Nov. 19, 1935. H. W. McQUAID 2,021,666

HEAT TREATING APPARATUS

Filed Oct. 5, 1933 2 Sheets-Sheet 1

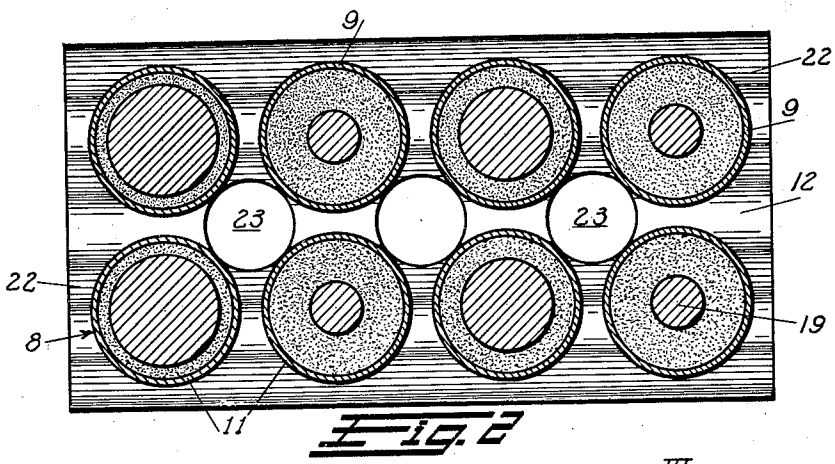


Fig. 2

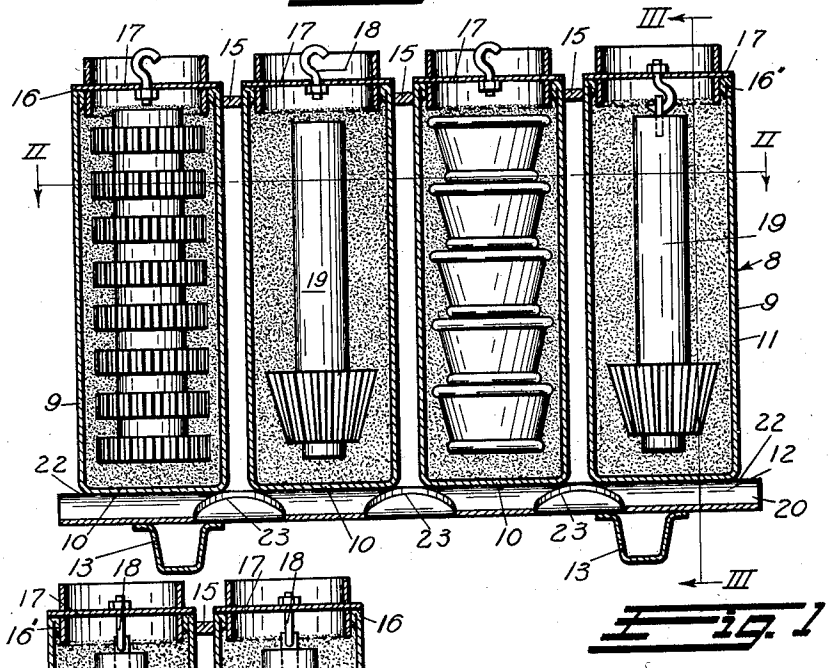


Fig. 1

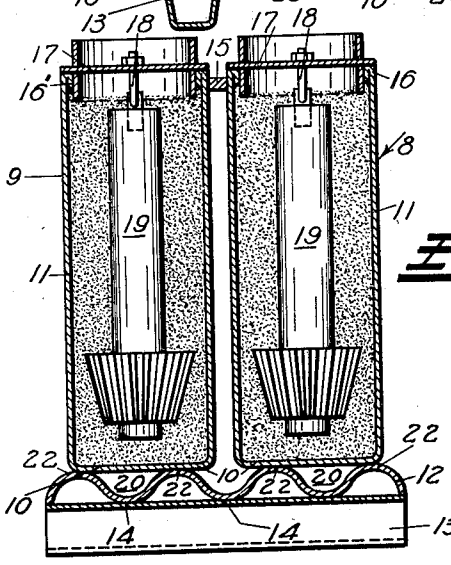


Fig. 3

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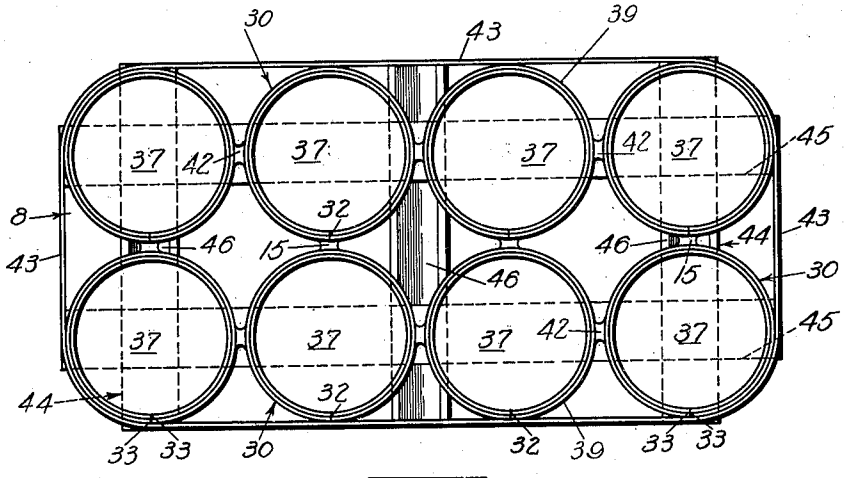


Fig. 5

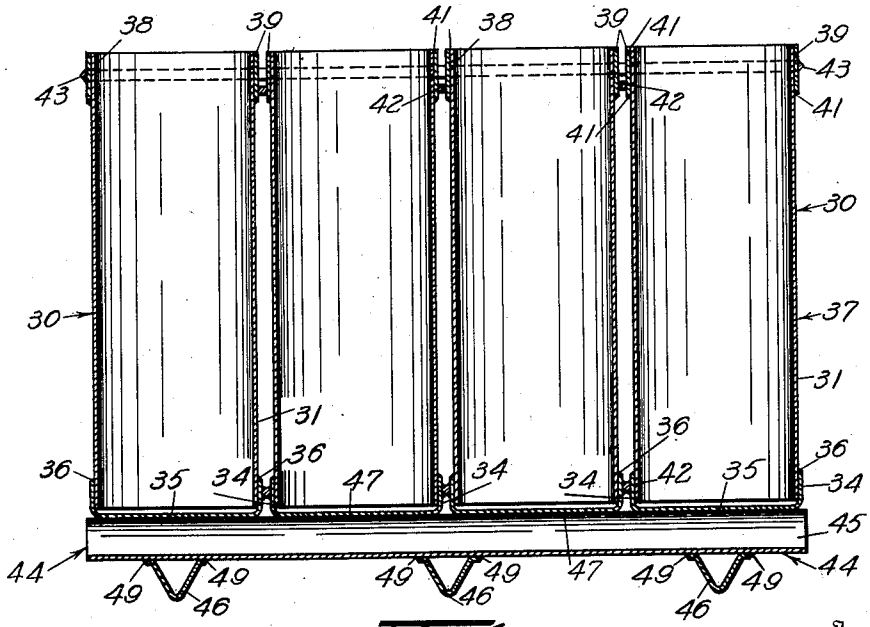


Fig. 4

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HEAT TREATING APPARATUS

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Application October 5, 1933, Serial No. 692,329

14 Claims. (Cl. 263—49)

The present invention relates to methods and apparatus for heat treatment of metallic articles wherein the articles are subjected to high temperatures.

More specifically, the present invention relates to the provision of improved case carburizing methods and boxes, and to methods of manufacturing the same.

It has heretofore been the general practice to make case carburizing boxes of relatively heavy metal and of such relative size and design that the handling of the articles being treated is extremely laborious and in many cases causes the articles to undergo undesirable distortion and to experience uneven heat application.

Another serious difficulty experienced in the use of carburizing boxes as hereinbefore manufactured is the inability to readily handle the same because of the unnecessary weight of said boxes which is due to the heavy metal used therein and to the fact that a substantial excess of carburizing compound is used to insure proper treatment of the articles.

It will also be apparent that due to the large amount of carburizing compound employed in the boxes now in use that the cost of treatment is much higher. The reason for the increased cost due to the large amount of compound is twofold, as will now be pointed out.

It is well known that the carburizing material utilized in case carburizing treatment is a fairly good heat insulator. If, as is the case in prior carburizing boxes, an excess of compound is required, the length of time needed to bring the boxes to an even temperature is materially increased. This necessitates the use of considerably more fuel and greatly reduces the output of the furnaces.

As a specific example of the comparative time required in treatment utilizing the boxes now in use and that proposed by the present invention, it has been found that to properly treat gears, e. g., rear axle drive pinions, in order to obtain case hardening to a depth of 0.055 inch, the standard boxes required ten to twelve hours and the articles even then were subject to distortion and uneven heat application. To obtain case carburizing of the same degree with the boxes of the present invention requires only five hours of treatment and the finished product is characterized by a more uniform heat application and the work of straightening is greatly reduced and in many instances eliminated.

This highly desirable decrease in time is due to the fact that the boxes of the present invention are made of a much thinner metal and are shaped to conform somewhat closely to the shape of the treated articles so that the compound required can be supplied in an amount only sufficient for proper treatment of the articles.

Another serious fault in the carburizing boxes now used is the inability to readily and easily quench the articles being treated directly from the carburizing box. This is due to the bulky size and heavy weight of the boxes commonly employed and also to the manner in which the articles are placed in the boxes. This invention overcomes this difficulty and thereby allows a finished product of improved quality.

It is therefore a primary object of this invention to improve carburizing methods and apparatus that ensure even heat treatment and minimum distortion of the articles, greatly decrease the cost of treating, and allow substantial saving of the time necessary for carrying out the process

A still further object of this invention is the provision of case carburizing apparatus comprising a plurality of individual containers mounted in upright spaced relation thereby providing maximum circulation of the heated gases around the individual carburizing containers.

Another object of this invention resides in the provision of a thin walled carburizing box adapted to uniformly transmit heat to the article being treated and to provide adequate support to the individual articles thereby reducing distortion of the treated articles.

Still another object of the present invention resides in the provision of a battery of carburizing boxes positioned on a supporting stand in such a manner that the boxes are maintained in spaced relation during the treating process thereby preventing overheating and burning out of the boxes at points where they might otherwise contact.

Another object of the present invention resides in the provision of a corrugated perforated supporting floor for the battery of boxes, providing free circulation of the heated gases to the bottom and completely around the individual boxes.

A further object of this invention resides in the provision of thin walled heat treatment boxes that are designed at their open ends to minimize gas leakage and to resist corrosion due to any leakage of the compound gases.

Another object of this invention resides in providing carburizing boxes with thin sheet metal reversible covers that are readily removable for the purpose of quenching the articles being treated directly from the carburizing boxes.

A further object of this invention resides in the provision of a method and apparatus for heat treating an article in an upright position thereby reducing or eliminating warpage or other undesirable distortion of the treated article.

A further object of this invention is to provide a metal cover with means for suspending the article to be treated thereby reducing distortion of the article and augmenting the seal between the top of the box and the cover because of the weight of the suspended article.

A further object of this invention resides in the provision of a case carburizing box made entirely of sheet metal thereby reducing the cost of manufacture and replacement.

Further objects will appear when the specification is studied in conjunction with the appended claims and attached drawings. In the drawings:—

Figure 1 is a longitudinal sectional view through an illustrative embodiment of the present invention.

Figure 2 is a horizontal sectional view taken on line II—II of Figure 1.

Figure 3 is a sectional view taken on line III—III of Figure 1.

Figure 4 is a sectional view similar to Figure 1 through a modified form of the invention.

Figure 5 is a plan view of the modification disclosed in Figure 4.

With continued reference to the drawings wherein like reference characters are applied to the same parts throughout the several figures, numeral 8 indicates generally the battery of individual carburizing boxes 9 of the present invention.

The boxes 9 comprising circular bottoms 10 and side walls 11 are preferably supported on a corrugated heat resistant sheet metal base 12, the purpose of which will be hereinafter pointed out. Base 12 is in turn supported upon preformed sheet metal legs 13, of any suitable character, which are preferably welded to base 12 at the points of contact 14. Although it is preferable to weld legs 13 to base 12 as pointed out above, any other suitable connection may be utilized.

The individual boxes 9 are maintained in definite spaced relation by means of spacers 15 which are welded to the individual boxes 9 adjacent the upper open end 16 which is provided with an annular thickened lip 16' for a purpose to be presently described. These spacers 15 are of sufficient strength to allow handling of the several boxes as a unit. Such handling greatly decreases the time required to place the boxes in the furnace and remove the same therefrom. It will be noted, in connection with the handling of the boxes as just described, that the novel arrangement of the present invention combines advantages of the prior boxes of the types wherein a multiplicity of articles are treated in one large extremely bulky and heavy box and a box of the type wherein a single article is treated in an individual box.

More specifically, the advantages to be obtained from the arrangement of boxes disclosed in the present invention lies in the ability of the workmen to fill the individual boxes with the amount of compound needed for the desired treatment of the articles contained therein so that the boxes will not be unnecessarily increased in size and therefore in weight, due to the use of a greater amount of compound than is needed for actual treatment of the articles. A further advantage of the present invention that is due to the welded spacers is the unitary assembly of the several boxes that allows the handling of the battery of boxes at a single operation rather than handling the individual boxes separately as has heretofore been proposed. As previously pointed out, the upper open end of each box 9 is provided with a thickened lip 16'. This lip 16' is provided in order that a substantial surface will be provided for allowing a good seal to be obtained when box 9 is closed by means of reversible cover 17. Although a reversible cover is preferred it will be understood, that if desired, the sealing of the box 9 may be obtained with a cover that is not designed for reversal. The lip 16' furthermore provides a reenforcement of the upper end of each box at the point where the hot compounded gases are prone to accumulate by providing a surface of double thickness. Cover 17 preferably is provided with a centrally disposed suspending hook 18. Hook 18 is adapted to allow articles 19 of a character that are longer in one direction than in the other to be suspended axially in a vertical position thereby greatly reducing the tendency of such articles to warp or undergo harmful distortions due to improper support of the article during the heating of the boxes. Although such hooks are a decided aid in accomplishing this feature, it is to be understood that the hooks are not required. By supporting an article 19 in an upright position within box 9 as shown in Figure 1, the straightening operation has been eliminated. This is due to the fact that in the individual boxes of the present invention the side walls 11 in conjunction with the carburizing compound contained therein provide sufficient support to prevent the elongated articles from warping and undergoing distortion. As a specific example of the improved results obtained by use of the present invention, the runout due to heat treatment has been reduced to 0.005 maximum without the use of the suspending hooks 18. It will be apparent that with such a negligible runout that the need of a straightening operation is eliminated.

Articles of a small character may be treated by stacking one on the other as seen in Figure 1. The battery of boxes 8 is associated with the supporting base 12 by welding or other suitable means sufficient to hold the same in position during handling of the assembly.

The articles being treated will be subjected to a quenching operation when it is desirable for the metal to be so treated. Such treatment may be accomplished in the following manner due to the construction of the boxes 9. The battery 8 is removed from the oven when the articles to be treated have been heated for the desired length of time and the cover 17 is removed from one box, the piece lifted therefrom and quenched in the quenching medium while still maintained in an upright position. After the first piece has been quenched, the process is repeated with the second piece and so on until all pieces of the battery are quenched. To prevent warpage, careful handling of the heated parts is very essential, for if they are struck even the slightest blow, considerable damage may be done. A further advantage of this method is that while the first piece is being quenched the other pieces are not losing any heat. In the old methods, all of the pieces were dumped out onto the floor and then quenched one at a time. By the time the last few pieces of the box were reached, they were quite cold in comparison with the temperature at

which the first piece was quenched. Further, dumping them onto the floor and picking them up from the horizontal position caused considerable warpage.

As previously pointed out, boxes 9 are supported on a corrugated base 12. This use of a corrugated base is preferred in order that better circulation of the heat of the furnace may be obtained. It will be seen from an inspection of the drawings that the heated furnace gases will be circulated in contact with the bottom 10 of each individual container due to the flues 20 which are formed by the corrugated base and the bottom of the boxes. The corrugated base furthermore prevents localized heating of the bottoms 10 since free circulation of the heat is allowed through flues 20. The only actual contact between the bottoms 10 and base 12 is along the convex surface of the corrugations 22. Since this contact is substantially a line contact and since there is free circulation of heated furnace gases on both sides of this line contact, it will be readily appreciated that the tendency for localized heating of the bottom of the containers is negligible. This feature of the present invention is one of material importance in providing a thin sheet metal carburizing container that will have a long life and allow decreased replacement costs. The above flue construction furthermore ensures equal application of heat to the compound contained in the box in a manner that will be clear to one skilled in the art.

In order to provide further circulation around the individual containers, corrugated base 12 is provided with suitable apertures 23 which lie between the containers 9 as is clearly illustrated in Figure 2 of the drawings. Apertures 23 allow the heated furnace gases to rise between the containers 9 and circulate freely around said containers. Apertures 23 furthermore serve to prevent the treating compound used in the containers from spilling on the base 12 and forming an insulating coating around the base of the containers. Although it is preferable that apertures 23 be provided in base 12, it is not necessary and it will be understood that satisfactory results may be obtained without providing base 12 with the apertures described above.

Modification

In Figures 4 and 5 of the present invention there is disclosed a modified construction of the heat treating boxes of the present invention which retains all of the desirable features of the previous embodiment while permitting even greater economies in construction.

In this embodiment the battery 8 is made up of a plurality of individual boxes 30, each comprising a body portion 31 made from a flat sheet metal blank which is suitably shaped into cylindrical form and welded at 32 along the line of contact made by the abutment of its edges 33. Body 31 is positioned within the upstanding walls 34 of cup-shaped bottom 35 and is suitably welded at 36 in order to seal the juncture of bottom 35 and body portion 31 as well as to retain the two sections in assembled relation to form a container 37. In order to strengthen the cylindrical body section 31 adjacent its open end 38 and provide a sealing surface for cooperation with the removable covers 17 (Figure 1) a circular band 39 is forced over body portion 31 and welded thereto at 41. If desired the containers 37 may be provided with integral lips, similar to those shown in connection with the previous embodiment of the invention, but preferably turned outwardly, to form the bands 39.

Containers 37 are retained in spaced relation by spacers 42, similar to the spacers 15 previously described, adjacent their upper open ends. To increase the rigidity of the assembly, additional spacers 42 are positioned adjacent the bottoms 35 of the several containers. An encircling metal band 43 is welded adjacent the top of the assembly and is adapted to snugly encompass the entire group of boxes to further increase the rigidity and to prevent them,—especially the corner boxes,—from being distorted in use.

The battery of boxes above described is adapted to be supported upon a modified form of base indicated generally by numeral 44, although the base described in connection with Figures 1 to 3 may be used. Base 44 is built up of V-shaped strips 45 and 46. One strip 45 passes longitudinally beneath each row of boxes 37 and is welded along lines 47 made by contact of the upstanding sides of the strip 45 with the bottoms 35. Strips 46 in the present instance are transversely disposed beneath strips 45 and are welded to strips 45 along the contacting lines 49. A strong and rigid supporting base thus is provided which will permit free circulation of the heated furnace gases longitudinally, transversely and upwardly of the battery of containers 37, without heat localization and with uniform distribution relative to the individual units.

From the preceding description, it will be readily appreciated that the preferred modified assembly is very similar to the embodiment previously described, and that a further detailed explanation is unnecessary.

The disclosed heat treating boxes are simple in design and cheap to manufacture; they produce articles of improved quality; and they materially decrease the time necessary for proper treatment of articles.

Although the present invention is described in detail in connection with case carburizing methods, it is to be understood that the heat treating boxes herein disclosed are applicable to any method wherein it is desired to apply high temperatures to metallic articles and such other methods are intended to be embraced by the appended claims.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by United States Letters Patent is:—

1. In combination, a heat treating box for carburizing metallic articles, means for supporting said box in a furnace, means for supporting articles to be treated within said box in contact with carburizing compound, means to exclude an oxidizing atmosphere from said box, means for circulating the heated furnace gases entirely around said box, said last named means comprising a sheet metal base provided with apertures and adapted to allow cross circulation of heated gases.

2. In combination, a plurality of heat treating containers comprising thin walled metallic con-

tainers adapted to roughly conform in shape to the articles being treated and of a design to permit of the handling thereof with articles therein, a corrugated supporting base for said containers providing flues for circulating heated furnace gases into intimate contact with the bottoms of said containers, said flues being defined by the corrugations of said base and the bottoms of the containers.

3. Apparatus for heat treatment of articles comprising a plurality of individual thin walled sheet metal containers constructed to support articles to be heat treated therein and to be handled with the articles supported therein, a supporting base for said containers, and means to maintain said containers in definite spaced relation and unitary assemblage.

4. In combination, a thin walled heat treating container having an open end, a reversible cover for closing and sealing said open end and means permitting ready removal of said cover irrespective of which face is positioned within said container.

5. The combination defined in claim 4 wherein the reversible cover is provided with means for suspending within the container, the article to be treated.

6. In combination in a carburizing apparatus, a battery of heat treating containers arranged in spaced relation, supporting means for said battery, said supporting means affording circulation of gases past the bottom of each container and upwardly through the spaces provided between the individual containers.

7. Heat treating apparatus comprising a row of individual sheet metal containers, means for maintaining said containers in definite spaced relation, and supporting means for said containers comprising a series of longitudinally and laterally disposed supporting strips.

8. In combination, a battery of light, small containers rigidly interconnected in spaced relation as a unit, supporting means for said battery comprising longitudinally disposed V-shaped supporting strips and laterally disposed V-shaped strips welded to said longitudinal strips, said longitudinal strips providing means for circulating the heated furnace gases longitudinally across the bottom of said boxes and said cross strips insuring the application of the heated gases upwardly around said individual boxes.

9. Apparatus for carburizing of articles comprising a plurality of individual, thin walled, sheet metal, sectional containers comprising a cup shaped bottom adapted to receive a cylindrical body portion, and means for supporting said containers in definite spaced relation as a unitary rigid assembly.

10. In combination, a plurality of individual sheet metal containers, means for confining said containers in definite spaced relation, a supporting base for said containers providing free circulation of the heated furnace gas around said containers, and a relatively long metal band encircling the plurality of boxes adjacent their upper ends whereby distortion of said boxes due to the high furnace temperatures is prevented.

11. The combination defined in claim 10 wherein each individual box is provided with a reenforcing band around its upper open end.

12. In combination, a thin walled heat treating container having an open end, a reversible cover for closing and sealing said open end, and means on said cover for suspending an article to be treated within said container.

13. A heat treating apparatus comprising a plurality of individual containers, supporting means for said containers, means to maintain the bases of said containers in spaced relation, and means to maintain the opposite ends of said containers in spaced relation.

14. Apparatus for heat treatment of articles comprising a plurality of individual thin walled sheet metal containers constructed to support articles to be heat treated therein and shaped to generally conform to the shape of the contained articles when surrounded by a thin, substantially uniform layer of heat treating compound, a supporting base for said containers, and means to maintain said containers in definite spaced relation.

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