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## (54) Improvements relating to furnaces.

(57) In a furnace having a muffle (1) with heating means and an endless conveyer (20) extending through the muffle (1), means are provided to supply gas to and extract gas from a volume of the muffle (1) above a part of the conveyer belt (20) thereby to cause turbulence in the atmosphere of said volume and extract contaminants therefrom. Said means may comprisė a sledge formed by cross bars (18) and runners (16, 17), the sledge supporting a positive pressure ladder formed by parallel tubes (22, 23) and apertured cross tubes (24) and a negative pressure plenum comprising an apertured plate (25) and extraction pipes (27, 28). Due to the sledge construction said means may easily be removed from the muffle for cleaning.

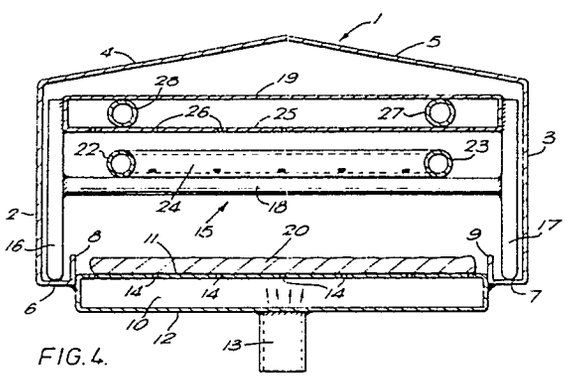


FIG. 4.

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# IMPROVEMENTS RELATING TO FURNACES

The invention relates to furnaces.

Conveyer furnaces have been previously proposed comprising a muffle with an endless conveyer belt extending therethrough and heating means. Articles placed on the conveyer belt and conveyed through the muffle are heated and may thereby be dried and/or fired. The articles may for example comprise ceramic substrates to form printed circuits and may have printing thereon.

Difficulty may be experienced in obtaining a pure atmosphere within a furnace. This may be caused by binding and brazing materials which are used in electrical circuit component manufacture breaking down under high temperature and causing contamination of the furnace. This problem is particularly prevalent in furnaces designed and manufactured for the micro-electronics industry and may cause unacceptable contamination of components leading to rejection thereof and consequent financial loss.

According to the invention there is provided a furnace having a muffle, an endless conveyer belt extending through the muffle and heating means, wherein adjacent an entry end of the muffle means are provided for supplying gas to and extracting gas from a volume above a determined length of the conveyer belt within the muffle thereby to cause turbulence in the atmosphere within said volume and extract contaminants therefrom.

The gas may be atmospheric air or if desired may be an inert gas. The gas is fed into the furnace under positive pressure and exhausted under negative pressure. Removal of contaminants from said volume may render the entire furnace free from contamination.

Preferably said means comprise a sledge which can slide in spaced apart sledge tracks provided one on each side of the conveyer belt adjacent the side walls of the muffle, the tracks also acting to guide the conveyor belt therebetween. The sledge may comprise a positive pressure ladder and a variable negative pressure plenum supported by runners. The runners support the ladder and plenum and elevate them above the belt so that they span the belt width and extend longitudinally for the initial heating zones of the furnace. The pressure ladder may comprise parallel supply tubes with interspersed pressure feed tubes drilled in staggered form with outlet holes at 45% to the horizontal. The ladder may be supported on crossbars fixed to runners of the sledge. The plenum may, preferably together with a further plenum, be provided above the positive pressure ladder. The sledge may comprise a Bern vent providing additional atmosphere separation and may be driven by a flow meter controlled bladeless fan with a 25:1 ratio.

A magnahelic gauge or manometer may be connected to the input end of the Bern unit.

Advantageously the sledge is readily retractable from the furnace upon disconnection of gas supply and extraction lines. The sledge may be extracted as a total unit or the pressure ladder may be removed independently to facilitate cleaning and/or modification.

Preferably the inner end of the sledge is fitted with a diverter blade which can be angularly adjusted to promote atmosphere separation.

Preferably at the muffle entrance said means is coupled to a powered vent box, the vent box being demountable for cleaning. The vent box may support a guard which will prevent insertion of a hand into the entrance of the muffle when said means is in a retracted position.

The invention is diagrammatically illustrated by way of example in the accompanying drawings in which:-

Figure 1 is a side elevation of entrance end of a conveyer furnace including means for supplying and extracting gas from a volume of the furnace;

Figure 2 is a plan view of a negative pressure plenum of the means of Figure 1;

Figure 3 is a plan view of a positive pressure ladder of the means of Figure 1; and

Figure 4 is a view to greater scale taken in the direction of arrow IV of Figure 1.

Referring to the drawings a furnace has a muffle 1, Figure 4, comprising side walls 2, 3 a roof formed by inclined members 4, 5 and a base which laterally comprises inturned portions 6, 7 of the side walls 2, 3 and upturned portions 8, 9. A heating plenum 10 is provided between horizontal plates 11, 12, the plate 12 having a supply pipe 13 therein and the plate 11 having apertures 14 for dispersal into the muffle 1 of gas provided though the supply pipe 13 into the plenum 10.

The inturned portions 6, 7 of the side walls 2, 3 of the muffle together with the upturned portions 8, 9 and lower portions of the side walls 2, 3 form runners for a sledge generally indicated at 15. The sledge has side members 16, 17 joined by crossbars 18 and an upper plate 19. The sledge 15 supported on the runners overlies a conveyer belt 20 which passes over the plate 11 and is advantageously of mesh form, the support bars 18 of the sledge 15 being spaced at a distance, for example 25 mm (1 inch) above the upper surface of the conveyer belt.

Supported on the crossbars 18 is a positive pressure ladder shown in Figure 3 to comprise a feed pipe 21 bifurcated into side pipes 22, 23 joined by cross pipes 24. The cross pipes 24 are preferably drilled in staggered form with exit holes extending at 45% to the horizontal, through which exit holes gas supplied through the feed pipe 21 passes.

Supported above the positive pressure ladder of Figure 3 is a negative pressure box shown in Figure 2. The negative pressure box comprises the plate 19 and a plate 25 extending parallel herebelow, the plate 25 having extraction apertures 26 therein. The negative pressure box in the embodiment shown is provided in two sections, an inner section being coupled to an extraction pipe 27 and an outer section being coupled to an extraction pipe 28.

Externally of the muffle 1 a further negative pressure vent box 29 is provided coupled to the extraction pipes 27, 28 and leading to a source of negative pressure such as a flow meter controlled bladeless fan. Preferably a magnahelic gauge or manometer of 118 mm outside diameter in the range of 0 to 75 mm water gauge is panelmounted and connected through the entrance of the muffle to monitor pressure. The pressure sensor within the muffle leads to a panelmounted inclined vertical manometer, and changeover with the entrance gauge can be effected for verification.

The vent box 29 is demountable for cleaning and supports a stainless steel expamet guard 30 which when the sledge 15 is retracted from the furnace onto a table top 31 shields the furnace against insertion of a hand thereinto.

A diverter blade 32 is preferably provided at the inner end of the sledge 15.

By means of the sledge unit of the invention the atmosphere within the muffle can be cleaned of gaseous and solid contaminants by entraining them in a turbulent airflow supplied through the apertures in the pipes 24 of the positive pressure ladder and extracted through the extraction apertures 26 into the negative pressure box thereabove to be drawn out of the furnace. Solid contaminants which alight on the sledge 15 and adhere thereto can be mechanically removed by extracting the sledge 15 on its runners from the furnace and mechanically cleaning it.

## Claims

1. A furnace having a muffle (1), an endless conveyer belt (20) extending through the muffle (1) and heating means, wherein adjacent an entry end of the muffle (1) means (21 to 29) are provided for supplying gas to and extracting gas from a volume above a determined length of the conveyer belt (20) within the muffle (1) thereby to cause turbulence in the atmosphere within said volume and extract contaminants therefrom.

2. A furnace according to claim 1, in which the gas is atmospheric air.

3. A furnace according to claim 1, in which the gas is an inert gas.

4. A furnace according to any one of claims 1 to 3, in which the gas is fed into the furnace under positive pressure and exhausted under negative pressure.

5. A furnace according to any one of claims 1 to 4, in which said means comprise a sledge which can slide in spaced apart sledge tracks (6, 7, 8, 9) provided one on each side of the conveyer belt (20) adjacent side walls (2, 3) of the muffle (1), the tracks (6, 7, 8, 9) also acting to guide the conveyer belt (20) therebetween.

6. A furnace according to claim 5, in which the sledge comprises a positive pressure ladder (21, 22, 23, 24) and a variable negative pressure plenum (19, 25, 26) supported by runners (16, 17).

7. A furnace according to claim 6, in which the runners (16, 17) support the ladder and plenum and elevate them above the belt so that they span the belt width and extend longitudinally for initial heating zones of the furnace.

8. A furnace according to claim 6 or claim 7, in which the pressure ladder comprises parallel supply tubes (22, 23) with interspersed pressure feed tubes (24) drilled in staggered form with outlet holes at 45% to the horizontal.

9. A furnace according to any one of claims 6 to 8, in which the ladder is supported on crossbars (18) fixed to the runners (16, 17) of the sledge and the plenum is provided above the positive pressure ladder.

10. A furnace according to any one of claims 6 to 9 in which the sledge comprises a Bern vent providing additional atmosphere separation and is driven by a flow meter controlled bladeless fan with a 25:1 ratio.

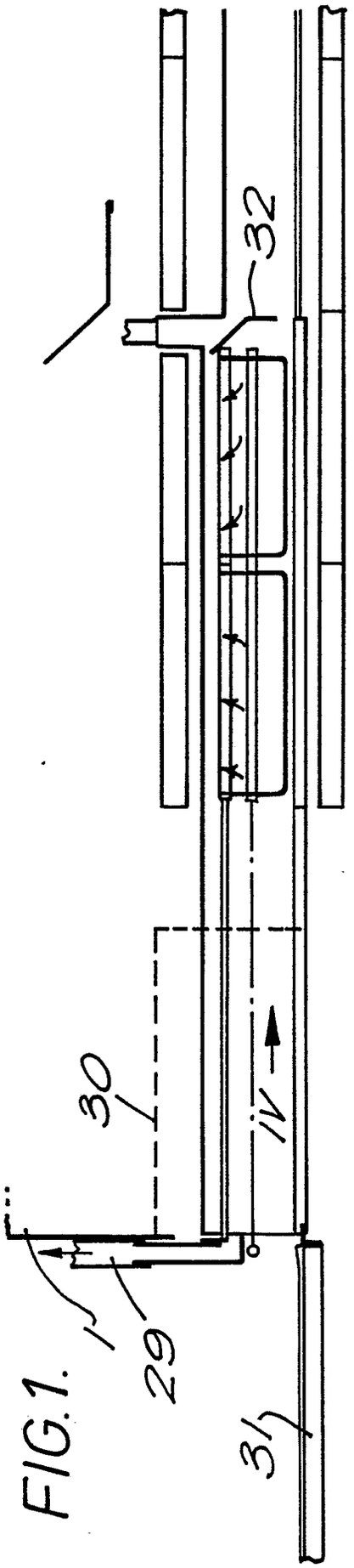


FIG. 1.

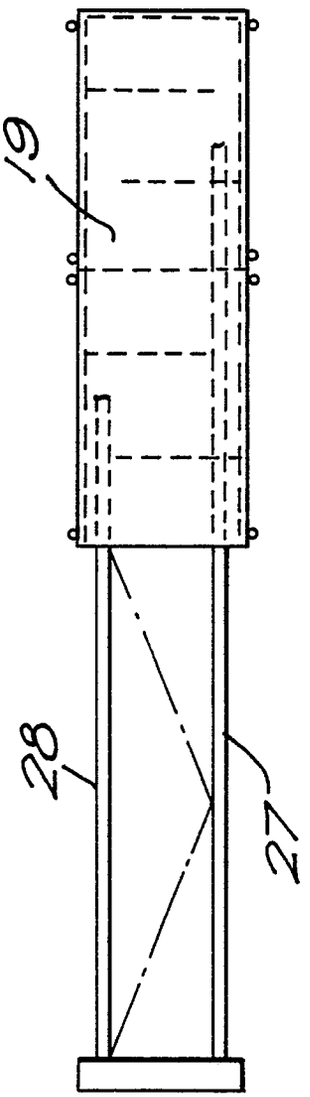


FIG. 2.

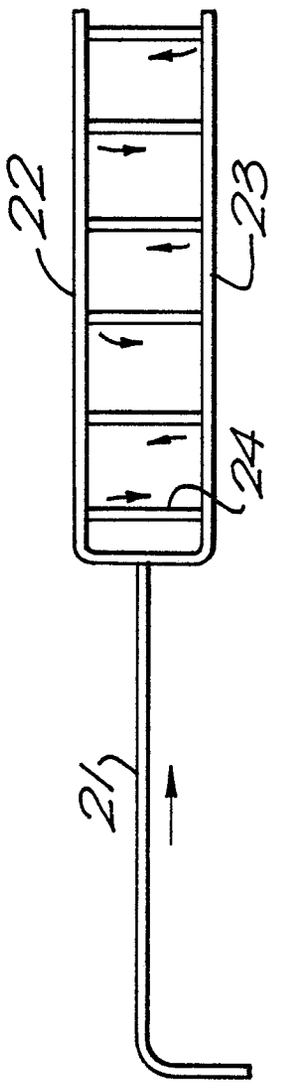


FIG. 3.

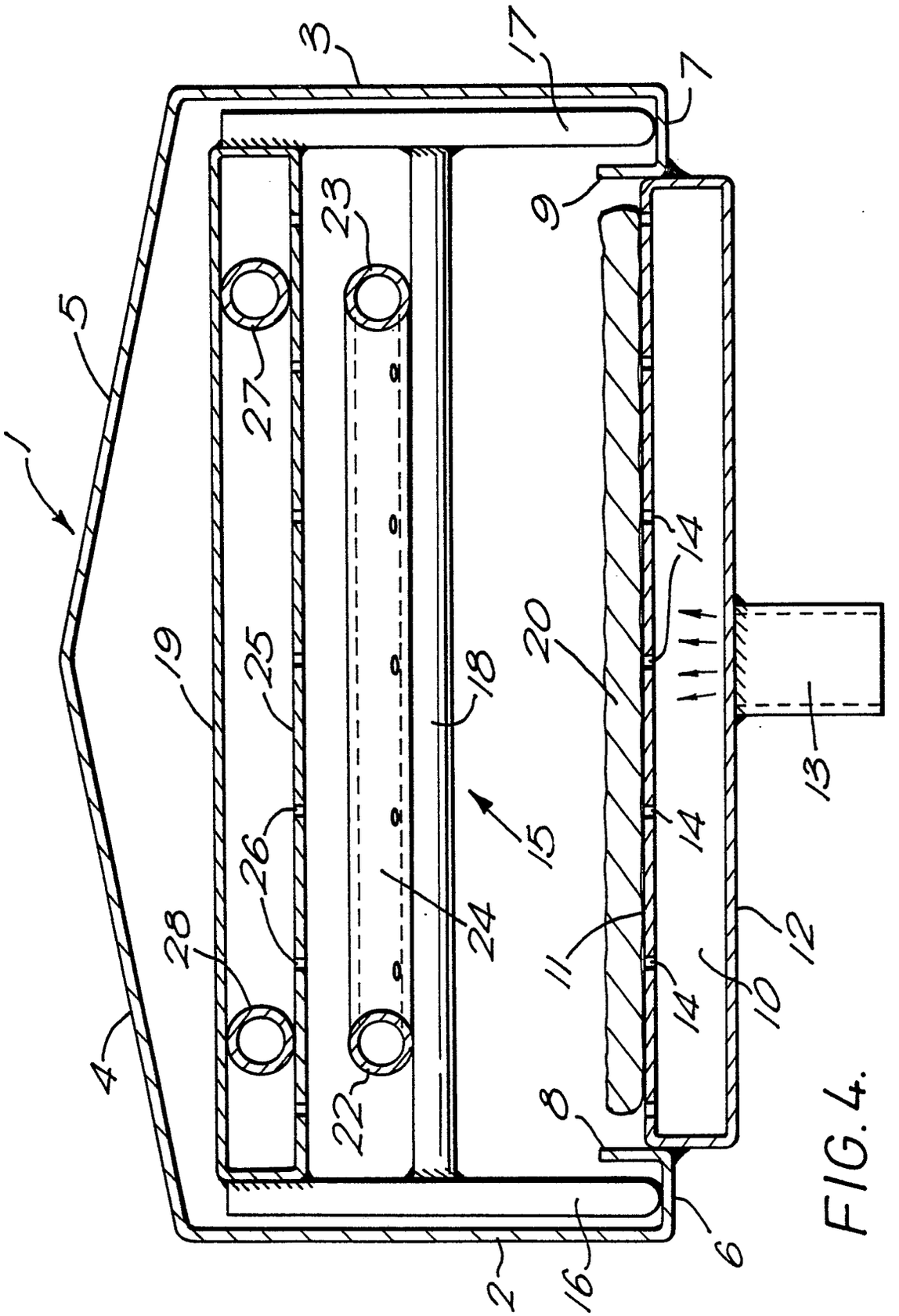


FIG. 4.

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# EUROPEAN SEARCH REPORT

Application Number

EP 89 30 2660

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (Int. Cl.4) |
|---|---|---|---|
| X | GB-A-2 057 107 (H.P. CARATSCH)<br>* Whole document * | 1,2,4 | F 27 B 9/30<br>F 27 D 7/00 |
| X | EP-A-0 202 988 (COMP. D'INFORMATIQUE MILITAIRE SPATIALE ET AERONAUTIQUE)<br>* Figure 1; column 1, line 1 - column 4, line 46 * | 1-4 | |
| X | EP-A-0 090 790 (GLASKÜHL S.A.)<br>* Figures 5-9; claims 1,4 * | 1,2,4 | |
| X | GB-A- 975 584 (PHILIPS ELECTRIC AND ASS. IND. LTD)<br>* Claims 1,5; figures 1-4 * | 1,4 | |
| X | EP-A-0 257 357 (VGT AG)<br>* Claims; figures 1-3 * | 1,2,4 | |
| X | FR-A-2 207 098 (SMIT NIJMEGEN B.V.)<br>* Claim 1; figures 1-5; page 3, line 10 - page 4, line 23 * | 1,2,4 | |

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

F 26 B

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| THE HAGUE | 22-06-1989 | COULOMB J.C. |

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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