May 25, 1965 L. A. FUGASSI 3,185,461

FURNACE CONSTRUCTION

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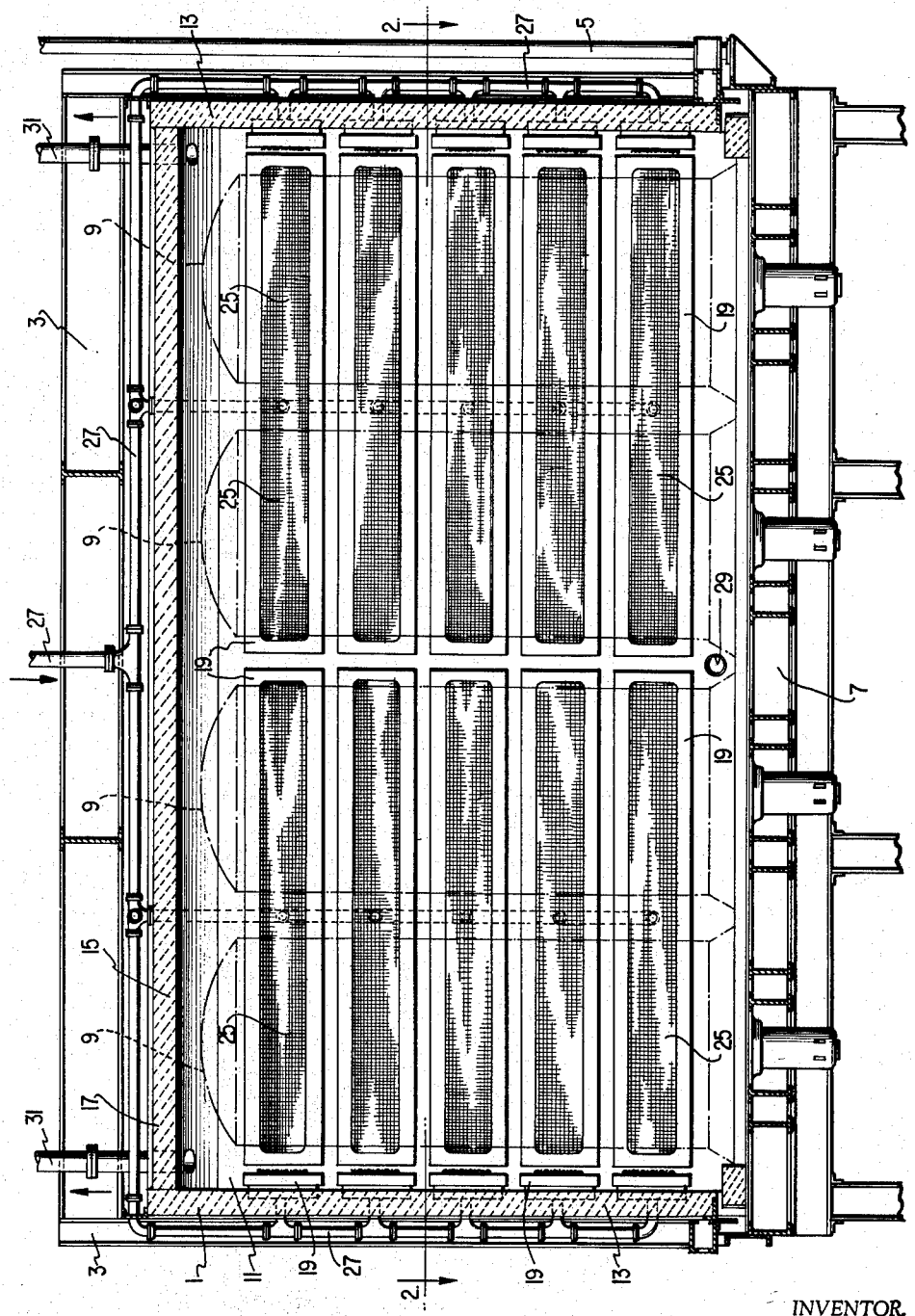


FIG. 1

INVENTOR.
LUCIEN A. FUGASSI
BY Shanley & O'Neil
ATTORNEYS.

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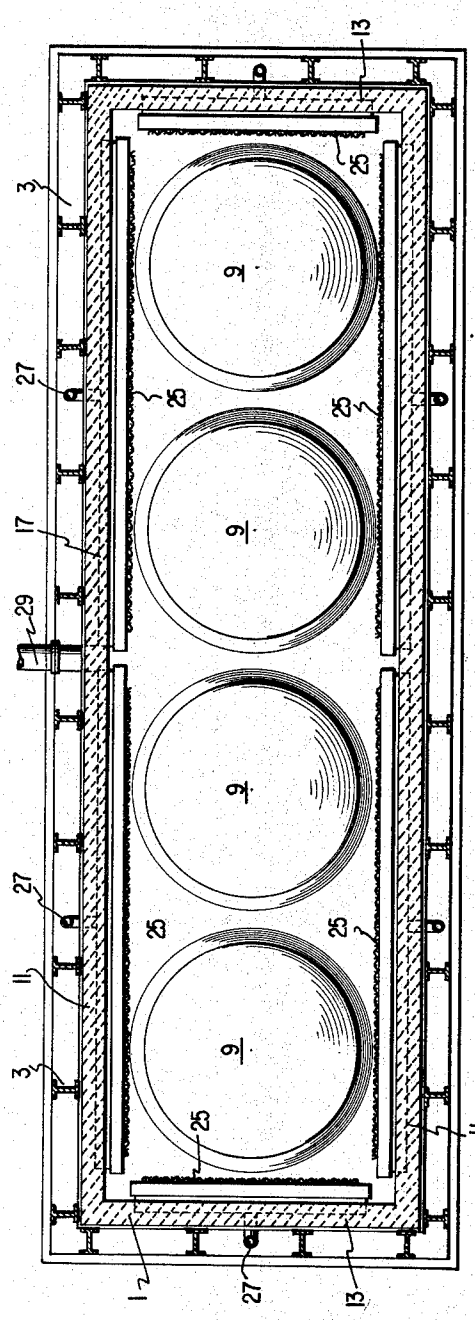


FIG. 2

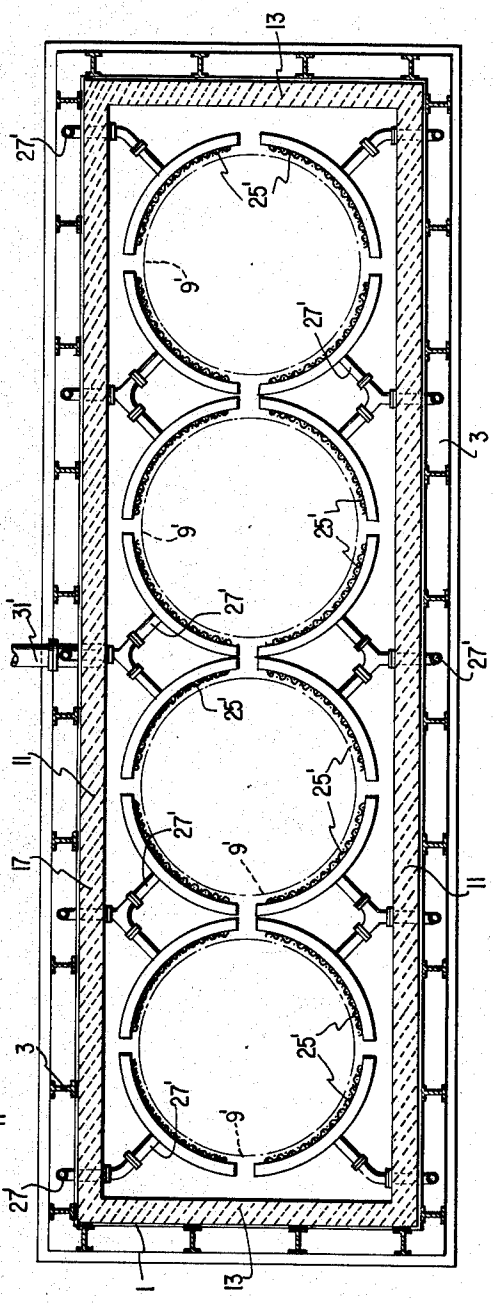


FIG. 3

INVENTOR.
LUCIEN A. FUGASSI
BY Shanley & O'Neil
ATTORNEYS.

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FIG. 6

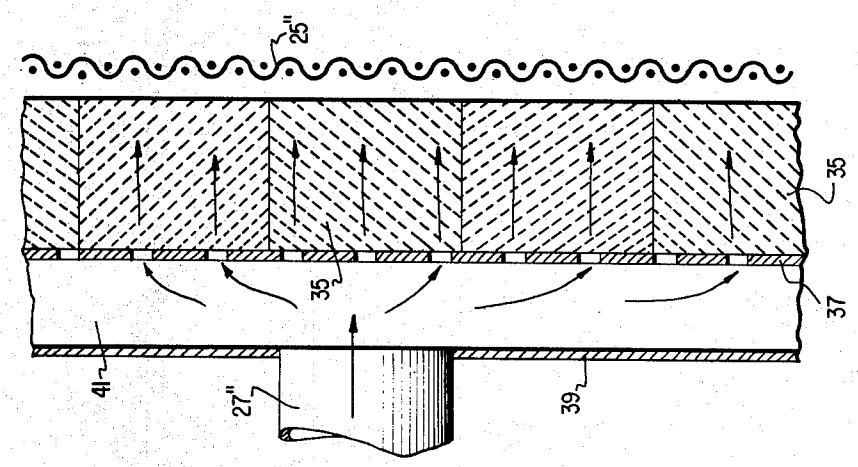


FIG. 5

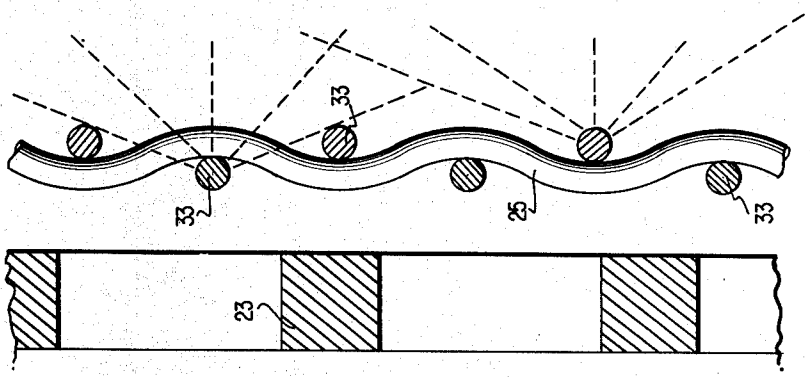
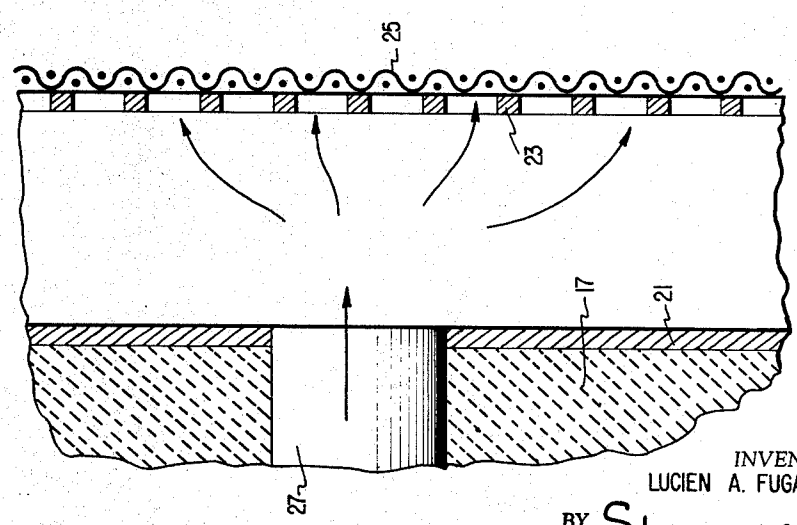


FIG. 4



INVENTOR.
LUCIEN A. FUGASSI
BY Shanley & O'Neil
ATTORNEYS

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3,185,461

FURNACE CONSTRUCTION

Lucien A. Fugassi, Pittsburgh, Pa., assignor to National Steel Corporation, a corporation of Delaware

Filed Aug. 1, 1963, Ser. No. 299,404
2 Claims. (Cl. 263—41)

The present invention relates to furnace construction, more particularly of the gas-fired type used for heating solid material, such as annealing furnaces.

An object of the present invention is the provision of gas-fired furnace construction of improved efficiency.

Another object of the present invention is the provision of gas-fired furnace construction in which the flames are distributed in a more desirable way relative to the material to be heated.

Still another object of the present invention is the provision of a gas-fired furnace in which heat transfer by radiation from solid surfaces is improved.

Finally, it is an object of the present invention to provide furnace construction that will be relatively simple and inexpensive to manufacture, easy to install, operate, maintain and repair, and rugged and durable in use.

Other objects and advantages of the present invention will become apparent from a consideration of the following description, taken in connection with the accompanying drawings, in which:

FIGURE 1 is a view in elevational cross section of furnace construction according to the present invention;

FIGURE 2 is a horizontal cross-sectional view of furnace construction according to the present invention, taken on line 2—2 of FIGURE 1;

FIGURE 3 is a view similar to FIGURE 2, but showing a modified form of the present invention;

FIGURE 4 is an enlarged fragmentary cross-sectional view taken along the line 4—4 of FIGURE 1;

FIGURE 5 is a still further enlarged fragmentary portion of the structure of FIGURE 4; and

FIGURE 6 is a view similar to FIGURE 4 showing another modified form of the invention.

Referring now to the drawings in greater detail, there is shown a furnace 1 of the annealing furnace type. Furnace 1 includes the usual framework 3 and is adapted to be raised and lowered on vertical guides 5 relative to a base 7 on which the material to be annealed is supported. The material to be annealed might for example be coils of sheet steel stacked one on top of the other and covered by covers 9 to protect the surface of the coils from the furnace atmosphere. As is usual in the case of such annealing furnaces, the furnace is opened by raising it vertically on guides 5 so that covers 9 can be removed and replaced on the material and the material thus introduced into or withdrawn from the furnace.

Furnace 1 is provided with spaced opposite sidewalls 11 and spaced opposite end walls 13, and an arched roof 15. The walls and roof of furnace 1 are covered with refractory ceramic material 17, which may for example be in the form of bricks. In the embodiment of FIGURES 1 and 2, a plurality of manifolds or plenum chambers 19 are disposed on the inner side of refractory material 17. Plenum chambers 19 are for the purpose of supplying a gas to the interior of furnace 1. In the embodiment of FIGURES 1 and 2, they are elongated with their lengths horizontally disposed and their inner surfaces disposed in generally vertical planes, and they surround and provide a surface confronting covers 9 on a major portion of at least the side and end walls 11 and 13 of furnace 1.

FIGURE 4 shows in greater detail the structure of an individual plenum chamber 19 according to the embodiment of FIGURES 1 and 2. As is there seen, the plenum chamber comprises a rear wall 21 preferably of metal sheet or plate and a spaced front wall 23 that is multi-

perforate. Front wall 23 provdies a rigid backing for screening 25 which is preferably of the woven wire type in which the wire from which the screening is woven is substantially circular in cross section. Conduits 27 convey to plenum chambers 19 a fuel gas such as natural gas or the like. A conduit 27 enters the rear of each plenum chamber 19, and the gas thus conveyed to the plenum chamber moves out through the openings of front wall 23 and out through screening 25 and into the interior of the furnace.

In the embodiments of FIGURES 1–5, the gas supplied through conduits 27 is flammable but not ignitable. This is because it contains no combustion-supporting component as supplied through conduits 27. Therefore, so long as the gas in plenum chambers 19 is maintained at a pressure higher than the pressure of the interior of the furnace, gas will flow from inside the plenum chamber to the outside of the plenum chamber and there will be no backfire within the plenum chamber. To cause the gas to burn, however, it is necessary to supply a combustion-supporting gas to the interior of the furnace. This can be done by introducing oxygen or air or other combustion-supporting gas or mixture of gases through the conduit 29 into the interior of the furnace. The waste gases or products of combustion can be withdrawn from the furnace through conduit 31.

A very important feature of the present invention is the material of at least the surface of screening 25. Screening 25 is metallic and is preferably comprised of woven wires which preferably have a circular cross-sectional configuration. The exposed surfaces of screening 25 thus are metallic and specifically are of a material that catalyzes the combustion of hydrocarbonaceous fuel whose componets are, for example, lower alkyl in nature, such as methane, ethane, propane, butane and so on. The preferred metallic catalysts for the combustion are of the so-called low temperature type and are preferably metal oxides such as iron oxide, nickel oxide, copper oxide, manganese oxide and so on, or relatively inert metals such as the plantinum series metals, for example, platinum, osmium, iridium, rhodium and the like, and alloys thereof. As used in this specification and claims, the term "metallic" includes metals and oxides of metals.

In the case of metallic catalysts which are quite expensive, such as the platinum series metals, and in the case of oxides which are too weak to be self-supporting, it is preferred that the catalyst be applied to the surface of the screening as a coating, in which case the screening serves as a supporting substrate. The coating on wire screening is shown in FIGURE 5 at 33. In the case of a coated screen, the material of the screen can be steel or stainless steel or other relatively inexpensive material having good strength at elevated temperature.

The embodiments of FIGURES 1–5 are adapted to handle gaseous fuel which is nonflammable and which requires admixture with a combustion-supporting gas before it will burn. Such a gas, of course, is not ordinarily subject to flashback or burning within the plenum chamber. However, the invention is also adaptable for use with premixed combustible gases, such as natural gas mixed with air or oxygen. One such embodiment of the invention is indicated in FIGURE 6, in which a wall of the furnace confronting the material to be heated is covered on its confronting surface with porous bricks 35 of a porosity sufficient to allow gas to pass therethrough at a suitably high velocity. Porous bricks 35 are supported by a multiperforate wall 37 which in turn is backed up by a spaced rear wall 39, the space between walls 37 and 39 providing a plenum chamber 41 into which a combustible mixture such as a mixture of natural gas and oxygen or air may be introduced through con-

duits 27''. The combustible gaseous mixture passes through the openings in multiperforate wall 37 and passes through the pores of bricks 35 and emerges from the pores on the hot side of the wall and contacts screening 25''. The metallic catalytic surfaces of screening 25'' assure combustion of the gas contiguous to the screening. Flashback of the flames into the plenum chamber is prevented by maintaining the temperature on the plenum side of the wall substantially lower than on the hot side of the wall. The flow of gas continuously from the plenum in one direction through the porous bricks maintains this desired temperature differential without the need for water-cooling of the plenum side of the bricks. Further description of a porous wall furnace can be found in U.S. Patent No. 2,828,813, April 1, 1958, to which reference is had for additional disclosure so as to avoid the inclusion of unnecessary detail in the present specification.

The screening can be positioned close to a supporting wall such as 23 or 35 or else it can be spaced a substantial distance from any wall. It is preferably contiguous to a wall, that is, at or closely adjacent a wall, so that the wall will provide support for the screening and also so that the wall can be used to distribute the fuel gas evenly adjacent the screening. Alternatively, the screening can itself define the front wall of the plenum chamber thereby to eliminate the need for a rigid front wall.

As noted above, the catalyst means is preferably multiperforate and still more preferably a woven wire screening, of which circular cross-sectional configuration is the preferred configuration for the wires that comprise the screening. The reasons why screening is preferred will be apparent from FIGURE 5. As can be seen there, woven wire screening presents a maximum of surface for a given porosity of the catalyst means. That is to say that for a combustion catalyst, having regard for the need to provide a maximum of unimpeded or unmasked catalyst surface, woven wire screening provides both a maximum of such useful catalyst surface and also a maximum of area for the gas to pass through the screening. In other words, for a screen having a certain percentage of its area occupied by the openings therethrough, woven wire screening will have a substantially greater useful catalyst surface than would, say, punched screening.

The circular or rounded cross-sectional configuration of the wires that comprise the screening is also a useful feature of the invention, for reasons that will also be apparent from a consideration of FIGURE 5. As can be seen there, radii perpendicular to the surfaces of the wires of the screening extend in all directions, so that the transmission of heat by radiation from the catalyst surface is substantially greater than if markedly different constructions were used. Therefore, not only is a greater area provided, but also that area is more usefully disposed than if markedly different constructions were employed.

From a consideration of the foregoing disclosure, it will be evident that all of the initially recited objects of the present invention have been achieved.

Although the present invention has been described and illustrated in connection with preferred embodiments, it is to be understood that modifications and variations may be resorted to without departing from the spirit of the invention, as those skilled in this art will readily understand. Such modifications and variations are considered to be within the purview and scope of the present invention as defined by the appended claims.

What is claimed is:

1. An annealing furnace comprising a base; a framework having walls and roof of refractory ceramic material, said framework being supportable by said base; elongated guide means vertical to said base and in sliding relationship with said framework to enable said framework to be raised and lowered; cover means having a vertically elongated side and being within said framework and supportable by said base, said cover means being imperforate whereby material within said cover means is isolated from combustion gases in the furnace; a multiperforate wall portion contiguous and substantially coextensive in area with said side of said cover means; means for catalytically burning gases, said means being metallic wire screening, said screening being contiguous to and substantially coextensive in area with said cover means and said multiperforate wall portion, said screening being disposed between said cover means and said wall portion; and means for feeding a gaseous fuel through the multiperforate wall portion onto the metallic wire screening.

2. The furnace of claim 1, said vertically elongated side portion of said cover means being substantially cylindrical.

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CHARLES SUKALO, *Primary Examiner.*

JOHN J. CAMBY, *Examiner.*