Sept. 13, 1966 W. E. HEYER ET AL 3,272,489

HEAT TREATING FURNACE WITH REMOVABLE HELICAL INSERT

Filed March 13, 1964 2 Sheets-Sheet 1

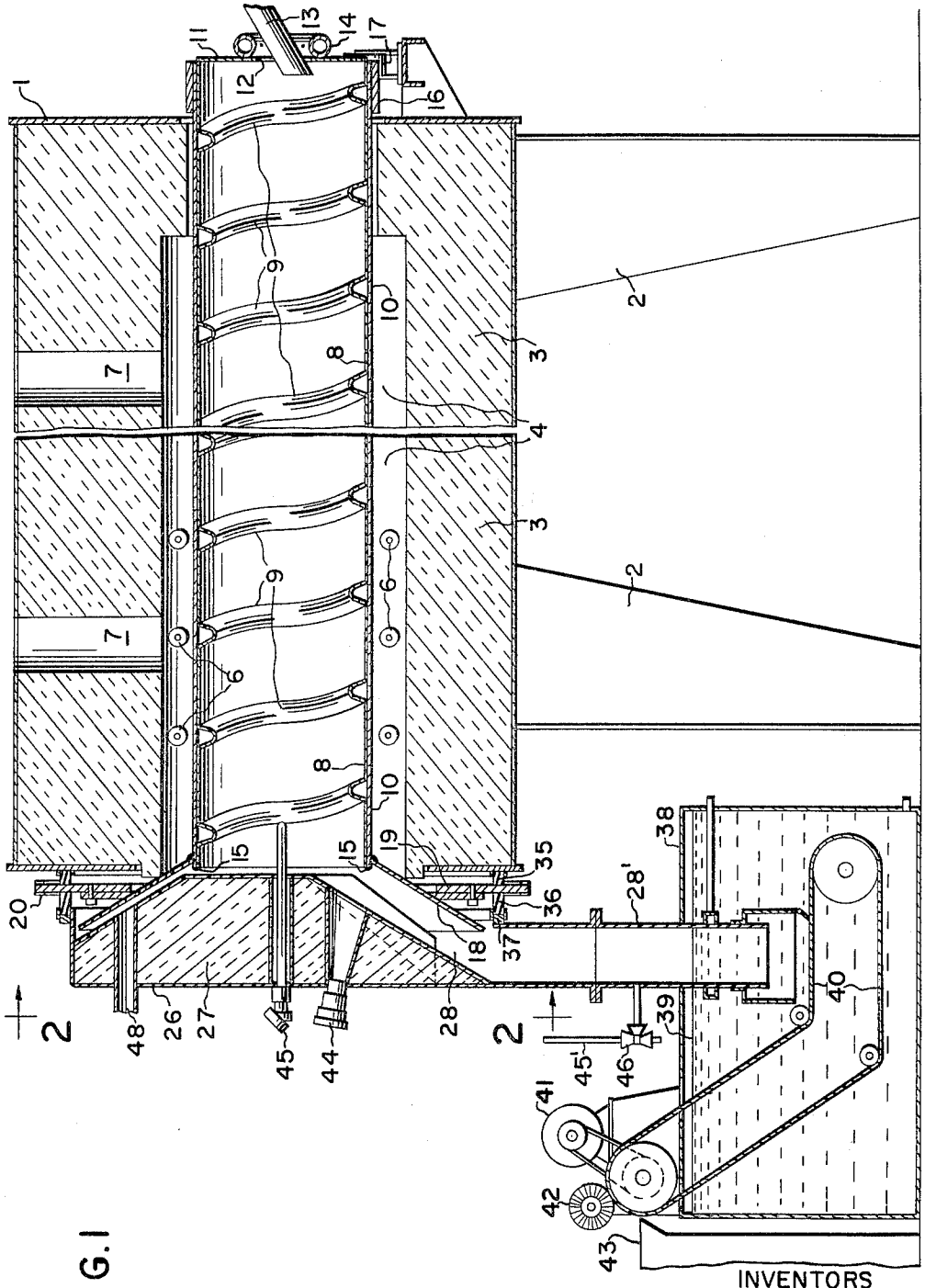


FIG. 1

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FIG. 2

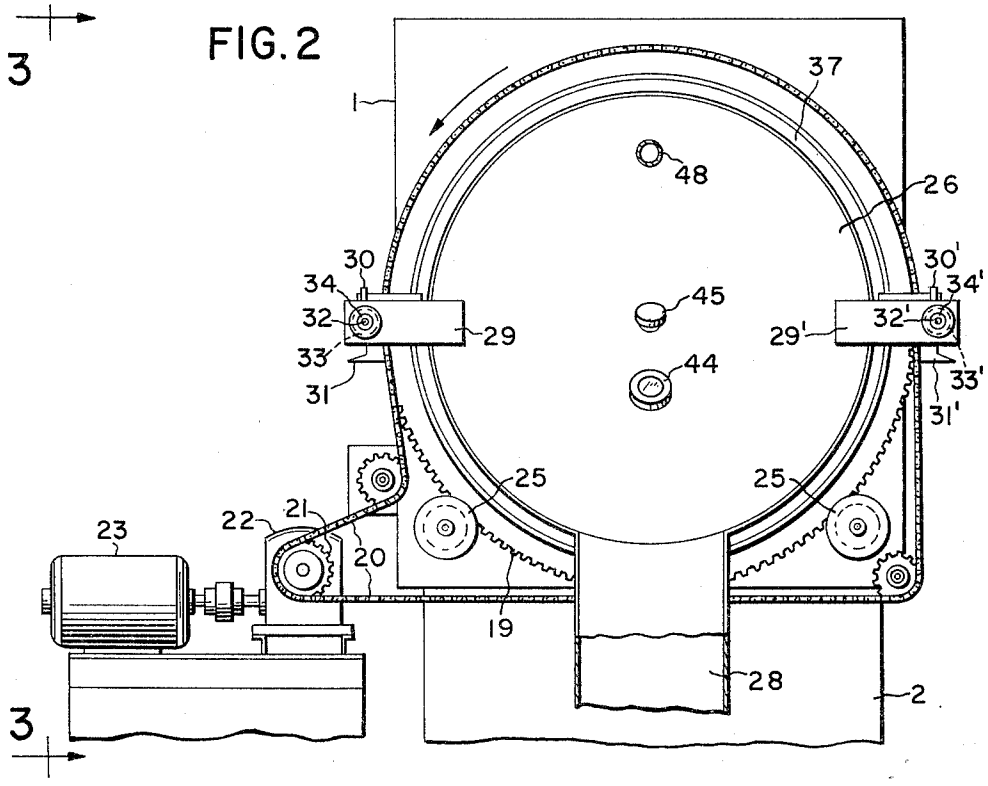
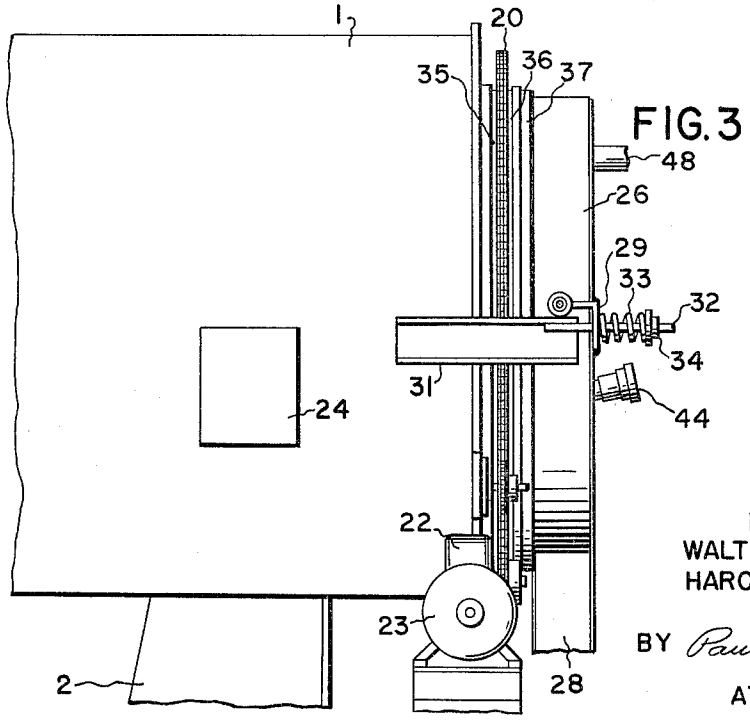


FIG. 3



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HEAT TREATING FURNACE WITH REMOVABLE HELICAL INSERT

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6 Claims. (Cl. 266—4)

This invention relates generally to heat treating furnaces, and the invention has reference, more particularly, to a novel rotary retort heat treating furnace especially adapted for controlled atmosphere, and continuous processing of parts which are difficult to treat otherwise and which usually require long retention times at desired temperatures as in cases of carburizing, carbonitriding and carbon restoration, hardening and drawing.

The carburizing, hardening and drawing of small and odd shaped parts such as nuts, bolts, screws, rivets, pins, balls, springs, clips, chainsaw teeth and parts is difficult. Prior art furnaces generally employ heavy walled rough cast retorts with internal spirals for conveying the work through the rotating retorts. The irregular shaped small pieces tend to catch and cling to these rough castings resulting in delays in passing through the furnace, so that ununiform case hardening, overheating or uneven heat treatment, results. Also, the discharge chutes on these prior art furnaces generally permit the ingress of outside air so that the desired uniformity of furnace atmosphere cannot be maintained within the retort. This is detrimental, not only to the parts being treated as in the case where gas firing is employed, but, in the case of an electrically heated furnace, the electrical elements being exposed to such mixed atmosphere quickly deteriorate and fail. Also, retort parts such as the spiral have short lives under such operating conditions.

The principal object of the present invention is to provide a novel heat treating furnace that eliminates the above deficiences, the said furnace having an extremely smooth spiral with no crevices or sharp corners upon which parts can engage, the spiral being formed from pressed thin metal serving also as a retort lining that is readily replaceable in use.

Another object of the present invention is to provide a novel heat treating furnace of the above character having a conically flared discharge end co-operating with a conical discharge plug having a sealed discharge opening preventing the ingress of outside air and hence preventing the contamination of the furnace atmosphere as well as preventing the escape of retort atmosphere, whereby parts are processed through the retort with the atmosphere completely controlled and utilizing either electric or open gas firing in the furnace chamber.

Other features and advantages will become apparent as the description proceeds.

In the drawings:

FIG. 1 is a side view with parts broken away of the novel furnace of this invention;

FIG. 2 is a rear end view of the furnace; and

FIG. 3 is a side view of a portion of the structure of FIG. 2.

Referring now to the drawings, the reference numeral **1** designates the furnace casing which is preferably of sheet metal and is supported upon legs **2**. Insulation **3** is contained within casing **1** and has a hollow cylindrical interior to provide a furnace heating chamber **4** near the periphery of which are mounted suitable heater elements shown as open gas fired burners **6**, or open electric heating elements may be used, if desired. Exhaust flues **7** are provided where open gas firing is used.

Extending axially within the cylindrical heating chamber **4** is a rotatable furnace retort comprising an inner

lining **8** preferably of wrought temperature resistant alloy of relatively light gauge material such as #16 gauge and is readily replaceable as will further appear. The retort lining **8** is formed throughout its length with a very smooth inwardly pressed hollow helix **9** for advancing the work to be treated in use, the smooth surfaces and curved tops of this helix eliminating crevices and sharp corners, thus preventing the pieces to be treated from catching and clinging thereto in use. This is extremely important since parts which stay in the furnace longer than required are subject to greater depths of carburization, or grain growth, both or either of which cannot be tolerated. Where this condition exists, as in prior art furnaces, one hundred percent inspection of the heat treated parts is necessary, resulting in prohibitive costs. The forward end of lining **8** is covered by a cylindrical end plate **11** that is sealed to the end of lining **8** and is closed except for a central opening **12** into which a vibrating tray **13** is shown extending for advancing work into the furnace. In case balls are fed into the furnace, a barrel feeder may be used. A curtain burner **14** is shown in surrounding relation to the lower half of opening **12** to prevent the entrance of oxygen into the furnace. The opening **12** is preferably kept as small as possible and still accommodate the work so as to limit any chance of air infiltration. A slight amount of infiltration is not detrimental at this charge or forward end of the retort since the parts or work are not yet up to temperature and the flow pattern of the atmosphere within the retort is toward this forward or charge end and exiting out the charging opening **12**.

The lining **8** is contained within and supported by an outer retort cylindrical support casing **10** which is of relatively heavy gauge such as #10 gauge or approximately three-sixteenths inch thickness. Support casing **10** is also preferably of temperature resistant alloy. The lining **8**, while being inserted into casing **10**, slides freely within this support casing and has its rear peripheral edge portion preferably welded gas tight to its casing **10** at **15**. The forward end portion of retort support casing **10** has an annular bearing collar **16** fixed thereon, and this collar is supported by rollers **17** turnable in brackets carried by furnace casing **1** so that this end of the retort **8–10** is free to rotate.

The rear end of the retort support casing **10** is provided with a frustro-conical discharge apron **18** secured in gas tight relation to the casing **10** to enable easy discharge of the work from the retort **8–10**. Apron **18** carries a driven sprocket wheel **19** fixed thereon which is driven by a sprocket chain **20**, in turn driven by drive sprocket **21** rotated from gear reduction box **22**, that is in turn driven from a motor **23**. Motor **23** is preferably a variable speed, reversible direct current electric motor controlled from control panel **24** which may be the electrodyne type and will serve either to drive the spiral **9** forwardly so that the work moves towards the rear of the furnace at any of a plurality of speeds depending on the nature of the work and the depth of case desired, or, if desired, the motor can be oscillated, i.e., reversed periodically with slightly longer forward drive than rearward drive as where long soak periods are desired.

The rear end of retort casing **10** is rotatably supported by sprockets **25** turnable on stub shafts carried by casing **1** and engaging sprocket wheel **19**. The rear end of retort **8–10**, including the frusto-conical discharge apron **18**, is adapted to be covered by a removable substantially conical plug **26** having a sheet metal casing of heat resistant alloy and filled with insulation **27**. The plug **26** is formed with a discharge chute or passage **28** in its lower portion opposite apron **18** for enabling the ready discharge of heat treated work or parts from the retort in operation. The plug is supported upon furnace casing **1** by means of brackets **29**, **29'** secured to the rear surface of plug **26**

and carrying anti-friction rollers 30 that ride on angle irons 31, 31' secured to the sides of the casing 1. Threaded rods 32, 32' project rearwardly from angle irons 31, 31' and carry compression springs 33 that are held under compression by nuts and washers 34, thereby retaining the plug assembled upon the furnace casing with desired yieldable pressure.

Annular seals 35 and 36 are interposed respectively between sprocket wheel 19 and the rear end wall of casing 1 and between this sprocket wheel and a gland 37 carried by the plug 26. Seal 35, by sealing off the annular space between the rotating sprocket wheel 19 and the furnace casing 1, serves to prevent the escape of products of combustion from the retort heating chamber 4, while seal 36, by sealing off the space between the plug 26 and sprocket wheel 19, prevents the loss of retort atmosphere or entry of outside air to the retort 8–10. The seals 35 and 36, acting in conjunction with a liquid seal associated with discharge chute 28, as will further appear, enable the retort atmosphere to be completely controlled during the processing of parts in the furnace, thus producing reliable case hardening or other heat treatment of the parts and eliminating the necessity for expensive careful inspection of the finished product, whether the furnace is heated electrically or by open gas firing.

The chute 28 discharges into a chute extension 28' that projects downwardly into a quench tank 38 containing circulating cooled quenching oil or other liquid 39. A quench mesh belt conveyor 40 is contained wtihin tank 38 and, driven by motor 41, serves to convey the finished parts out of the quench tank to be dropped or brushed by brush 42 on to a waiting basket 43.

A thermocouple 45 is shown extending through the plug 26 in sealed relation thereto and projects into the retort 8–10 for accurately determining the temperature of the parts as they pass onto apron 18 and into duct 28 as the temperature of the work as it enters the quench is very critical and must be monitored. The gas atmosphere inlet 48 also is shown extending through the plug 26.

A peepsight 44 passing through plug 26 permits viewing of the work as it drops from the retort into the quench to assure proper operation. An atmosphere and oil fume exhaust 45' using venturi 46 prevents oil fumes from entering retort 8–10. Suitable piping (not shown) for conducting controlled atmosphere into the retort may also be connected to duct 28'.

In use, the parts or work to be treated and fed into the furnace retort 8–10 through tray 13 are carried through the retort by the stem of the helix 9. The depth of the loaded parts is not limited by the height of this helix and may exceed this height as the parts on top are carried along by the layer under them which is being driven. Tumbling action is achieved by the rotation of the retort 8–10 and in so doing all surfaces of the parts are exposed to the active atmosphere present in the retort. If greater tumbling action is required than can be achieved by a single direction of travel under conditions of long soak periods wherein the retort would be turning very slowly, the drive motor 23 may be oscillated by proper setting of control panel 24 with slightly longer forward drive times to increase the tumbling at the same actual total retort retention time. The parts leaving the retort via apron 18 and duct 28 in plug 26 drop through extension 28' into the oil bath in tank 38 and onto conveyor belt 40 upon which they are delivered to the basket 43. It will be noted that seals 35 and 36, acting in conjunction with the liquid seal in tank 38, serve to prevent the ingress of outside atmosphere into the retort 8–10 and chamber 4, whereby uniform heat treating and/or case hardening results.

Since many changes could be made in the above construction and many apparently widely different embodiments of this invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. A heat treating furnace comprising a furnace casing having a heating chamber therewithin, means for heating said chamber, and a substantially cylindrical retort extending within said heating chamber for rotation therein, said retort having a relatively thin inner lining provided with a hollow smooth rounded helix extending the length thereof, said retort having an outer support casing for supporting said inner lining in use, said inner lining being of slightly lesser diameter than its support casing whereby the former can be slipped into the latter for use and secured therein, said inner lining being readily removable from its support casing for replacement of said lining when worn.

2. A heat treating furnace as defined in claim 1 wherein said inner lining is welded around its rear periphery to said support casing, said casing having a flared apron at its rear discharge end for facilitating the easy discharge of work from said retort, the front end of said retort being provided with a central aperture for receiving the work to be treated by passage therethrough, said helix serving to move the work along the retort toward its rear discharge end while tumbling the same, the smooth contour of said helix preventing the work from catching thereon in use and being delayed in passage through the retort.

3. A heat treating furnace as defined in claim 2 wherein a rear substantially conical plug is removably carried by said casing and projects into the flared discharge end of said retort, means for sealing said flared apron to said furnace casing and said conical plug to said retort to prevent the escape of heating chamber gases and retort atmosphere, said conical plug having a discharge chute for work flowing from said retort flared discharge end, and means to seal said discharge chute.

4. A heat treating furnace as defined in claim 3 comprising a driven sprocket fixed upon said flared apron and extending through said sealing means in sealed relation, a chain for driving said sprocket, and reversible variable speed motor means for driving said chain for rotating said retort to feed the work therethrough.

5. A heat treating furnace comprising a casing, a cylindrical heating chamber within said casing, a cylindrical retort having a thin inner lining formed with a relatively wide well rounded axially extending smooth inner helix and an outer thick support casing for supporting said inner lining against deflection in use, said retort having a relatively small central opening at its forward end for receiving work to be advanced through said retort by said helix during the rotation thereof, said outer support casing having a flared rear end for facilitating the discharge of finished work from said retort, and a yieldable conical plug co-operating with said flared end in the discharge of the work.

6. A heat treating furnace as defined in claim 5 wherein said conical plug is provided with a discharge chute, a quench tank containing circulating cooling fluid into which said discharge chute extends in sealing relation, a conveyor belt within said quench tank for receiving and discharging the quenched work, and means for sealing the joint between said conical plug and said furnace casing for preventing the ingress or egress of gas into or out of said retort and said heating chamber.

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