FREE FLOATING FLIGHT IN A RETORT AND METHOD

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References Cited

UNITED STATES PATENTS

A pair of helical strips for holding a flight adjacent the interior surface of a cylindrical heating retort. The flight is movable between the helical strips relative to the interior surface of the retort to prevent the occurrence of thermal stress cracking in the retort and/or the flight adjacent their interface.

13 Claims, 2 Drawing Figures
FREE FLOATING FLIGHT IN A RETORT AND METHOD

BACKGROUND OF THE INVENTION

This invention relates to the field of heat treating furnaces and more particularly is directed to a rotary retort used for continuous processing of workpieces, requiring controlled heat treating to produce, for example, carburizing, carbonitriding, carbon restoration or hardening. The flight or spiral which is mounted on the interior surface of the cylindrical retort is designed to move the workpieces from one end of the cylindrical retort to the other end.

In the prior art the retorts used for the continuous processing of workpieces have generally been heavy walled rough cast retorts with cast-in spirals or have been fabricated retorts of wrought materials with the internal spiral welded directly to the cylindrical shell. In the processing of particular types of workpieces it is necessary to have a smooth clean interior portion of the retort for the conveying of the workpieces through the heat treating process to prevent possible damage to the workpieces.

When using a smooth retort, it is generally necessary to weld a flight or spiral to the interior surface of the outer shell of the retort in order to provide the smooth interior surface necessary for certain specialized workpieces. However, thermal stresses are developed in the flight and the shell of the retort whenever the flight and shell are at different temperatures. The degree of stress depends upon the magnitude of the temperature differences. There are several conditions where the temperature differential is of significant magnitude to cause stress conditions that result in possible failure and cracking of either or both the flight and the retort. One condition is the rapid heating from a shut down condition up to the operating temperature which results in the shell being much hotter than the flight. In another situation, there may be accelerated cooling, by turning off the natural gas and permitting the combustion of air to flow through the burners or by opening of vents in electric heated versions. As a result, the shell becomes cooler than the flight. In another typical condition, the cold incoming work keeps the flights cooler than the outer shell which is most severe with the first of the incoming load after the retort has been stabilized at the operating temperature (with no work passing through).

Therefore, the presence of these and other typical conditions may cause the premature failure of the retort by cracking occurring adjacent the intersection of the flight and the shell. Typically, the failure will appear as a spiral crack in the retort following the path of the flight while in the flight the cracking is radially due to the temperature difference from the inside to the outside diameter of the flight, wherein the outside diameter of the flight is welded to the shell.

As a result, when utilizing a retort having a smooth interior surface with the flight welded directly to this interior surface, problems ultimately occur with the failure in the flight due to these thermal stresses, requiring a costly maintenance operation of replacing the flight and/or the retort shell.

SUMMARY OF THE INVENTION

The present invention comprises a pair of helical strips which are secured to the interior surface of the retort on opposite sides of the flight for holding the flight adjacent to the interior surface of the retort. The flight is not directly connected to the interior surface of the retort and, therefore, is free to move relative to the interior surface of the retort. The pair of helical strips do not protrude as far from the interior surface of the retort as the flight. Since the flight is "free floating," no thermal stresses develop between the flight and the retort due to temperature differentials. Because the strips are essentially small, narrow bands, very little temperature difference can exist across them, and thus the bands and the retort are kept at essentially the same temperature.

By eliminating the presence of this thermal stress condition between the flight and the shell, the retort shell can be constructed of less ductile and less expensive materials. Furthermore, the desirable smooth bore features of the retort as required by certain workpieces is retained, so that none of the parts or workpieces will become caught in the retort and become mixed with subsequent parts of a different configuration.

This invention allows for the easy placement of the flight within the retort, by first tack welding the strips to opposite sides of the flight, and then connecting the two strips permanently to the interior surface of the retort shell by continuous welds. The tack welds between the flight and the strips are readily broken by the first thermally produced stresses on the parts, thus permitting the flight to move between the strips.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partial sectional view of a rotary retort heat treating furnace, and
FIG. 2 is a partial perspective view of the flight attached to the retort shell.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIG. 1, the cylindrical retort 10 is shown mounted in a heat treating furnace 12 supported by the legs 14. For specific details of the construction and operation of the heat treating furnace reference is made to U.S. Pat. No. 3,441,259. Located between the retort 10 and the housing 12 is a heating chamber 16 which heats the outer surface or shell 18 of the retort 10. Positioned on one end 19 of the retort 10 is a circular plate 20 having an entire row of receiving workpieces. A series of discharge ribs 24 are located at the other end 23 of the retort 10 adjacent a discharge chute 26 for directing the exiting workpieces.

Positioned on the interior surface 28 of the retort 10 is a flight or spiral 30 which proceeds in a helical orientation from adjacent one end 19 of the retort to adjacent the other end 23. As shown more clearly in FIG. 2, the flight or flange member 30 is held in position on the interior surface 28 of the retort 10 by a pair of helical guide strips or bands 32 and 34. The lower surface 46 of the guide strip 34 is secured to the interior surface 28 of the retort by a continuous weld 48 and the bottom surface 50 of the guide strip 32 is also secured to the interior surface 28 by a continuous weld 52.

With respect to the centerline of the retort, the outside edge 54 of the flight 30 is positioned closely adjacent the interior surface 28, but is not attached to that surface. There is no gap between the inside surface 56 of the strip 34 and the side 40 of the flight 30. Similarly, there is no gap between the inside surface 58 of the strip 32 and the side 44 of the flight 30. This juxtaposed relation of the strips 32 and 34 along the flight 30 is to insure that no foreign matter or workpieces can become...
lodged between the strips 32 and 34 and the flight 30. Turning to the operation of the heat treating retort, reference again is made to FIG. 1 where workpieces are fed into the inlet port 22 and proceed from the one end 19 to the other end 23 of the retort 10 by the rotative motion of the retort and the spiral orientation of the flight 30. As the workpieces exit the end 23 of the retort, they are guided by the discharge ribs 24 into the discharge chute 26. Because the heating area 16 is adjacent the exterior surface 18 of the retort, the retort becomes hotter than the flight 30 when first initiating the operation of the retort. This causes a temperature differential between the flight 30 and the retort 10 resulting in possible thermal stress failure if the flight were connected to the retort interior surface 28. However, as shown in FIG. 2, because the outside edge 54 of the flight 30 is not connected or attached directly to the interior surface 28 of the retort, no significant thermal stresses are developed as a result of temperature differentials between the flight 30 and the retort 10. The flight 30 is preferably a single continuous flight extending from the one end 19 of the retort in a spiral direction to the other end 23 of the retort.

It should be noted that the orientation and construction of the helical strips 32 and 34 adjacent the flight 30 allow for relative movement of the flight with respect to said retort 10 in a direction generally normal to said retort surface 28 while preventing relative movement of the flight with respect to the retort in a direction generally parallel to the general direction of work pieces moving through the retort from the entry port 22 to the discharge end 23.

With respect to the preferred method of constructing the disclosed invention, the top portion 36 of strip 34 is tack welded at spaced locations 38 to one side 40 of the flight 30 while the top portion 42 of the strip 32 is similarly tack welded at spaced locations 43 to the other side 44 of flight 30. Then, the flight with the attached strips is placed within the retort adjacent the interior surface 28. The strips 32 and 34 are respectively welded securely to the interior surface 28 by the continuous welds 52 and 48 which follow the spiral path of the helical strips 32 and 34 throughout their placement within the retort.

As a result of some thermal stresses which develop between the strips 32 and 34 and the flight 30, the spaced tack welds 38 and 43 are designed to prevent the flight to be in a “free floating” orientation with respect to the retort and the strips 32 and 34. The spiral configuration of the flight causes it to support itself against the interior surface 28 of the retort. Furthermore, the flight is welded at each of its extreme ends 60 and 62 to the interior surface of the retort in order to anchor it within the retort.

What is claimed is:

1. A heat treatment device for treating workpieces, and device comprising:
   a heating surface;
   guide means located on said heating surface for directing said workpieces along said heating surface;
   and
   means connected to and extending away from said heating surface adjacent said guide means for maintaining the location of said guide means on said heating surface, said maintaining means allowing said guide means to move relative and substantially normal to said heating surface so that any temperature differential between said heating surface and said guide means will not cause thermal stress cracks in said heating surface and said guide means adjacent their interface.

2. A heat treatment device as defined in claim 1 wherein said guide means comprises a continuous member extending along said heating surface and protruding from said heating surface.

3. A heat treatment device as defined in claim 1 wherein said maintaining means comprises:
   a first strip secured to and extending away from said heating surface; and
   a second strip secured to and extending away from said heating surface adjacent and parallel to said first strip, said first and second strips with said heating surface establishing a channel for receipt of said guide means, the distance between said first and said second strips being approximately equal to the thickness of said guide means so that the placement of said guide means in said channel results in a tight fit between said guide means and said first and said second strips, said guide means protruding further from said heating surface than said first and second strips.

4. A heat treatment apparatus comprising:
   a cylindrical retort surface;
   a helical flight on said heating surface; and
   means affixed to and extending away from said surface in close proximity to said flight for holding said flight adjacent said surface, said flight being free to move within said holding means relative and substantially normal to said surface, said flight being a continuous single piece of at least a sufficient length to support itself within said holding means.

5. A heating apparatus comprising:
   a cylindrical rotatable heating surface;
   a one piece helical flight on said heating surface; and
   means for holding said flight adjacent said heating surface, said flight being free to move within said holding means relative to said heating surface, said holding means being on both sides of said flight adjacent said surface to cover any gap between said flight and said surface.

6. A heating apparatus as defined in claim 5 wherein said holding means comprises a pair of track members secured to said heating surface forming a groove for receipt of said flight, said track members being parallel and following the path of said continuous helical flight member, said flight member being able to expand and contract relative to said heating surface without causing thermal stress cracking in said flight member and said heating surface adjacent their interface.

7. A heating device for treating workpieces moving in a direction from an entry port to a discharge end, said device comprising:
   a heat source;
   a heating surface mounted adjacent said heat source; a flange member mounted on said heating surface; and
   means for holding said flange member on said heating surface, said holding means preventing relative movement between said flange and said surface in a direction generally parallel with said direction of said moving workpieces while allowing said flange to move with respect to said surface in a direction generally perpendicular to said direction of said moving workpieces, so that temperature differen-
trials between said heating surface and said flange member will not cause failure in said heating surface and said flange member adjacent their interface.

8. A heat treatment furnace comprising:
   a cylindrical retort;
   a pair of helical strips secured in parallel and spaced relation to each other on the interior surface of said retort; and
   a helical flight member positioned within said pair of helical strips and adjacent said interior surface of said retort, said flight member being movable relative to said interior surface of said retort to allow said flight member to freely expand and contract relative to said retort to prevent thermal stress cracking in said retort and said flight member adjacent their interface.

9. A method of placing a helical flight within a cylindrical heating retort so that said flight is free to move relative to said retort to prevent thermal stress cracking in said flight and said retort adjacent their interface, said method comprising the steps of:
   temporarily attaching a first helical strip to said flight;
   temporarily attaching a second helical strip to said flight; and
   securing said first and second helical strips to the interior surface of said retort, said temporary attachment of said first and second helical strips to said flight being broken when said retort is operating.

10. A method of placing a helical flight on the interior surface of a cylindrical heating retort to allow said flight to move relative to said retort, said method comprising the steps of:
   temporarily attaching a first helical strip to one side of said flight;
   securing said first helical strip to said interior surface of said retort; and
   securing a second helical strip to said interior surface adjacent the other side of said flight, said temporary attachment of said first helical strip to said flight breaking when said heating retort is operating.

11. A method of placing a helical flight on the interior surface of a cylindrical heat treating retort, said method comprising the step of positioning said helical flight on said surface by a pair of spaced helical strips secured on the surface in a manner to confine the flight while allowing the flight to move relative to said retort.

12. A heat treatment device for treating workpieces, said device comprising:
   a heating surface;
   guide means located on said heating surface for directing said workpieces along said heating surface; and
   means connected to and extending away from said heating surface adjacent said guide means for maintaining the location of said guide means on said heating surface, said maintaining means being in juxtaposed relation along said guide means and allowing said guide means to move relative to said heating surface so that any temperature differential between said heating surface and said guide means will not cause thermal stress cracks in said heating surface and said guide means adjacent their interface.

13. A heat treating apparatus comprising:
   a cylindrical retort surface;
   a helical flight on said surface; and
   means affixed to and extending away from said surface in close proximity to said flight for holding said flight adjacent said surface, said holding means being in juxtaposed relation along said flight, said flight being free to move within said holding means relative to said surface, said flight being a continuous single piece of at least a sufficient length to support itself within said holding means.