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HEAT TREATING FURNACE TRAY

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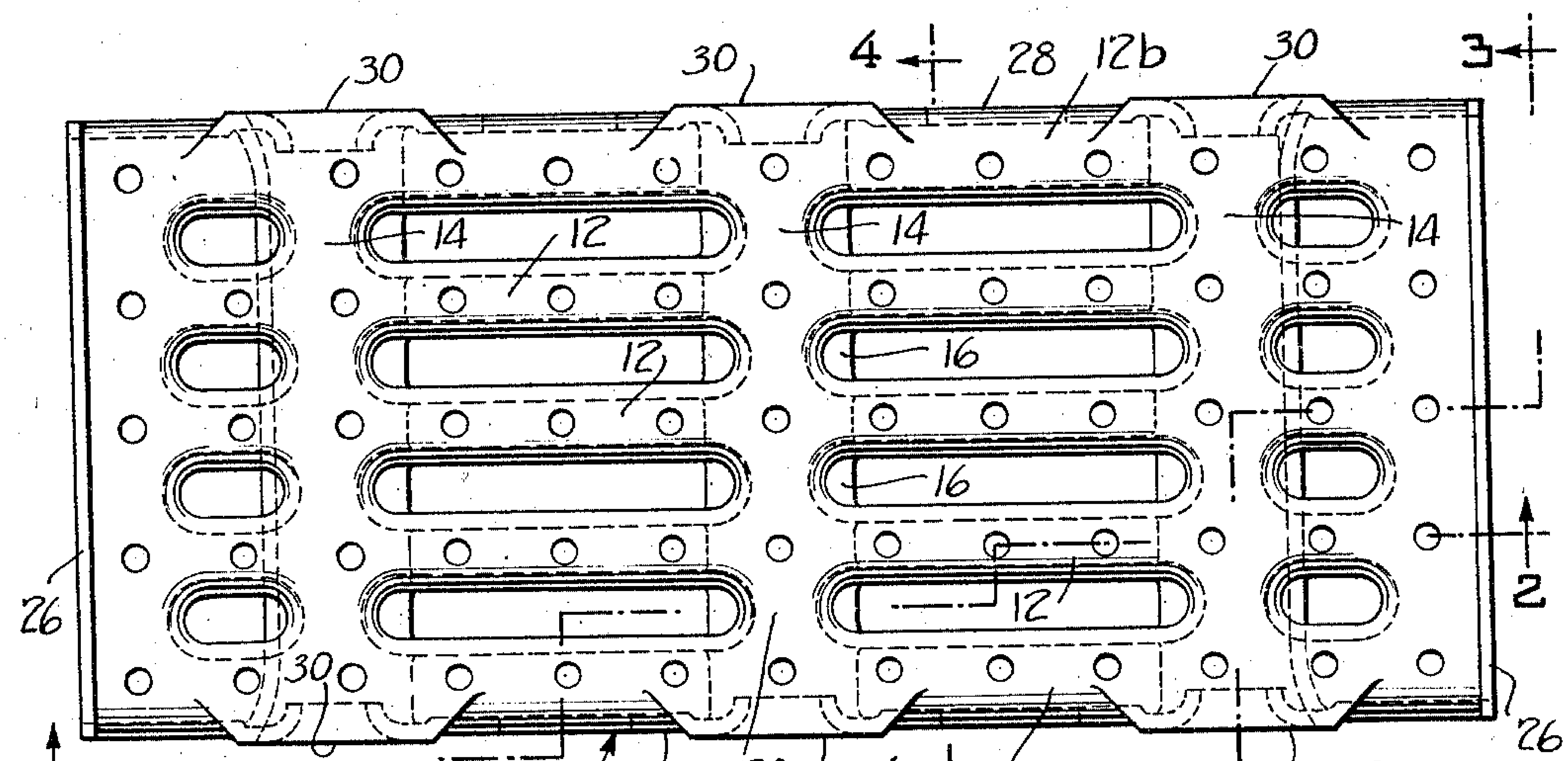

Fig. 1.

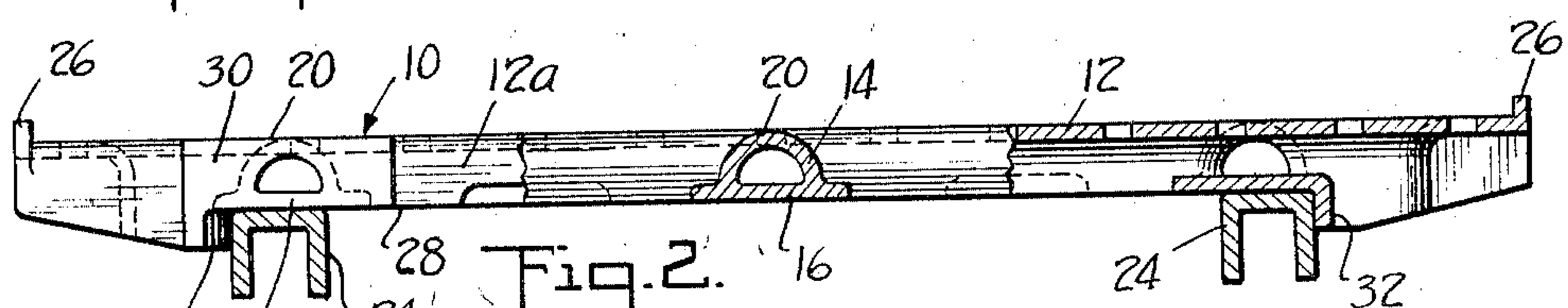

Fig. 2.

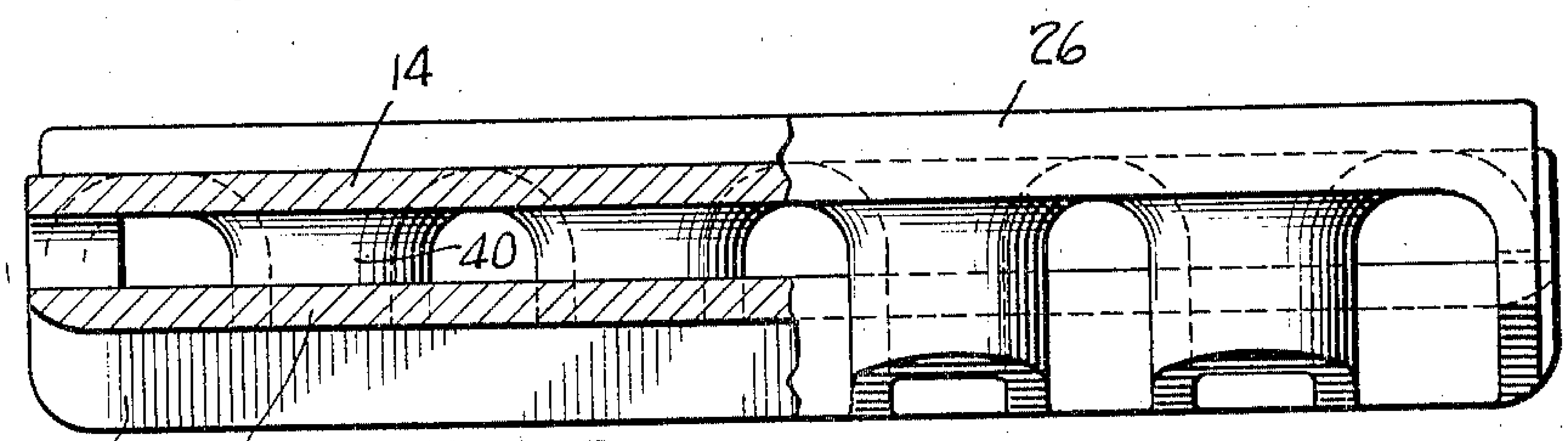

Fig. 3.

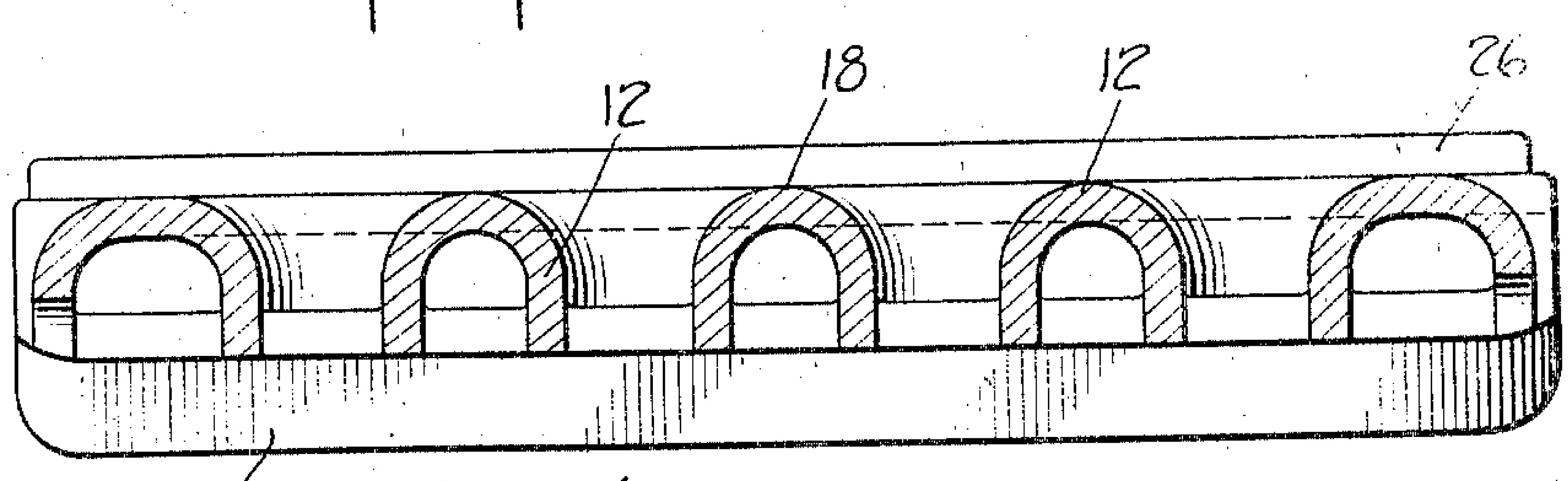

Fig. 4.

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HEAT TREATING FURNACE TRAY

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6 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 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 as much of the surface of the article being treated as is possible be exposed directly to furnace heat and this can best be effected 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 contain a large number of intersections, that is, points where the bars cross and there is a greater thickness of metal at and about the intersection 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. 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 tubular portions combined with hollowed out, trough-like semi-tubular portions, and providing them with a minimum of angular intersections and avoiding sharp corners and thick heavy places, I can obtain a substantial decrease in the development of crack or fissure formation, making for longer useful operative life and correspondingly increased economical furnace operation of my trays or supports. It is, therefore, the main object of my invention to provide a skeleton or openwork type of tray for use in heat-treating furnaces of tubular and semi-tubular construction with a minimum of angular intersections and sharp corners and hence a minimum of danger spots.

The tubular and semitubular construction of my trays or supports is also advantageous as a matter of foundry practice. Many failures in alloy castings result from fatigue occasioned by the presence of porous uneven spots, and from non-yielding foreign substances, such as sand, and the like. In my improved form of tray, I provide the largest radius possible, consistent with size, and have the edge portions of the semi-tubular members preferably uppermost during pouring so that the metal rises in the casting to the height of the edge and then stops, thereby obtaining a free and even flow and avoiding the destructive results of damming and back-flow of the molten metal. When molten metal runs or flows against the angular intersections and sharp corners found in the conventional solid trays, porosities result and particles of the mold are carried into the casting. My tray avoids these sources of danger.

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 travelling 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 openwork type of tray which will have a greater load-bearing capacity in conjunction with ability to resist compression stresses. I accomplish the former purpose by the curved, arched upper surface of the tray, and by arranging the tubular components of my tray in line with the compression stresses, I impart increased transverse strength thereto.

Other and related objects of my invention will in part be obvious and are 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;

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

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

Figure 4 is an enlarged sectional view on the line 4—4 of Figure 1.

Reference numeral 10 indicates the tray generally, which is usually a one-piece alloy steel casting.

My tray as a unit comprises a plurality of lengthwise inverted trough-like or semi-tubular members 12 interconnected by a plurality of transversely extending tubular members 14. The upper surfaces 18, 20 respectively of both semi-tubular and tubular members 12, 14 are curved or arched, but the undersides 16 of said tubes 14 are flattened to provide floor or skid portions to bear upon the rails or rollers on which the trays are travelled through the furnace. The ends of semi-tubes 12 are provided with upstanding portions 26, cast as an integral part thereof, to serve as an end retaining wall for work placed thereon.

Outer sides 28 of the semi-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 30, 30. Portions 30, 30 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 underside of tray 10 and near the ends thereof are formed a pair of downwardly depending walls 32 in line with the outer edge of the outer cross-tubes 14, which serve as guides to keep the trays aligned on the conventional skid rails 24 within the furnace, as indicated in Fig. 2. Holes 34 indicate openings cored in the upper surface of the tray through which the sand of the core may be removed from within the completed unit. Holes 34 also receive hooks or pins which serve as anchor posts for placing articles on the supports.

It will be seen that my tray, as a unit, is made up of a number of trough-like, semi-tubular members 12 and tubular members 14, arranged in criss-cross pattern with the interiors of the tubular and semi-tubular members in communication, as at 40 see Fig. 3. The curved and arched construction of the upper surface of the tray 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, particularly since the transverse stresses will always be applied in line with the tubular members 14.

An important feature of my invention is the provision of semi-tubular members 12 and transverse tubular members 14 the upper surfaces of which, upon which the load rests, are rounded and hollowed out. Another feature is the smooth, uniform thickness of my tray at the points where the semi-tubes 12 and tubes 14 join and merge into one another. The uniform thickness at substantially all points of the tray and the substantial absence of thick inter-sections and sharp corners except at the points where the floor portions 16 extend beyond the tubes 14, eliminate danger spots and sources of cracks and shrinks, since the nickel-chrome-iron alloy material of which the tray is preferably made will thus expand and contract under heat and cold at a substantially uniform rate over its entire area. There are thus few 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 thus fewer strains set up in initial heating.

The tubular components 14 of the tray have no exposed edges, and only their outer surface portions are directly exposed to heat, and the tube components will thus heat more uniformly. The circulation of heated air through the tubular and semi-tubular members will also facilitate uniform heating through the tray, by the flow or convection of such hot air.

By the use of component portions which are semi-tubular and completely tubular, and therefore much stronger and stiffer than if made up of solid 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 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 set of trough-like, semi-tubular members extending from side to side of the tray, and means to secure same in parallel spaced apart relationship, said means comprising a set of tubular members arranged transversely of

and in the same plane with the members of the first set.

2. In a tray as defined in claim 1 in which the second set is merged with the first set and the interiors of both sets are in communication.

3. A tray for use in heat-treating furnaces comprising a plurality of arched members, the interiors of which are hollowed out, and open at the bottom thereof, said members being connected by a set of transverse arched members in the same plane therewith, the interiors of which are similarly hollowed out, having flat portions on the bottom thereof forming transverse tubes defining skids whereby the trays are travelled through the furnace.

4. A tray as in claim 3 in which the sides of the outermost of the arched members are provided with flat portions in line with the transverse tubes.

5. A tray for use in heat-treating furnaces comprising a plurality of arched members in parallel, spaced apart relationship, the interiors of which members are hollowed out, and open at the bottom thereof, said members being secured and connected in such relationship by a plurality of tubular members merging with and in the same plane with the arched members, the sides and ends of the arched members defining the limits of the tray.

6. A tray as defined in claim 5 in which the tubular members are disposed between the arched members and extend from the outer edge of the first thereof to the outer edge of the last thereof in the plurality.

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