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Hintenberger

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[54] **VACUUM OVEN FOR FIRING CERAMIC FACINGS**

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[52] **U.S. Cl.** **13/31,** 219/390, 219/393

[51] **Int. Cl.** **H05b 1/00**

[58] **Field of Search** 219/385, 388, 390, 219/393; 13/31

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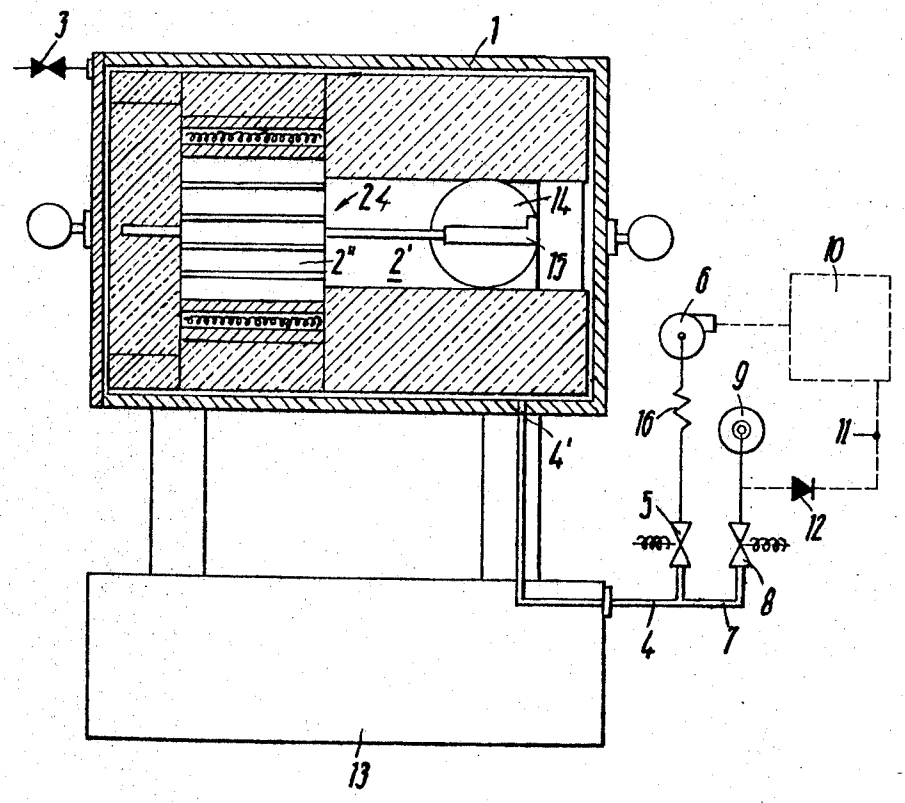
[57] **ABSTRACT**

Ceramic facings are filed in a refractory lined oven having a pre-heating zone and a firing zone, the facings being charged into the pre-heating zone on a carriage which may be moved into the firing zone. The oven chamber may be selectively evacuated through a main conduit which connects the lower part of the oven housing to the intake of a vacuum pump or supplied with inert gas from a supply thereof. For this purpose, branch conduits lead from the vacuum pump and the inert gas supply to the main conduit, and valves in the branch conduits may be selectively operated. A venting valve is mounted in the upper part of the oven housing for venting inert gas from the oven chamber.

3 Claims, 3 Drawing Figures



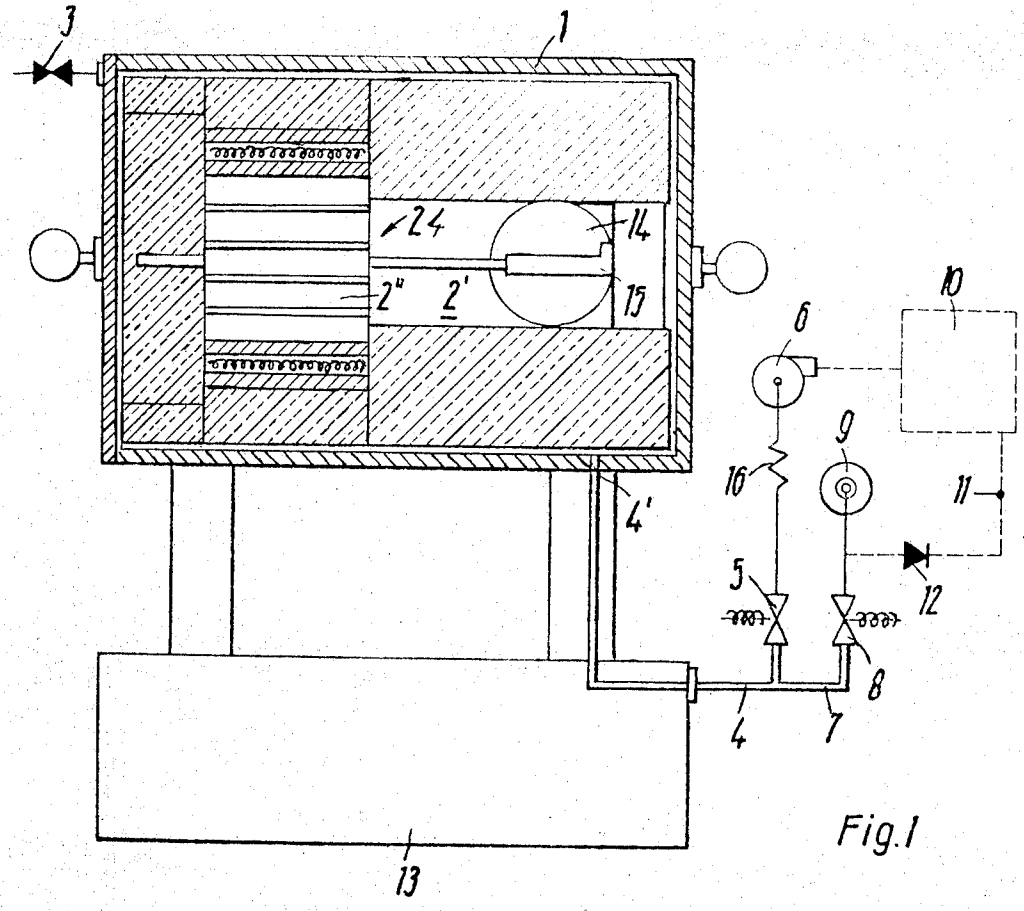


Fig.1

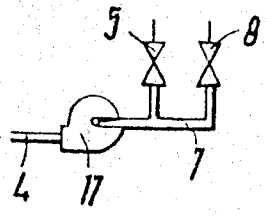


Fig.2

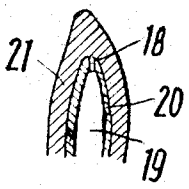


Fig.3

VACUUM OVEN FOR FIRING CERAMIC FACINGS

The invention concerns an oven for firing ceramic facings mounted on metal supports made of alloys containing no noble metal which tend to oxidise when fired, where the object to be fired is exposed to the necessary firing temperatures in at least two stages with the creation of a vacuum.

The firing of dental ceramic facings in special dental ceramic firing ovens, in particular under vacuum, is quite generally known in dental engineering. For the metal supports on which the dental ceramic paste is mounted and to which it must adhere strongly as a result of the firing, alloys containing no noble metals have already been suggested, for example, chromium cobalt alloys, which are more closely related to the ceramic paste than known noble metal firing alloys because of, among other things, their heat transfer properties. As advantageous as such new alloys are in dental engineering as regards favourable heat transfer behaviour, their use is associated with a considerable disadvantage in that such alloys tend to oxidise strongly when fired. In other words, the uncovered parts of the support do not come out of the firing oven clean and must often undergo further finishing treatment that is difficult and expensive.

Attempts to control these hitherto undesirable oxidations by certain adjustments to firing times in the firing processes which in the majority of cases are carried out in several stages, have led to unsatisfactory results.

The purpose of the present invention is to provide a firing oven which ensures that such finishing treatment can be completely, i.e. to a large extent, dispensed with, or that oxidation of such alloys cannot occur during firing. This purpose is accomplished according to the invention, with an oven comprising a housing defining a vacuum-tight inner chamber having a pre-heating zone and a firing zone. A carriage is mounted in the inner chamber and is movable between the pre-heating zone and the firing zone. A venting valve is mounted in the upper part of the housing and is operable between a closed and a venting position. A main conduit is connected to the lower part of the housing and opens into the inner chamber, branch conduits connecting the intake of a vacuum pump and a supply of inert gas to the main conduit. Valve means is selectively operable to connect the vacuum pump or the inert gas supply to the main conduit.

This means that first all the atmospheric oxygen may be displaced from the inner chamber of the oven with inert gas. With the evacuation used hitherto, which in the case of such an oven does not, however, result in a sufficiently high vacuum (about 20 Torr), a large part of the inert gas is withdrawn again but the conditions of the medium surrounding the ceramic facing become such that any atmospheric oxygen remaining in the inner chamber of the oven as a result, for example, of the escape of gas from the ceramic paste, can no longer cause strong oxidation on the exposed metal parts of the dental prosthesis.

In the drawings there is shown schematically in

FIG. 1 the oven, in section, and the vacuum branch and inert gas feed lines;

FIG. 2 a portion of a modified feed line with an additional pressure pump incorporated and

FIG. 3 a section through a part of the denture to be fired.

In FIG. 1 the firing oven is shown to have a housing **1**, defining a vacuum-tight inner chamber **2** having a pre-heating zone **2'** and a firing zone proper **2''**. The pre-heating zone is lined by a conventional refractory lining **2***a* and the firing zone is lined by a conventional refractory lining **2***b*. Resistance heaters **22** of known design are mounted in the refractory lining wall **2***b* of firing zone. An end wall **2***c* of refractory material closes off the firing zone **2''**.

The inner chamber **2** of the oven housing may be vented by venting valve **3** mounted in the upper part of housing **1** and operable between a closed and a venting position. A main conduit **4** is connected to connector **4'** in the lower part of the housing and opens into the inner chamber **2** of the oven. Branch conduits **7***a* and **7** connect the intake of vacuum pump **6** and a supply container **9** of inert gas, respectively, to main conduit **4.**

A charging duct **14** extends transversely through the refractory lining **2***a* and opens into pre-heating zone **2'** to enable the object to be fired to be charged into the oven, the duct being closable vacuum-tight by a door. When the oven is charged through duct **14,** the object is placed on carriage **15** which is mounted in the inner chamber **2** and is movable between the pre-heating zone **2'** and the firing zone **2''**.

Evacuation of the inner chamber of the oven is effected with the valve **5** in branch conduit **7***a* open and the valve **8** in branch conduit **7** closed through the vacuum pump **6,** while valve **3** is also closed. This valve is only opened in the case of initial charging or flooding of the inner chamber of the oven with inert gas.

A filter in series with the vacuum pump **6** is shown at **16** whilst **10** indicates in broken lines a receiver for the withdrawn inert gas which can be provided if necessary and from which a further branch conduit **11** with non-return valve **12** leads to a section of branch conduit **7** which connects valve **8** with the inert gas container **9.**

The vacuum and inert gas conduit system essential to the invention is shown beside the firing oven merely for the sake of simplicity in control housing **13** below the oven. FIG. **3** shows a section through a part of a preferred dental prosthesis for the oven of this invention where, in the top of the metal support element **20** which carries the paste to be fired **21,** there is provided a small hole **18** to improve venting of the cavity **19** in the support **20.**

The oven is operated as follows:

When the firing oven is put into operation, the venting valve **3** is opened after the object to be fired has been placed on carriage **15** and the duct **14** has been closed again. Valve **5** is closed while valve **8** is opened to flood the inner chamber of the oven with inert gas while it is being vented. After flooding the inner chamber **2** with inert gas, venting valve **3** and valve **8** are closed and valve **5** is opened to evacuate the inner chamber. The object is moved on carriage **15** by means of rod **15'** from the pre-heating zone **2'** into the firing zone **2''** where it is fired for a predetermined time. After firing has been completed, the inner chamber is again flooded with inert gas by manipulating the valves in the above-indicated manner, whereupon all the valves are closed, and the fired object is removed from the oven through duct **14,** having been moved back on carriage **15** from the firing zone into the pre-heating zone.

Since the inner chamber of the oven is now filled with inert gas, venting may be dispensed with in the next firing cycle. Loss of inert gas is reduced to a minimum by provision of inert gas receiver **10** receiving evacuated inert gas from vacuum pump **6**, the inert gas being fed back into branch conduit **7** through further branch conduit **11** and back-flow of the inert gas being prevented by check valve **12** in conduit **11**.

As shown, valves **5** and **8** are solenoid valves which may be connected in an electric control circuit also containing the time and temperature regulators for heaters

What is claimed is:

1. An oven for firing ceramic facings mounted on metal supports of an oxidizable alloy containing no noble metals, comprising

a. a housing lined with electrically and thermally insulating refractory linings defining a vacuum tight inner chamber having a pre-heating zone and a firing zone,

b. electrical resistance heating means mounted in the refractory lining of the firing zone,

c. a charging duct in the refractory lining of the pre-heating zone and leading thereinto, the housing having a door for vacuum-tightly closing the charging duct,

d. a carriage for the ceramic facings mounted in the inner chamber for movement between the charging duct in the pre-heating zone and the firing zone,

e. a venting valve mounted in the upper part of the housing and operable between a closed and a venting position,

f. a vacuum pump having an intake and an output,

g. a supply of inert gas,

h. a main conduit connected to the lower part of the housing and opening into the inner chamber,

i. branch conduits connecting the intake of the vacuum pump and the inert gas supply respectively to the main conduit, and

j. valve means in the branch conduits selectively operable to open the vacuum pump intake or the inert gas supply to the main conduit for evacuating the inner chamber or to feed inert gas thereto.

2. The firing oven of claim **1**, comprising a pressure pump mounted in the branch conduit connecting the inert gas supply to the main conduit.

3. The firing oven of claim **1**, further comprising a receiver for the inert gas, the output of the vacuum pump being connected to the inert gas receiver, a further branch conduit connected between the inert gas receiver and the branch conduit connecting the inert gas supply to the conduit, the further branch conduit opening into the latter branch conduit upstream of the valve means, and a check valve arranged in the further conduit.

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