# United States Patent

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[73] Assignee **United States Steel Corporation**
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[54] **HOLDER FOR A CIRCULAR WORKPIECE SUBJECT TO EXPANSION AND CONTRACTION**
**5 Claims, 3 Drawing Figs.**


[52] **U.S. Cl.** ..... **269/48.1,** 164/291
[51] **Int. Cl.** ..... **B23q 3/14,** B23b 31/40
[50] **Field of Search** ..... 269/48.1, 50, 52, 57, 83, 321, 321B; 228/48; 164/291, 279; 60/(Inquired); 279/2; 308/15(Cursory), 77(Cursory)



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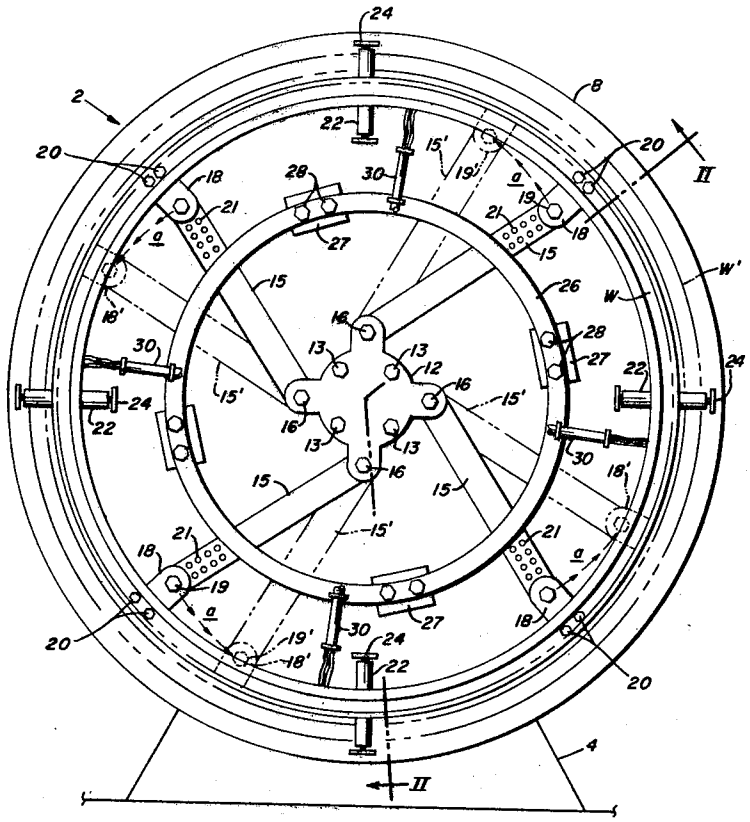
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**ABSTRACT:** Apparatus for supporting a workpiece while it is undergoing expansion or contraction in a manufacturing process. Through a unique linkage-type support for the workpiece, the apparatus maintains the workpiece centered about its central axis in spite of expansion or contraction. The invention is particularly useful in holding large metal rings or conical metal workpieces, such as blast furnace hopper rings, bells, and hoppers while they are being heated prior to applying abrasive-resistant coverings.

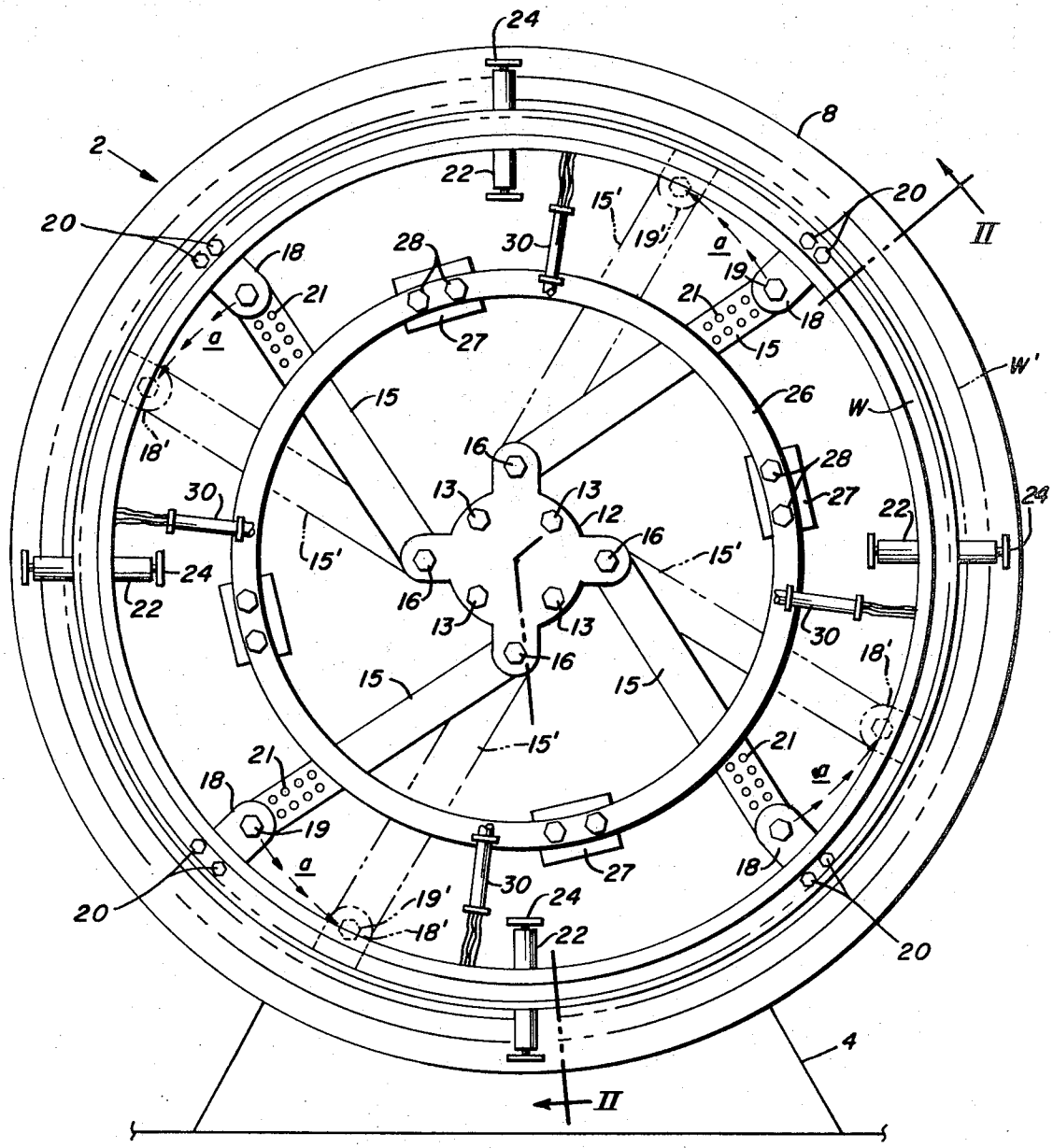



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SHEET 1 OF 2

FIG. 1




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FIG. 2.

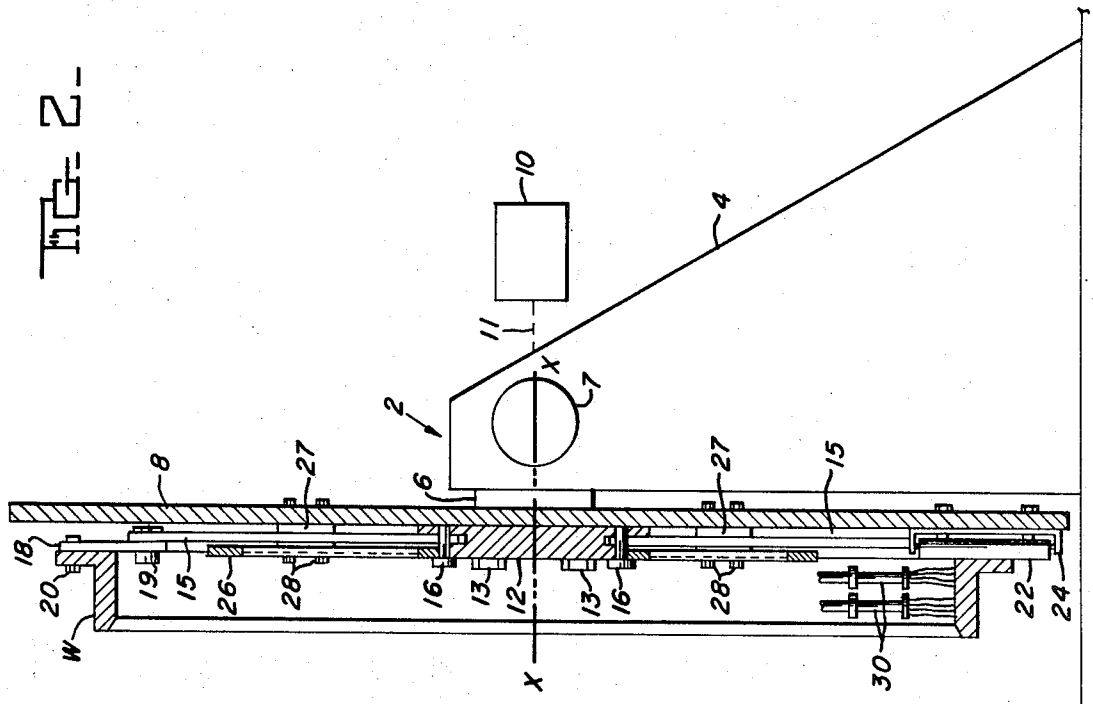
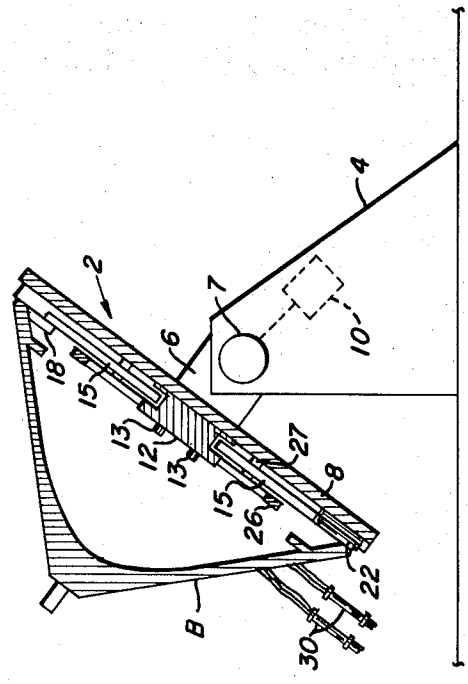



FIG. 3.




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# HOLDER FOR A CIRCULAR WORKPIECE SUBJECT TO EXPANSION AND CONTRACTION

This invention relates to apparatus for supporting workpieces that are undergoing thermal expansion or contraction. One use of the apparatus is in holding large circular metal articles, such as blast furnace hopper rings, bells, and hoppers while they are being surface-treated with abrasive-resistant coatings.

In applying an abrasive-resistant coating to a large, circular, metal workpiece, the usual practice is to mount the workpiece on a carrier which can rotate about a horizontal axis. While the workpiece is turned slowly, the surface to be treated is preheated uniformly by circumferentially spaced burners. Then, an abrasive-resistant material, such as chrome carbide steel or stainless steel, is applied by a submerged arc welding process while the preheating burners remain on. Bands of the abrasive-resistant material build up as the workpiece continues to rotate. When these bands reach their desired weight and uniformity, the welding process is stopped, the burners are turned off, and the workpiece is allowed to cool while attached to its vertical carrier.

Since the metal workpiece is usually heated to over 700° F. before welding, the expansion and contraction of the workpiece during the foregoing process has presented considerable problems in designing suitable carrier for the workpiece. Previous carriers have included a plurality of arms radiating from a central hub. With one type of carrier, often used for treating blast furnace bells, the ends of the arms carry turnbuckles which have their bolt ends facing outwardly for attachment to the workpiece. As the workpiece expands during preheating, a workman periodically turns the bolts of the turnbuckles to increase the effective length of the carrier arms. After the welding operation, while the workpiece is cooling, the bolts of the turnbuckles are gradually turned back to their original positions. With another type of carrier, often used for treating blast furnace hopper rings, the ends of the arms are bolted directly to the workpiece, with short sleeves around the bolts keeping the workpiece spaced from the arms. As the workpiece expands or contracts, the portions of the bolts within the sleeves bend outwardly or inwardly.

There have been a number of disadvantages with the foregoing workpiece carriers. If the turnbuckles are not adjusted at the proper times and by the proper amounts while the workpieces are expanding or contracting, the resulting high stresses will cause the workpiece to become "out of round." The bolts will also be unduly stressed and may shear off, causing the workpiece to fall with damaging results to both the workpiece and possibly men and equipment in the vicinity of the workpiece. Another possibility is that the bolts instead of shearing will cause the attachment means to bind, thereby requiring them to be burned off to relieve the stresses that such binding transmits to the workpieces. Similar disadvantages also attend the sleeve and bolt type connection of the workpiece, when the expansion and contraction is more than the bending of the bolts will permit.

Another disadvantage with the previous carriers is their inability to adjust evenly in all directions to the expansion and contraction of the workpiece. This forces the workpiece to an offcenter position on its carrier, thereby causing a nonuniform application of the abrasive-resistant coating.

Still another disadvantage with the turnbuckle type carriers is that a workman must place himself in a hazardous position near the hot workpiece to adjust the bolts of the turnbuckles. Yet another drawback is the many man-hours spent by the workman in constantly adjusting the bolts while the workpiece is expanding and contracting.

It is an object of my invention to provide apparatus for supporting a workpiece undergoing expansion or contraction, which apparatus includes a unique linkage-type support for the workpiece and eliminates the foregoing disadvantages attending previously known apparatus.

This and other objects obtained by my apparatus will be more apparent from the following detailed description of my invention and the attached drawings in which:



FIG. 1 is a front elevation of apparatus for supporting a metal workpiece while the workpiece is receiving an abrasive-resistant coating;

FIG. 2 is a sectional view of the apparatus of FIG. 1, taken along lines II–II of FIG. 1; and

FIG. 3 is a sectional view similar to FIG. 2, showing the apparatus of FIG. 1 holding a second type of workpiece.

Referring to FIGS. 1 and 2, apparatus 2 includes a stand 4 on which is mounted a bearing support 6, pivotal on shaft 7. A workpiece carrier 8, in the form of a plate, is mounted on the bearing support 6. The carrier 8 is rotatable about axis X–X and is driven by a motor 10. The mounting of the motor 10 and its drive connection to the rotatable carrier 8 are conventional and are shown diagrammatically in FIG. 2 by dotted line 11.

As shown in FIG 1, a hub 12 is attached by bolts 13 to the center of the carrier 8. Four links 15 are pivotally connected to the hub 12 by pins 16. The pins 16 are spaced substantially equal distances from the axis X–X about which carrier 8 turns, and they hold the links 15 rotatable about axes substantially parallel to the axis X–X.

At their outward ends, links 15 are pivotally connected to lugs 18 by pins 19. The lugs 18 are in turn fixed by bolts 20 to a workpiece in the form of a hopper ring W. The hopper ring W is thus supported by links 15, with its central axis coinciding with the axis of rotation X–X of the carrier 8. Each link 15 is provided with a plurality of holes 21 through which pins 19 may be inserted, so that adjustments can be made in the effective lengths of the links to insure that the workpiece W is centered on axis X–X. The plurality of holes 21 in each link also enables the apparatus to hold other workpieces of different diameters.

The carrier 8 includes four rollers 22, to provide a rolling engagement for the workpiece W on the carrier. The rollers 22 are mounted on supports 24 and are rotatable about axes that are substantially radial from the axis X–X. When the workpiece W expands or contracts it rolls on the rollers 22 in a motion that is nearly tangential to a circle about axis X–X. However, this motion is not exactly tangential, due to the radial movement of the workpiece in all directions as it expands or contracts. For this reason, there is some lateral sliding of the workpiece W as it expands or contracts on the rollers 22. This sliding may be greatly reduced by setting the axes of rollers 22 at slight angles to the true radial lines from the axis X–X of the carrier 8.

The workpiece W is kept from lateral movement away from the rollers 22 by a retaining ring 26 mounted on top of links 15 (FIG. 1). The retaining ring 26 is mounted on blocks 27 and is secured by bolts 28.

For the purpose of preheating the workpiece W and keeping it hot during the welding operation, burners 30 are placed at a number of locations around the circumference of the workpiece W (FIG. 1). The burners 30 are connected to an appropriate gas supply line (not shown).

In operation, the carrier 8 is moved to its horizontal position by rotating it about shaft 7. Then, the hopper ring W is placed on rollers 22, and lugs 18 are secured to the hopper ring by bolts 20. If any adjustments in the length of the links 15 are required, due to a difference in size between the ring W and the last previous workpiece to be mounted on the apparatus, pins 19 are removed and inserted in appropriate holes 21 of the links 15. The effective length of each link 15, or the distance between its pivot points, should be such that the link is rotated away from a position coincident with the radial line drawn between the pin 16 and the axis X–X.

When the hopper ring W is thus fixed to the carrier 8, the carrier is rotated back to its vertical position shown in FIG. 2. The preheating burners 30 are then ignited to begin heating the surface of the workpiece to be treated. The motor 10 is turned on to cause the workpiece W to rotate slowly. A typical rotating speed of the hopper ring W is approximately .035 revolutions per minute.

In the preheating, the hopper ring is usually heated to a temperature over 700° F. This causes it to expand to a new posi-

tion W', shown in the chain lines in FIG. 1. With this expansion, the links 15 rotate to new positions 15', with the pins 19' at the outward ends of the links moving away from the axis X–X of the carrier 8. The path followed by the pins 19 when the hopper ring W expands is indicated by arrows *a* (FIG. 1). When the hopper ring contracts during cooling, the links 15 and pins 19 move in the opposite direction from arrows *a*.

Thus, by a simple pivotal movement of the links 15, the apparatus 2 permits the workpiece to expand or contract without any manual adjustments or large stresses imposed on mechanical parts. The workpiece W at all times remains secure against rollers 22 because retaining ring 26 holds the links 15 from lateral movement or "bowing out" during the heating or cooling.

FIG. 3 shows the apparatus 2 supporting a blast furnace bell B while an abrasive-resistant coating is applied to the bell. In this case, the lugs 18 are welded, rather than bolted, to the workpiece. Also, the preheating burners 30 are located on the outside of the bell B, in preparation for welding on the abrasive-resistant coating. In all other respects the apparatus 2 operates the same as when treating the hopper ring W of FIG. 1 and 2.

While one embodiment of my invention has been shown and described, modifications and additions may be made while remaining within the scope of the invention. For instance, the number of links 15 (FIG. 1) may be varied, as long as there are three or more links to hold the workpiece in stable equilibrium. Rollers may also be added between the retaining rings 26 and the links 15 to reduce the friction between those parts. Also, any number of various attachment means may be used to connect the lugs 18 to the workpiece.



I claim:

1. Apparatus for supporting a circular workpiece during an operation in which the workpiece is subject to thermal expansion and contraction relative to its axis, said apparatus comprising:

a carrier for said workpiece, said carrier having an axis,

at least three links pivotally connected to said carrier about pivot axes substantially parallel to said carrier axis, said pivot axes being spaced from one another and spaced at substantially equal distances from said carrier axis,

means for pivotally connecting said links to said workpiece about second spaced apart axes that are substantially parallel to said carrier axis, said pivotal connecting means holding the workpiece centrally about said carrier axis, but permitting, by the rotation of said links, the workpiece to expand and contract toward and away from said carrier axis, and means for heating said workpiece.

2. Apparatus of claim 1 wherein said carrier includes rollers adjacent its outer periphery and adapted to engage said workpiece, said rollers being mounted with their axes of rotation substantially radial from said carrier axis.

3. Apparatus of claim 2 wherein said carrier includes a retaining means fixed to hold said links from substantial lateral movement away from said rollers.

4. Apparatus of claim 3 wherein said links are of substantially the same lengths.

5. Apparatus of claim 1 including means for rotating said carrier about its axis.