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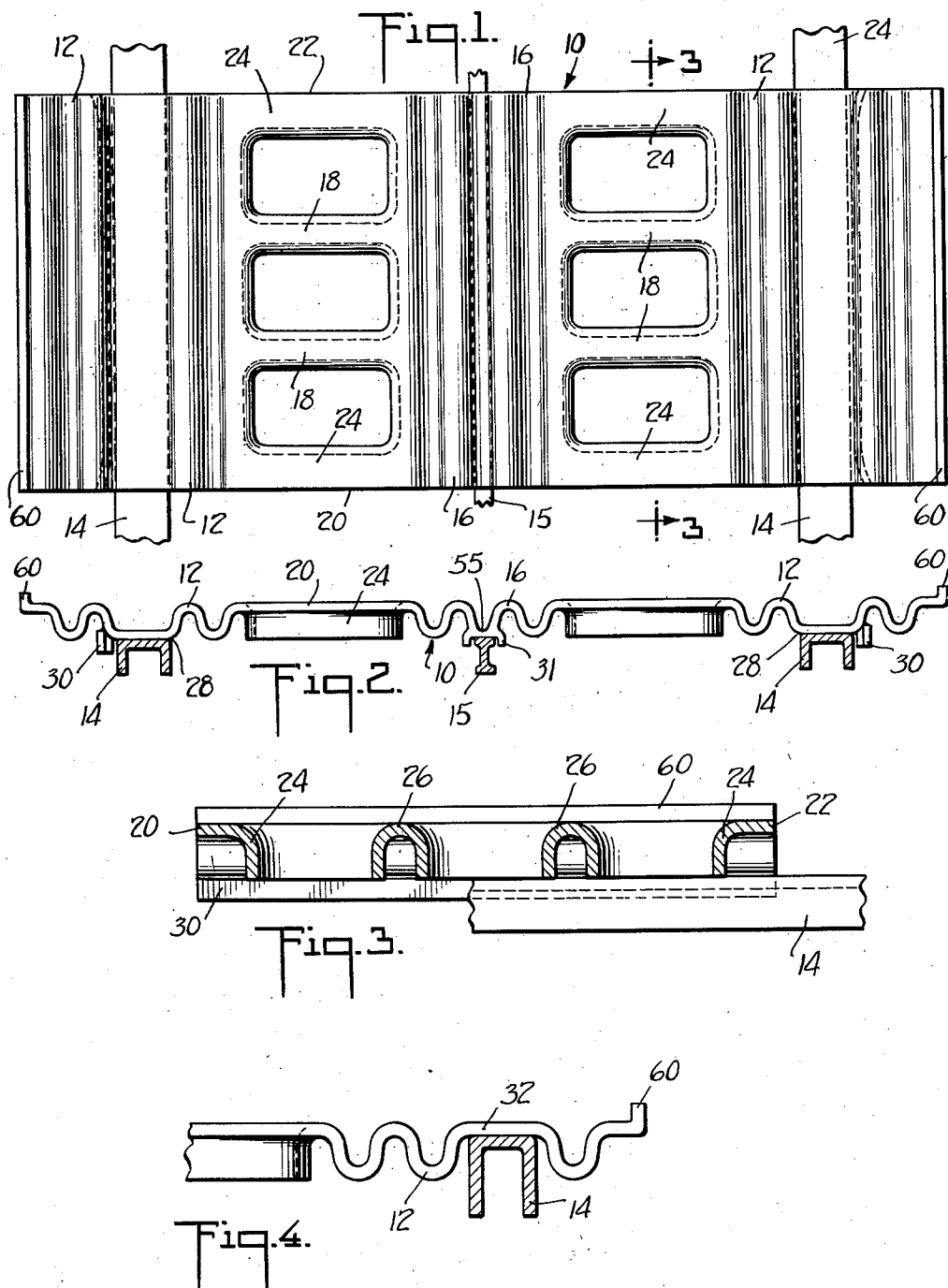
H. H. HARRIS

2,168,333

HEAT TREATING FURNACE TRAY

Filed Oct. 14, 1937

2 Sheets-Sheet 1



INVENTOR
Henry H. Harris
BY
Dyke and Schaines
ATTORNEYS

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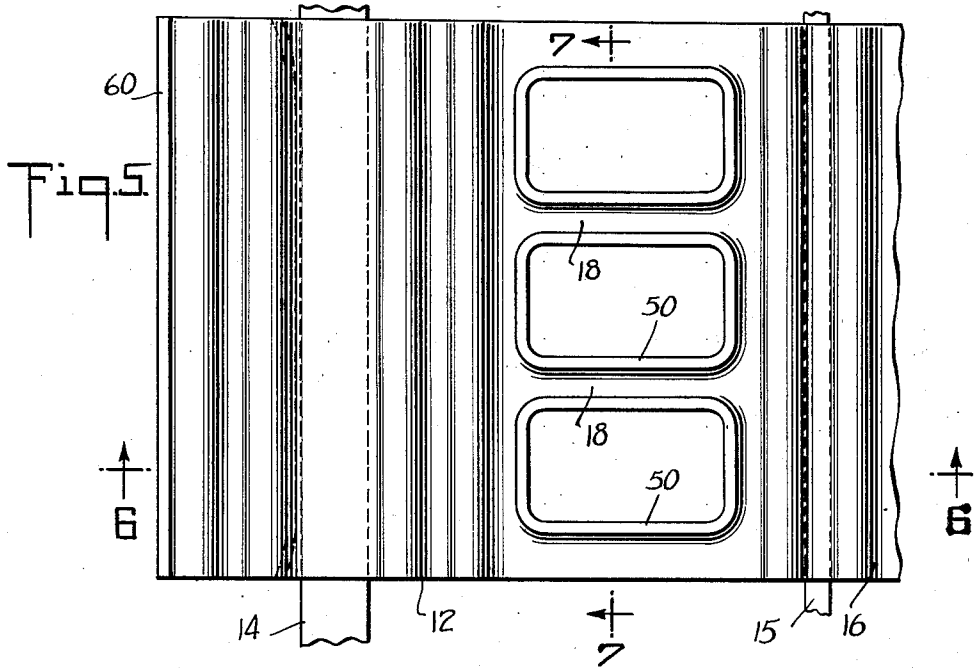
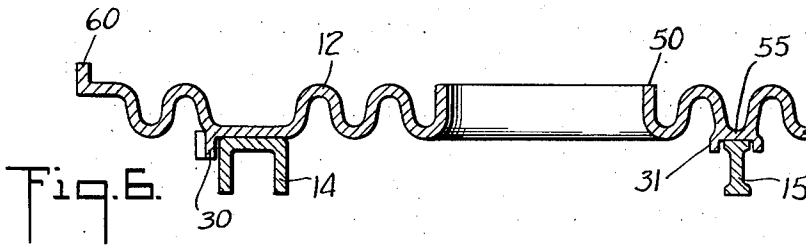
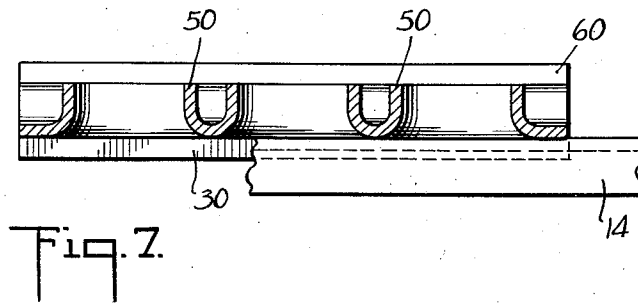
H. H. HARRIS

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INVENTOR
Henry H. Harris
BY
Dyke and Schaines
ATTORNEYS

UNITED STATES PATENT OFFICE

2,168,333

HEAT-TREATING FURNACE TRAY

Henry H. Harris, Champaign, Ill.

Application October 14, 1937, Serial No. 168,907

3 Claims. (Cl. 263-49)

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

Conventionally, articles to be carburized, or otherwise heat-treated, are disposed within boxes or containers having therein a carburizing compound. The container or carburizing box is then sealed and placed within a furnace or muffle and subjected to high heat and the carburizing effected under the influence of this heat. While the supports or trays of my invention could be used for carrying such boxes or containers, I preferably use same in furnaces and with heat treatments wherein articles to be treated are placed or loaded directly upon the supports or trays which are then 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 of which the trays or supports are made, the gas will enter therein 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, however, the tray comes into contact with a cooler atmosphere and a shrinkage takes place. This shrinkage contracts the metal around the soot or deposited carbon, and what might originally have been a barely discernible crack or fissure becomes larger and more clearly defined. Repetition of this process and consequent subjection of the tray to the action of heat, carbon deposit, and cold, causes the cracks or fissures to reach such proportions as to result in the virtual destruction of the tray as a usable article.

The conventional trays used in this type of furnace operation have necessarily been of skeleton or open-work formation, rather than continuous sheets or cast imperforate members. There are several reasons for this, namely, in order 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 open-work support; also, the skeleton formation necessitates use of less metal and hence

a lighter and cheaper product can be obtained. These open-work trays or grids are usually solid one-piece castings and necessarily represent a large number of intersections, that is, points where the bars forming the tray cross or intersect 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, subsequently to develop into destructive cracks or fissures.

I have found that by making the tray of uniform thickness and avoiding angular intersections, sharp corners and thick heavy places, a substantial decrease in the development of crack or fissure formation results, making for a longer useful operative life and correspondingly increased economical furnace operation. It is, therefore, an object of my invention to provide a tray for use in heat-treating furnaces which is of substantially uniform thickness throughout, with a minimum of angular intersections or sharp corners, and hence a minimum of danger spots.

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 stresses and to compression stresses of the travelling pressure, and additionally to the heat conditions within the furnace. During normal furnace operation, these conditions also occasion a great many tray failures since they cause spreading, buckling and bending, and tend to develop cracks or shrinks.

Heretofore, furnace work supports as trays and the like have usually been of rigid, one piece construction and have been travelled over a plurality of rails or skids, usually three in number, which extend lengthwise of the furnace. Three rails have been found to be most desirable since support for the tray at the two ends and at the center is obtained thereby. These rails or skids are constantly being subjected to the heat conditions prevalent within the furnace and after some use, bulge, buckle or warp out of line. Because of this, the work supports have been of thick, heavy construction to prevent sagging and cracking, but this has proven unsatisfactory, since, upon change in alignment of the rails, the support could not flex in response thereto, and

would sag, buckle, and ultimately crack and break.

Another object of my invention is the provision of a tray for use in heat treating furnaces which will be responsive to heat conditions within the furnace and which will respond and conform to changes in rail alignment.

A further object of my invention is the provision of a tray which will be laterally flexible, and able to expand and contract during furnace operation in response to varying conditions within the furnace, without destructive after-effects. I accomplish these objects by the particular construction which will be explained below in connection with the following description of an illustrative embodiment. Other objects of my invention will in part be obvious, and in part be pointed out specifically.

In the drawings annexed hereto and made a part hereof:

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

Figure 2 is a side elevation;

Figure 3 is an enlarged section along the line 3—3 of Figure 1; and

Figure 4 is an enlarged side elevational view, similar to part of Figure 2, of a modification on the form of my invention shown in Figures 1-3;

Figure 5 is a plan view of another modification of my invention;

Figure 6 is a sectional view thereof on the line 6—6 of Figure 5; and

Figure 7 is a section along the line 7—7 of Figure 5.

Referring to the modification of Figures 1 to 3 inclusive; reference numeral 10 indicates the tray or support generally, which is preferably a one-piece casting of nickel-chromium-iron alloy steel. As seen in Figure 2, tray 10 is uniformly thick throughout.

Corrugated portions 12 are formed on tray 10 at or near the ends thereof, and preferably at the parts thereof overlying the skids or rails 14. These corrugations extend from the front to the back of the tray. During travel of the trays or supports through the furnace, each tray bears against and exerts a pushing pressure upon the tray in front of it, and I preferably provide these corrugated portions 12 at those parts of the tray which overlie the rails or skids since it makes for more efficient furnace travel that the fronts and backs of the trays bear against each other in line with the skid rails; it being at those points that the pressure is applied. Additional corrugated portions, such as 16, are provided midway between the corrugations 12 and overlying central skid rail 15 to impart additional transverse strength to the tray. In addition to giving to the tray increased resistance against the transverse, pushing pressures, these corrugations 16 give to the tray the ability to yield and conform somewhat to load-bearing pressures under the influence of heat, while retaining the ability to resume its original shape upon removal from the furnace.

The corrugations 16 are in the center of the tray and are provided with a pair of depending guide walls 31, 31, on the underside thereof, to receive rail 15 within the channel formed by said depending walls. These central corrugations 16 provide a region at which the flexibility of my improved tray is largely localized since various changes in the vertical alignment of rails 14, 14, 15, will be accommodated by flexion of

tray 10 along corrugations 16, as indicated generally at 55, that part of tray 10 which overlies the central rail 15. Thus, if any of rails 14, 14, or 15 bend or shift, tray 10 will flex at region 55 on corrugations 16 and conform to the changed position of the rail or rails affected.

Between the corrugated portions 12, 16, 12, of tray 10, I form a plurality of spaced apart integral semi-tubular, trough-like portions 18, at right angles to the corrugations. At the front 20, and at the rear 22 of tray 10, I provide, also between corrugations 12 and in line with semi-tubes 18, substantially right-angled members 24, the edges thereof at the front and back of the tray being straight and normal to the plane of the tray to provide strength to resist the pushing tray-travelling pressures. Members 24 are similarly spaced from semi-tubes 18, the spaced-apart arrangement of members 18 and 24 defining openings 29 through the tray. The semi-tubular construction gives more strength to the tray and provides increased stiffness for supporting the load between the corrugated sections.

The upper surfaces of semi-tubes 18 are rounded, as at 26, 26 and these surfaces, with the curved corrugations 12, provide a line or point contact between the tray as a whole and the work placed thereon. These curved surfaces make for smaller surface contact and for freer heat circulation between the work and the tray, and a cold load deposited upon a heated tray will thus have a minimum chilling effect, and fewer strains will be set up in initial heating, both in the work and in the tray.

As shown in Figure 2, the trough on the underside of one of the corrugations 12 may be shaped to provide a projecting flat bearing surface 28 to rest upon rails 14. With this arrangement, I provide depending guide walls 30, 30, secured to the outer edge of bearing 28, from front to back of the tray to keep same in line on skids or rails 14 during travel through the furnace. I may, as shown in Figure 4, shape the crest 32 of one of corrugations 12 to provide an inverted U so that rails 14 may be received within the concave trough therewithin on the underside of the tray and be guided through the furnace thereby.

In these modifications of Figures 1-4, I have shown the semi-tubular members opening toward the underside of the furnace. This is advantageous because the curved surfaces leave no place for the deposited soot or carbon to gather. In the modification of Figures 5-7, however, in which corresponding parts are given similar numbers, I arrange the semi-tubular members 18 to open toward the top of the tray. So arranged, the edges 50 of the semi-tubes 18 are toward or in contact with the work or load, which is thus shielded from rapid heating or cooling. The heat, in conventional furnace operation, is generally applied from beneath, and the load usually comes to the desired temperature at a faster rate on the bottom than at the top. This modified arrangement, while it lacks certain of the advantages pointed out with respect to the other form of my invention, is advantageous in that it provides a more uniform heat distribution than otherwise obtainable. The uniform thickness at substantially all points of the tray and the absence of thick intersections and sharp corner eliminate danger spots and sources of cracks and shrinks since the nickel-chrome-iron alloy material of which the tray is preferably made will expand and contract under heat and

cold at a substantially uniform rate over its entire area. There are substantially 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. While the tracks shown in Figure 6 are in downwardly projecting or extending parts, they may be in hollowed out parts, as in Figure 4, if desired.

At the opposite ends of the tray, I provide upstanding walls 60, extending from the front to the back thereof and cast as an integral part of the tray, to serve as guards or retaining members to keep articles placed upon the tray from falling off during travel through the furnace.

Various other modifications may be resorted to without departing from the teachings of my invention, which is not to be limited to the exact forms shown hereinabove, but only by the scope of the appended claims.

I claim:

1. A flexible tray for use in heat-treating furnaces formed of a continuous sheet of metal having formed therein a plurality of spaced-apart,

trough-like members, and having formed in the sheet corrugated portions on either side of the trough-like members and at right angles thereto, the sheet having openings therein between said trough-like members.

2. A one-piece flexible tray for use in heat treating furnaces, which tray is subject to flexion in use, and means to accommodate the tray to flexion conditions which prevail during use, which comprise a corrugated portion at substantially the center of the tray extending from front to back thereof, at which portion the tray is flexible in response to varying furnace conditions.

3. In combination, a flexible tray for use in heat treating furnaces, and a plurality of rails in said furnaces on which said tray is travelled therethrough, said rails being in substantially horizontal alignment and the tray being subject to flexion in use, and having a corrugated portion overlying the centermost of said rails and in line therewith, at which portion the tray is flexible in response to changes in the horizontal alignment of the rails.

HENRY H. HARRIS.