth and does not interfere with movement of conveyer belt 56 through the muffle. With the gas pipe 60 disposed below conveyer 56, the muffle is free of protuberances, and gas pipe 60 is protected against damage and undue wear. The gas provides, via openings 62 provided along the length thereof, a fresh supply of gaseous atmosphere which is directed up through the conveyer belt and which flows past the work product carried by the conveyer. As the gas is heated, it rises to the roof of the muffle away from the work product and can exit at the ends of the furnace.

In the embodiment of FIG. 4, the unitary muffle structure is formed with a single weld between the confronting edges of the muffle wall in V-shaped slot 58 and the associated gas pipe 60. As described hereinabove, continuous welding is employed to form a large area extremely strong weld. It will be appreciated that, prior to welding, the confronting edges of the inclined walls 64 and 66, define a V-shaped region in which is disposed the flange portion of gas pipe 60. A bevel need not be formed on the confronting edges of the muffle wall in this instance since such a bevel is effectively provided by the inclined disposition of the confronting muffle walls. As described hereinabove, the gas pipe 60 and the muffle 50 are of a metal having the same metallurgical characteristics and work history, and the large area deep weld formed according to the invention provides a unitary muffle structure capable of operation at extreme elevated temperatures without degradation or distortion.

What is claimed is:

1. A furnace muffle comprising:

- a first elongated member of generally U-shaped cross-section having first and second elongated parallel edges of predetermined beveled configuration adapted to provide a mechanically strong large area weld;
- a second elongated member of generally U-shaped cross-section having first and second elongated parallel edges of the same predetermined beveled configuration, the first and second edges of said second member confronting the first and second edges of said first member to form a tubular muffle structure, the beveled edges of said confronting members defining a groove in each outer side wall of said confronting members;

first and second gas pipes, each having a tubular por-

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- tion and an outwardly extending flange portion, and each disposed on respective opposite sides of said muffle structure with said tubular portion within said confronting members and with said flange portion between and in intimate contact with said confronting edges and disposed in said groove; 5
- said flange portion and confronting edges being continuously welded along the length thereof, said flange portion serving as a source of welding metal to provide a mechanically strong large area weld in the region of said predetermined beveled configuration and along the length of said muffle structure; and 10
- said first and second elongated members and first and second gas pipes each being formed of an identical metal having the same metallurgical characteristics and work history such that said members and gas pipes exhibit substantially uniform thermal expansion and stress relieving. 15
2. A furnace muffle according to claim 1 wherein said first and second members each include a bevel found on the outer elongated parallel edges thereof, the bevels of the confronting members defining a V-shaped groove in the outer side wall of said confronting members, and said flange portion being disposed in said V-shaped groove. 20
3. A furnace muffle according to claim 1 wherein said predetermined beveled configuration includes a beveled portion formed across approximately half the wall thickness of its elongated member, and a non-beveled portion formed across the other half of the wall thickness of said member in a direction orthogonal to the plane of the muffle wall, the bevels of said confronting members defining a V-shaped groove in the outer side wall of said confronting members, and said flange portion being disposed in said V-shaped groove. 25
4. A furnace muffle comprising: 30
- an elongated member of closed cross-sectional configuration having first and second confronting elongated parallel edges of predetermined beveled configuration defining a V-shaped groove in the outer wall of said member and adapted to provide a mechanically strong large area weld; 35
- a gas pipe having a tubular portion and an outwardly extending flange portion disposed with said tubular

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- portion within said closed configuration and with said flange portion within said V-shaped groove between and in intimate contact with said confronting edges; said elongated member and gas pipe each being formed of an identical metal having the same metallurgical characteristics and work history such that said member and gas pipe exhibit substantially uniform thermal expansion and stress relieving; and
- said flange portion and confronting edges being continuously welded along the length thereof, said flange portion serving as a source of welding metal to provide a mechanically strong large area weld in the region of said predetermined beveled configuration and along the length of said muffle structure.
5. A method of fabricating a unitary elongated furnace muffle comprising the steps of: 40
- forming a first and a second elongated section of generally U-shaped cross-section from a metal having predetermined metallurgical characteristics and work history;
- forming first and second rectangular sheets of a metal having the same characteristics and work history as said elongated sections into respective pipes each having a tubular portion and a flange portion;
- forming a bevel on the outer elongated edges of said first and second sections;
- placing the flange portion of each of said pipes between and in contact with said beveled elongated edges with said flange portion disposed in the V-shaped groove defined by said beveled edges; and
- heating said flange portions and adjacent portions of said confronting sections to cause formation of a large area mechanically strong weld using the metal of said flange portion as a source of welding metal.

References Cited

UNITED STATES PATENTS

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JOHN J. CAMBY, Primary Examiner

U.S. Cl. X.R.

29—483

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,615,082 Dated October 26, 1971

Inventor(s) Jacob Howard Beck

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 3, line 49, "tice" should be --tive--.

Column 4, line 35, after "gas" insert --pipe--.

Column 5, line 20 (claim 2), "found" should be --formed--.

Signed and sealed this 29th day of February 1972.

(SEAL)

Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents