Feb. 28, 1939. H. H. HARRIS 2,148,462

TUBULAR HEAT TREATING FURNACE TRAY

Filed Sept. 16, 1937

Fig. 1.

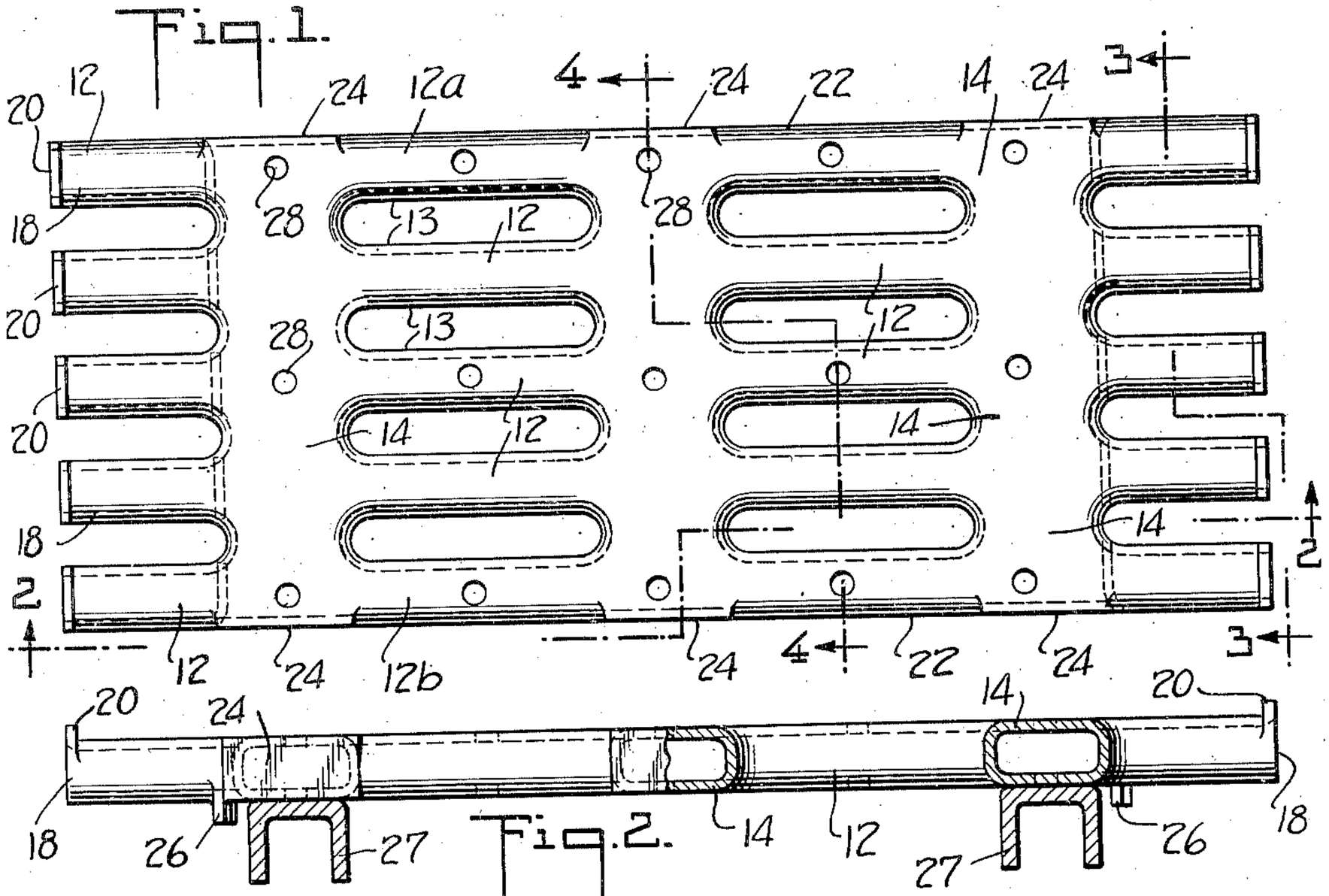

Fig. 2.

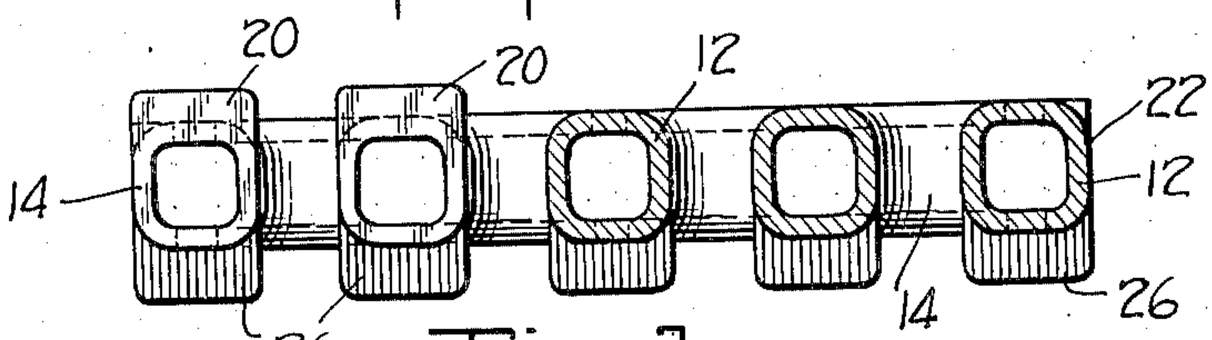

Fig. 3.

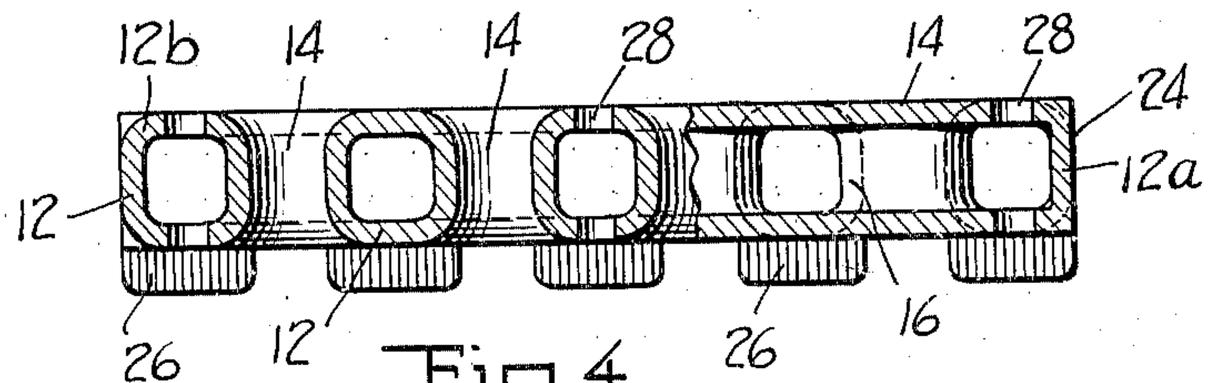

Fig. 4.

INVENTOR
Henry H. Harris
BY
Dyke and Schaines
ATTORNEYS

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TUBULAR HEAT TREATING FURNACE TRAY

Henry H. Harris, Champaign, Ill.

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5 Claims. (Cl. 263—49)

My invention relates to work supports, commonly called trays, for use in heat treating furnaces.

Conventionally, articles to be carburized are disposed within containers or boxes also having therein a carburizing compound, the container or carburizing box being sealed and placed within a furnace or muffle and subjected to high heat, and the carburizing effected under the influence of the heat.

While the supports or trays of the present invention could be used for supporting such carburizing boxes, they are preferably made use of in furnaces and with heat treatments wherein articles to be heat treated are placed or loaded directly upon the supports or trays which are traveled, as by being pushed in tandem, through the furnace, muffle or the like so as to be directly exposed to the heat and furnace gases, preferably carbonaceous gas. This carbonaceous gas is a saturated hydrocarbon, and when it comes into contact with the articles being treated, it is apparently cracked and deposits a certain amount of soot on both the articles or work being treated and the support or tray upon which the work is carried.

Normally this soot is harmless, but if there are any imperfections, such as cracks or shrinks, either deep-seated or of superficial nature, in the alloy material, as nickel-chrome-iron alloy, of which the trays are usually made, the gas will enter thereinto and deposit its carbon. At the time of this deposit, the tray is being subjected to high heat and is largely expanded. Upon removal from the furnace the trays come into contact with a cooler atmosphere and a shrinkage takes place. This shrinkage contracts the metal around the soot or deposited carbon, and what was originally a barely discernible crack or fissure becomes larger and more clearly defined. Upon repetition of this process and consequent subjection of the tray to the action of heat, carbon deposit, and cold, the cracks or fissures may reach such proportions as to result in the virtual destruction of the trays as a usable article.

The conventional trays used in this type of furnace operation have been of skeleton or openwork formation, rather than continuous sheets or cast imperforate members. There are several reasons for this, namely, that to obtain optimum results in the heat treatment process it is necessary that every part or side of the article being treated be exposed directly to furnace heat and this is possible only with use of an openwork support; also, the skeleton formation necessitates use of less metal and hence a lighter and cheaper product can be obtained. These openwork trays are usually solid one-piece castings and necessarily represent a large number of intersections, that is, points where the bars cross and there is a greater thickness of metal than through the bars themselves. Experience has shown that the imperfections occur principally at these thicker points, and such imperfections subsequently develop into destructive cracks and fissures. Furthermore in such conventional trays a very considerable proportion of the exposed surfaces consists of relatively thin edges which tend to heat up and to cool off more quickly than other parts of the trays and any defects even though originally slight in such edge portions are likely to develop into larger cracks. The present invention is directed to the solution of the problem of avoiding or reducing difficulties such as are referred to above.

I have found that by making the skeleton or grid trays of hollow tubular construction, and providing them with a minimum of metal intersections and avoiding thin exposed edges, a substantial decrease in the development of crack or fissure formation results, making for longer useful operative life and correspondingly increased economical furnace operation. It is, therefore, the main object of my invention to provide a hollow tubular skeleton or openwork type of tray for use in heat-treating furnaces with a minimum of metal intersections and free or substantially free from exposed edges and hence a minimum of danger spots.

These thicker danger points are not uniform in cross-section with the rest of the conventional tray, and in solid, i. e., non-hollow castings cannot be made uniform with the rest of the tray to obtain a uniform surface-to-mass ratio over the entire structure. It is an object of my invention to provide a tray for use in heat-treating furnaces, which is of uniform thickness throughout with a correspondingly uniform surface-to-mass ratio over the entire tray.

In operation the trays or supports have loaded thereon the various articles to be heat-treated, and the loaded trays are usually pushed through the furnace in tandem, that is, a number of trays, similarly loaded, are placed within the furnace and pressure applied against the rearmost thereof to push the trays through the furnace, each tray communicating the pressure to the one in front. The heated trays are thus subjected to stresses in two transverse planes, namely, to load bearing stress and to compression stresses of the

traveling pressure. During normal furnace operation, these stresses cause a great many tray failures since they tend to develop the cracks or shrinks, and cause buckling and bending. It is also an object of my invention, therefore, to provide a skeleton or open-work type of tray which will have a greater load bearing capacity in conjunction with ability to resist compression stresses.

Other and related objects of my invention will in part be obvious and in part pointed out specifically in connection with the following description of an illustrative embodiment thereof.

In the drawing annexed hereto and made a part hereof,

Figure 1 is a plan view of one form of device constructed according to and embodying my invention;

Fig. 2 is a side view thereof, partly in section along the line 2—2 of Fig. 1;

Fig. 3 is an end view, partly in section, along the line 3—3 of Fig. 1; and

Fig. 4 is a transverse sectional view on the broken line 4—4 of Fig. 1.

Reference numeral 10 indicates the tray generally, which is either a one-piece alloy steel casting or is formed of two precast halves welded together. The tray, as a unit, comprises a number of generally cylindrical hollow tubes 12, spaced apart in parallel relationship as at 13, and secured in this relationship by a number of similarly generally cylindrical though somewhat flattened hollow tubes 14, extending cross-wise of tubes 12, which tubes 14 are interconnected and communicate with tubes 12 as indicated at 16. These tubes 12 which extend to the ends of the tray are provided with upstanding portions 20 cast as an integral part thereof to serve as an end retaining wall for work placed thereon.

Outer sides 22 of tubes 12*a* and 12*b*, at the front and back of tray 10, are preferably formed flat at those points thereon in line with cross tubes 14, as at 24, 24. Portions 24, 24 are made flat to provide a bearing surface against which the pushing, tray-travelling pressure is exerted, when a plurality of trays 10 are disposed in the furnace side by side, one pushing directly against the other until pushed out at the exit side of the furnace. The tubes 14 extending endwise in the line of application of pushing pressure form transverse regions of great stiffness and strength to effectively take the pushing pressure without deformation thereby of the tray.

On the under side of tray 10 are formed a number of downwardly depending lugs 26 in line with the outer edge of cross-tubes 14, which serve as guides to keep the trays aligned on the conventional skid rails 27 within the furnace, as indicated in Fig. 2. Holes 28 indicate openings cored in the top and bottom surfaces of the trays through which the sand of the cores may be removed from within the completed units. The holes also provide additional inlets for heat, but are not needed when the tray is cast in top and bottom halves and welded together along the medial line.

It will be seen that my tray, as a unit, is of substantially uniform cross-sectional thickness, made up of a number of hollow tubular members 12, 14, arranged in criss-cross pattern. The completely hollow construction will not only give a greater load-bearing capacity than a similarly sized solid tray, but also will have greater resistance to the transverse compression stresses to which these trays are subjected. An important feature of my invention is that the tubes and cross-tubes are entirely hollow and slightly rounded in shape. The substantially uniform thickness at all points of the tray eliminates danger spots and sources of cracks and shrinks since the alloy material of which the tray is made will expand and contract under heat and cold at a substantially uniform rate over its entire area. There are no spots materially thicker and heavier than others, at which uneven expansion and contraction may take place, and hence the crack or fissure development process outlined above as an inevitable consequence of the use of solid trays is avoided.

Another advantage secured by my tubular tray is that line or point contact is obtained between the load and the tray. The curved surfaces upon which the load rests affords less surface contact and makes for freer heat circulation. Additionally, a cold load deposited upon a hot tray, because of this line or point contact has a minimum chilling effect, and there are fewer strains set up in initial heating.

The tube components of the tray have no exposed edges, except at their ends, and only their outer surface positions are directly exposed to heat, and the tube components will thus heat more uniformly, the circulation of heated air inside the tube facilitating the uniform heating throughout the tube, by the flow or convection of such hot air.

By the use of component portions which are tubular and therefore much stronger and stiffer than if made up of bar or bar-like portions, as is usual, the criss-cross spacings in my improved tray can be spaced further apart and the number of crossings in a tray of given area are correspondingly reduced with no loss and usually with a gain in strength and stiffness.

Having now described my invention, what I claim and desire to secure by Letters Patent is:

1. A tray for use in heat treating furnaces comprising a plurality of hollow tubular members, and means to secure same in parallel spaced-apart relationship, said means comprising a second plurality of similarly hollow tubular members arranged transversely of and between the members of the first plurality.

2. A tray for use in heat treating furnaces comprising a plurality of hollow tubular members, and means to secure same in parallel spaced-apart relationship, said means comprising a second plurality of similarly hollow tubular members arranged transversely of, in the same plane with, and between the members of the first plurality, the interiors of both pluralities being in communication.

3. A tray for use in heat treating furnaces comprising a plurality of hollow tubular members extending from side to side of the tray, and means to secure same in parallel spaced apart relationship comprising a plurality of hollow tubular members extending from front to back of the tray the sides and edges of the first plurality of hollow tubular members defining the outer markings of the tray.

4. A tray for use in heat treating furnaces comprising a plurality of hollow tubular members, the tops and bottoms of which are flattened, and means to secure same in parallel spaced apart relationship comprising a second plurality of similarly hollow tubular members arranged transversely of the first plurality, the second plurality also having flattened tops and bottoms.

5. A tray adapted to be pushed through heat

treating furnaces comprising a plurality of hollow tubular members extending from side to side of the tray, and means to secure same in parallel spaced apart relationship comprising a plurality of hollow tubular members extending from front to back of the tray in line with the pushing stresses the outer sides of the outermost of the first plurality of hollow tubular members being provided with a plurality of flattened portions adapted to take the pushing pressure without deformation.

HENRY H. HARRIS.