April 14, 1953 D. P. COOPER 2,634,964

CONVEYER FURNACE

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Fig. 1.

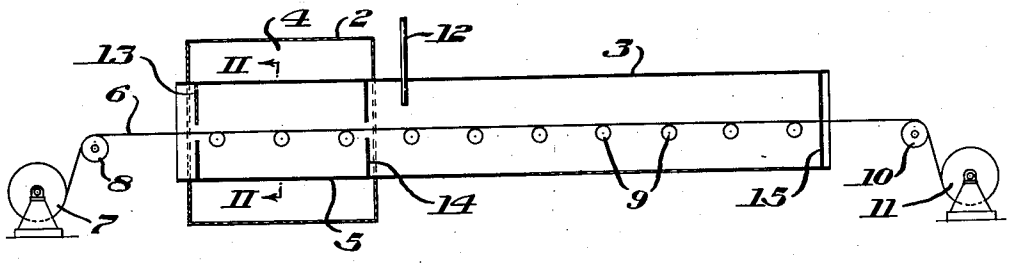


Fig. 3.

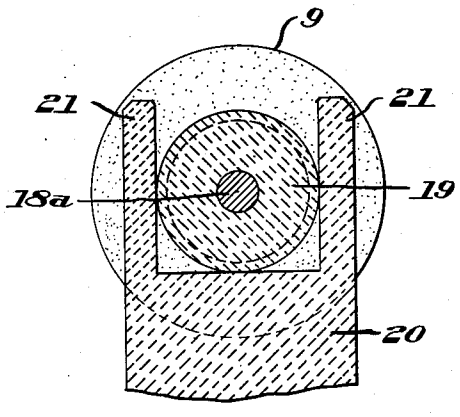
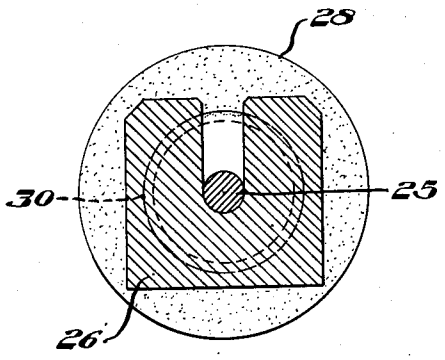


Fig. 5.



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Fig. 2.

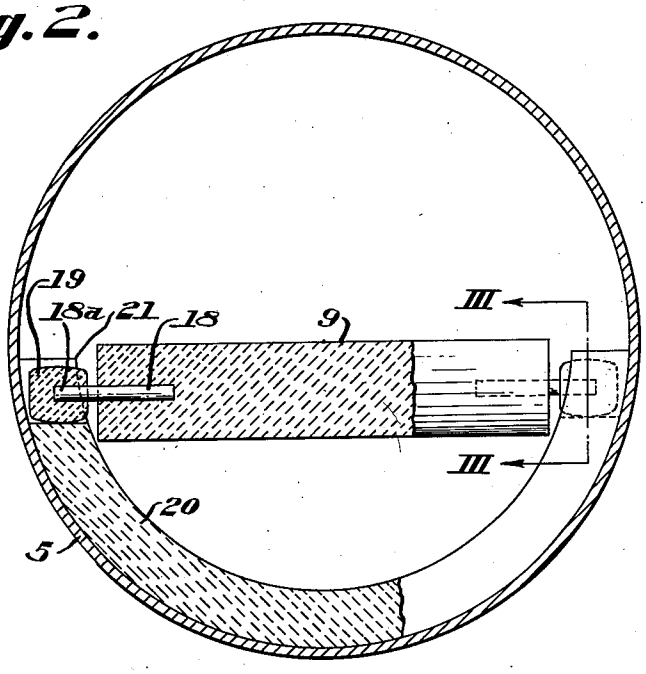
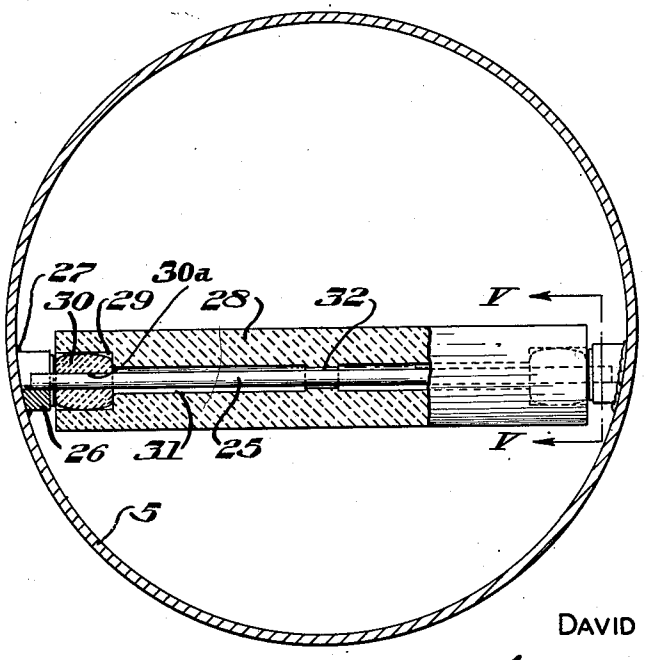


Fig. 4.



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CONVEYER FURNACE

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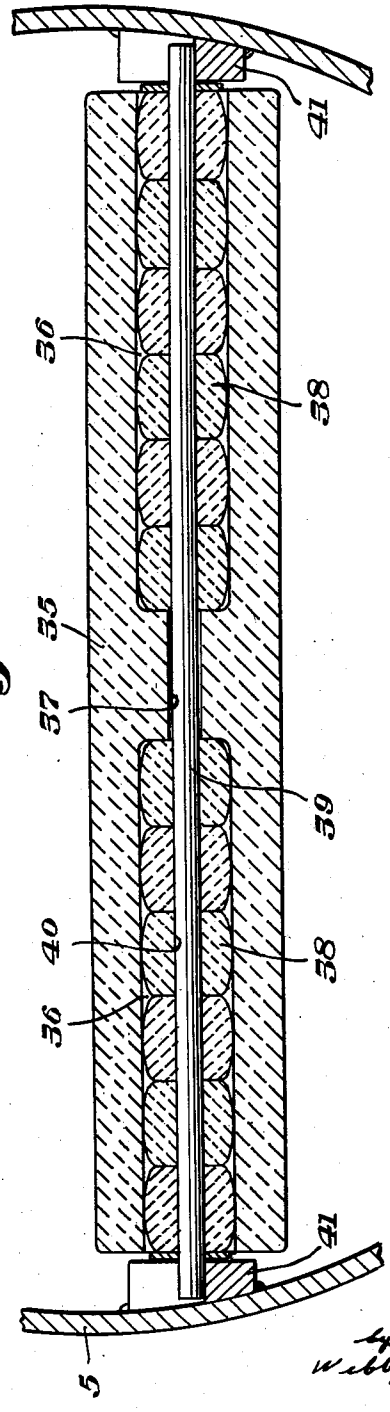


Fig. 6.

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CONVEYER FURNACE

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12 Claims. (Cl. 263—6)

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This invention relates to conveyer furnaces and more particularly to conveyer furnaces for heat treating material passed through the furnace while protecting the material from oxidation in a protective atmosphere such as dissociated ammonia.

In the accompanying drawings which illustrate several embodiments of my invention—

Figure 1 is a diagrammatic side elevation of an annealing furnace for annealing stainless steel strip.

Figure 2 is a vertical section through the heating chamber of the annealing furnace, taken on the line II—II of Figure 1;

Figure 3 is a section taken on the line III—III of Figure 2;

Figure 4 is a vertical section taken through the heating chamber on a line corresponding to the line II—II of Figure 1 but illustrating a different embodiment of the invention;

Figure 5 is a section taken on the line V—V of Figure 4; and

Figure 6 is a view similar to Figures 2 and 4 but illustrating a further embodiment of the invention, the heating chamber being broken away.

The invention will be described as applied particularly to the annealing of stainless steel strip in an atmosphere of dissociated ammonia gas.

Referring to Figures 1–3, an annealing furnace is shown in Figure 1 comprising a heating chamber 2 and a cooling chamber 3. The heating chamber 2 is of the muffle type having a combustion chamber 4 and a muffle chamber 5. The stainless steel strip 6 is fed from a pay-off reel 7, passes over a guide roll 8, then passes successively through the muffle heating chamber 5 and the cooling chamber 3 on conveying rollers 9, after which it passes over a guide roller 10 and is wound on a take-up reel 11. Dissociated ammonia gas is fed to the annealing furnace through a pipe 12. The dissociated ammonia fills the heating chamber 5 and the cooling chamber 3, thereby protecting the steel strip from oxidation. A baffle 13 is located adjacent the entrance end of the heating chamber 5, a baffle 14 is located adjacent the exit end of the chamber 5 and a baffle 15 is located adjacent the exit end of the cooling chamber 3. The baffle 15 forms a tight seal with the strip, whereas the baffles 13 and 14 have substantially larger openings through which the strip passes. This arrangement insures that the bulk of the dissociated ammonia will flow towards the strip entrance end of the furnace so as to sweep out any contaminating gases or vapors that enter with the strip, which if permitted to be present

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at the time the stainless steel strip is hot enough, would oxidize or stain the strip.

In order that the protective atmosphere of dissociated ammonia be effective in protecting the stainless steel strip, it is necessary that the conveying rollers 9 in the heating chamber and the bearings for such conveying rollers be located entirely within the heating chamber. The usual arrangement for conveyer furnaces is to have the bearings for the rollers located on the outside of the heating chamber, the rollers or stubs connected thereto extending through openings in the wall of the heating chamber. The openings are sealed to prevent loss of heat and protective atmosphere but such seals are not entirely satisfactory when annealing stainless steel in dissociated ammonia. The admission of even a slight amount of air into the heating chamber may result in oxidizing of the stainless steel being treated.

In accordance with my invention, the conveying rollers and the bearings for such rollers are located entirely within the heating chamber, the chamber not having any openings through which the rollers or extensions thereof project. In the annealing of stainless steel strip in a dissociated ammonia atmosphere, the strip is heated to a temperature in the neighborhood of 2000° F. Alloy steels grow and warp under such conditions and are not entirely suitable as material for the bearings for the conveying rollers. I have found, however, that graphite bearings may be employed satisfactorily under such conditions.

One embodiment of conveying roller and graphite bearings therefor is illustrated in Figures 2 and 3. The conveying roller 9 shown in these figures is made of graphite. It could, however, be made of alloy steel or other suitable refractory material. An alloy steel pin 18 is fixed to each end of the roller 9, as by driving the pin with a tight fit into a recess formed in the roller. Each pin has a portion 18a extending outwardly beyond the end of the roller and this portion fits in a recess formed in a graphite bearing 19. The bearing 19 is substantially barrel-shaped so that it can rock on its support 20. The support 20 is in the form of a saddle which is semi-circular to conform to the contour of the muffle chamber 5. The support 20 is made of graphite and is provided at its ends with flanges 21 which retain the bearing 19 in place on its support.

The conveying rollers 9 are not driven but turn merely due to the action of the strip 6 supported thereby. In the embodiment shown in Figures 2 and 3, the pins 18 are fixed to the conveying rollers and rotate in the recesses in the graphite bearings 19 which do not rotate.

Referring now to the embodiment shown in Figures 4 and 5, a series of alloy steel shafts 25 are spaced longitudinally of the annealing furnace and extend across the muffle chamber 5. Each shaft 25 is supported at its ends in a U-shaped bracket or support 26 which is secured to the interior of the muffle chamber by welding 27. A graphite conveyer roller 28 is rotatably mounted on the shaft 25. The conveyer roller is provided with a pocket 29 at each end in which is located a substantially barrel-shaped graphite bearing 30, the bearings 30 being rockable in the pockets to compensate for misalignment due to warpage or growth of the shaft. Each of the bearings 30 has a central bore 30a for receiving the shaft 25. In this embodiment the roller 28 and the bearings 30 rotate relative to the shaft 25 which remains stationary. The graphite roller 28 is provided with a hole 31 located centrally of the roller and connecting the two recesses 29. The shaft 25 extends through this hole. The roller 28 is provided at its mid-portion with a collar 32 which forms a bearing on the shaft 25.

Referring to the embodiment shown in Figure 6, a plurality of graphite conveyer rollers 35 extend transversely of the heating chamber 5. Each of the conveyer rollers has a deep pocket 36 formed in each of its ends, these pockets being connected by a smaller diameter bore 37. A plurality of barrel-shaped graphite bearings 38 are received in each of the pockets 36, the bearings having slight spaces between them to enable them to rock slightly. An alloy steel shaft 39 extends through the bores 40 of the graphite bearings and through the bore 37 of the conveyer roller. The ends of the shaft are supported in supports 41 secured to the inside of the heating chamber 5.

The arrangement shown in Figure 6 is similar to that shown in Figure 4 except that a plurality of graphite bearings are employed in each of the pockets 36 instead of a single bearing. In the arrangement shown in Figure 6 the shaft is supported throughout practically its entire length by the bearings, although each bearing is free to move independently of the other and is self-aligning. With this construction it is much more difficult for the shaft to get out of alignment, but if it does get slightly out of alignment the bearings can still to a certain extent compensate for such misalignment.

In each of the embodiments shown for purposes of illustration, the conveyer rollers such as the rollers 9, 28 and 35 are made of graphite These rollers could, however, be made of alloy steel or other heat-resisting material, but in any case, in accordance with my invention the bearings such as the bearings 19, 30 or 38 are made of graphite. Graphite bearings have been found to satisfactorily withstand the high temperatures when protected by extremely dry dissociated ammonia atmospheres.

The invention is not limited to the preferred embodiment but may be otherwise embodied within the scope of the following claims.

I claim:

1. A conveyer furnace comprising a heating chamber having conveyer rollers and bearings located entirely within the chamber for rotatably supporting said conveyer rollers, said bearings being made of graphite, and means connected to a source of dissociated ammonia for introducing dissociated ammonia into said chamber for protecting the graphite bearings.

2. A conveyer furnace comprising a heating chamber, conveying rollers in said chamber, an alloy steel pin fixed in each end of the rollers and extending therefrom, graphite bearings inside the chamber for rotatably supporting said pins, and means connected to a source of dissociated ammonia for introducing dissociated ammonia into said chamber for protecting the graphite bearings.

3. A conveyer furnace comprising a heating chamber, conveying rollers in said chamber, an alloy steel pin fixed in each end of the rollers and extending therefrom, graphite bearings inside the chamber for rotatably supporting said pins, supports for said bearings, said bearings being rockable on their supports, and means connected to a source of dissociated ammonia for introducing dissociated ammonia into said chamber for protecting the graphite bearings.

4. A conveyer furnace comprising a heating chamber, conveying rollers in said chamber, an alloy steel pin fixed in each end of the rollers and extending therefrom, substantially barrel-shaped graphite bearings inside the chamber for rotatably supporting said pins, supports for said bearings, said bearings being rockable on their supports, and means connected to a source of dissociated ammonia for introducing dissociated ammonia into said chamber for protecting the graphite bearings.

5. A conveyor furnace comprising a heating chamber, graphite conveying rollers in said chamber, an alloy steel pin fixed in each end of the rollers and extending therefrom, graphite bearings inside the chamber for rotatably supporting said pins, and means connected to a source of dissociated ammonia for introducing dissociated ammonia into said chamber for protecting the graphite bearings and conveying rollers.

6. A conveying furnace comprising a heating chamber, shafts extending across the chamber and mounted in supports located in the chamber, a conveying roller rotatably mounted on each shaft, graphite bearings interposed between the shaft and conveying roller, and means connected to a source of dissociated ammonia for introducing dissociated ammonia into said chamber for protecting the graphite bearings.

7. A conveying furnace comprising a heating chamber, shafts extending across the chamber and mounted in supports located in the chamber, a graphite conveying roller rotatably mounted on each shaft, graphite bearings interposed between the shaft and conveying roller, and means connected to a source of dissociated ammonia for introducing dissociated ammonia into said chamber for protecting the graphite bearings and conveying rollers.

8. A conveying furnace comprising a heating chamber, shafts extending across the chamber and mounted in supports located in the chamber, a conveying roller rotatably mounted on each shaft, the conveying roller having a pocket formed in each end and at least one graphite bearing in each pocket for rotatable engagement with the shaft, and means connected to a source of dissociated ammonia for introducing dissociated ammonia into said chamber for protecting the graphite bearings.

9. A conveying furnace comprising a heating chamber, shafts extending across the chamber and mounted in supports located in the chamber, a conveying roller rotatably mounted on each shaft, the conveying roller having a pocket formed in each end, at least one graphite bearing in each pocket for rotatable engagement with the

shaft, said graphite bearings being rockable in their pockets, and means connected to a source of dissociated ammonia for introducing dissociated ammonia into said chamber for protecting the graphite bearings.

10. A conveying furnace comprising a heating chamber, shafts extending across the chamber and mounted in supports located in the chamber, a graphite conveying roller rotatably mounted on each shaft, the conveying roller having a pocket formed in each end, at least one graphite bearing in each pocket for rotatable engagement with the shaft, said graphite bearings being rockable in their pockets, and means connected to a source of dissociated ammonia for introducing dissociated ammonia into said chamber for protecting the graphite bearings and conveying rollers.

11. A conveying furnace comprising a heating chamber, shafts extending across the chamber and mounted in supports located in the chamber, a conveying roller rotatably mounted on each shaft, the conveying roller having a pocket formed in each end, at least one graphite bearing in each pocket for rotatable engagement with the shaft, said graphite bearings being substantially barrel-shaped and rockable in their pockets, and means connected to a source of dissociated ammonia for introducing dissociated ammonia into said chamber for protecting the graphite bearings.

12. A conveying furnace comprising a heating chamber, shafts extending across the chamber and mounted in supports located in the chamber, a graphite conveying roller rotatably mounted on each shaft, the conveying roller having a pocket formed in each end, at least one graphite bearing in each pocket for rotatable engagement with the shaft, said graphite bearings being substantially barrel-shaped and rockable in their pockets, and means connected to a source of dissociated ammonia for introducing dissociated ammonia into said chamber for protecting the graphite bearings and conveying rollers.

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