Sept. 20, 1971 E. C. BAYER 3,606,285

BARREL-TYPE BATCH GAS CARBURIZING FURNACE

Filed Oct. 20, 1969 5 Sheets-Sheet 1

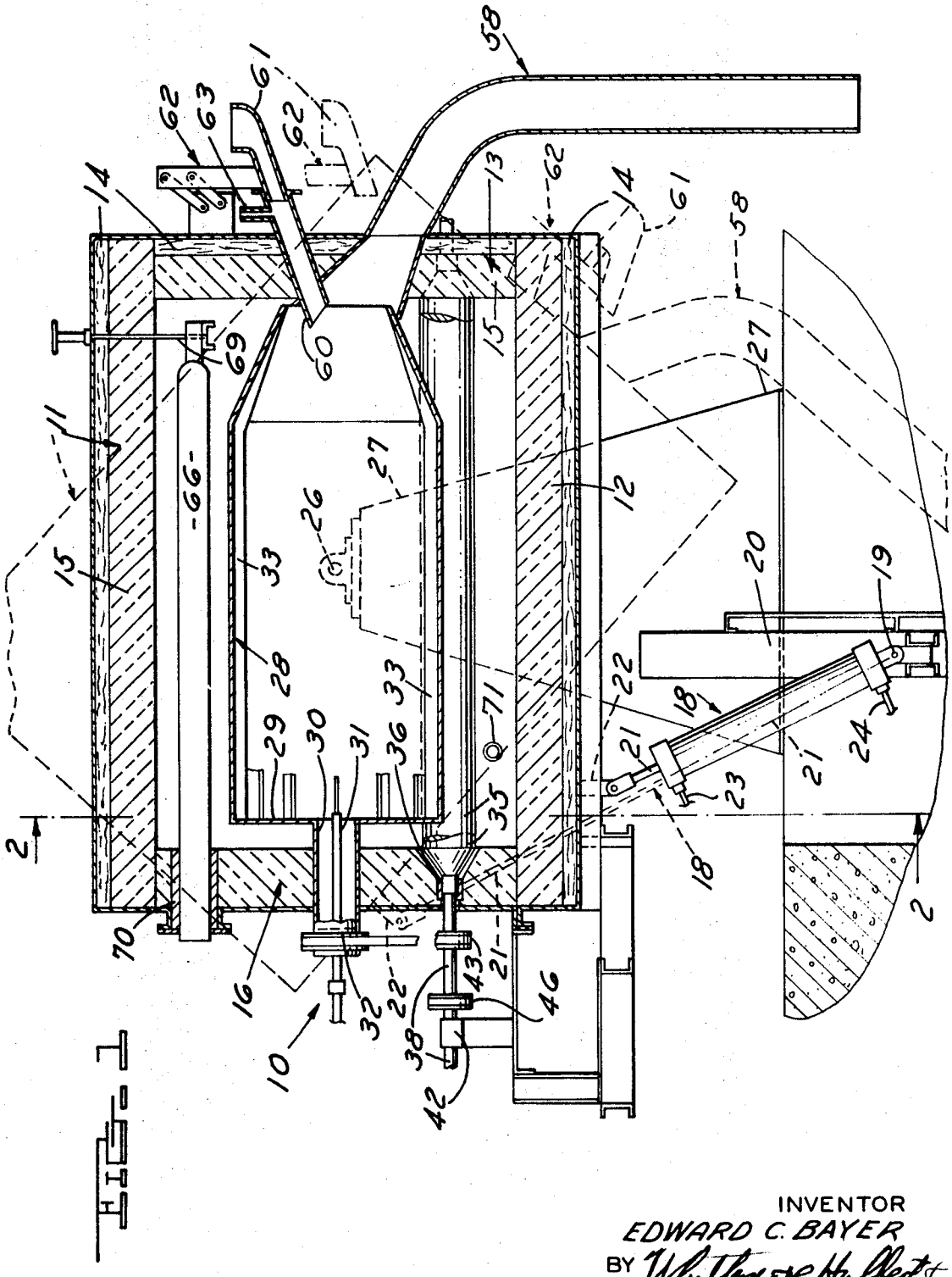


FIG. 1

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BARREL-TYPE BATCH GAS CARBURIZING FURNACE

Filed Oct. 20, 1969 5 Sheets-Sheet 2

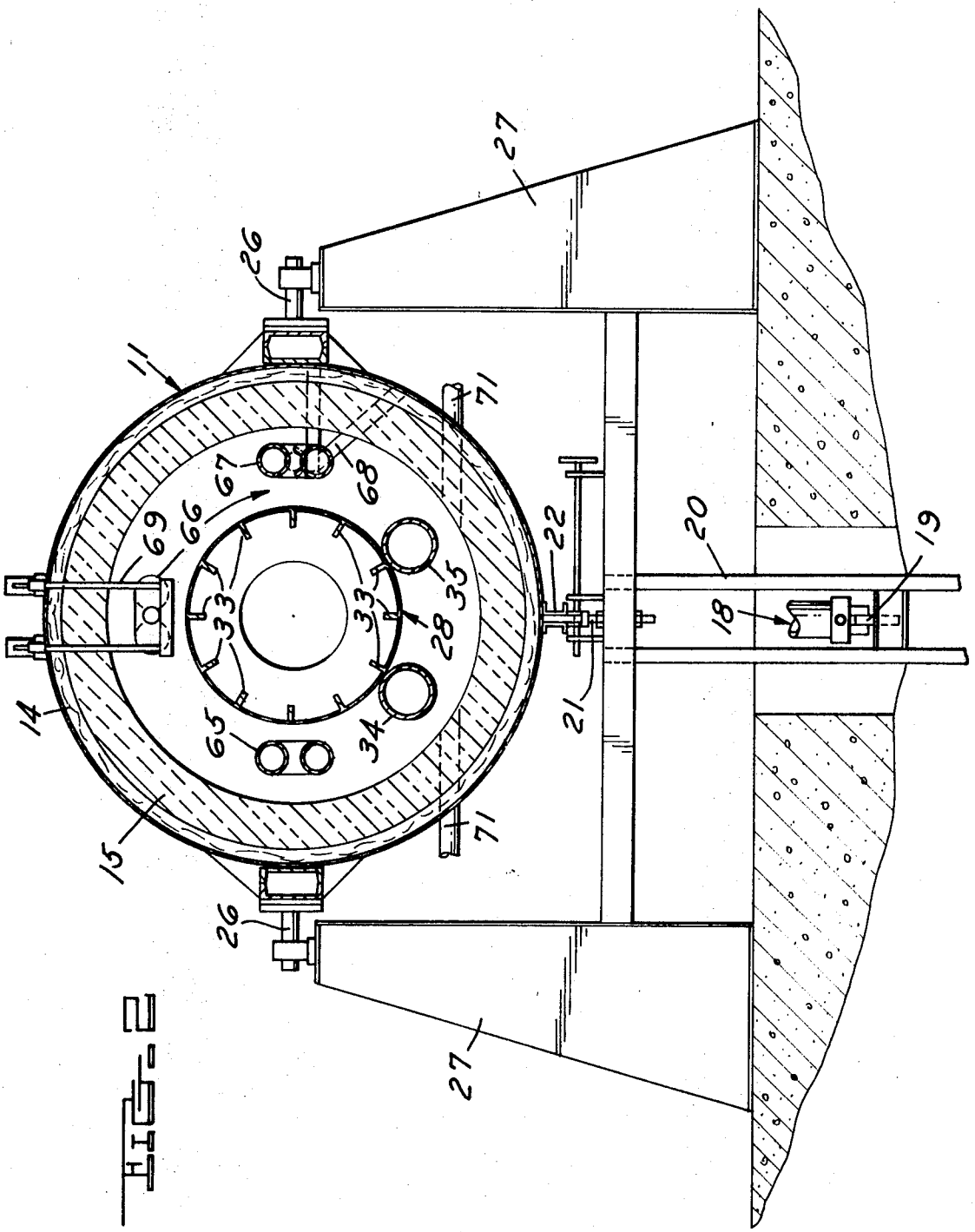


FIG. 2

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BARREL-TYPE BATCH GAS CARBURIZING FURNACE

Filed Oct. 20, 1969 5 Sheets-Sheet 3

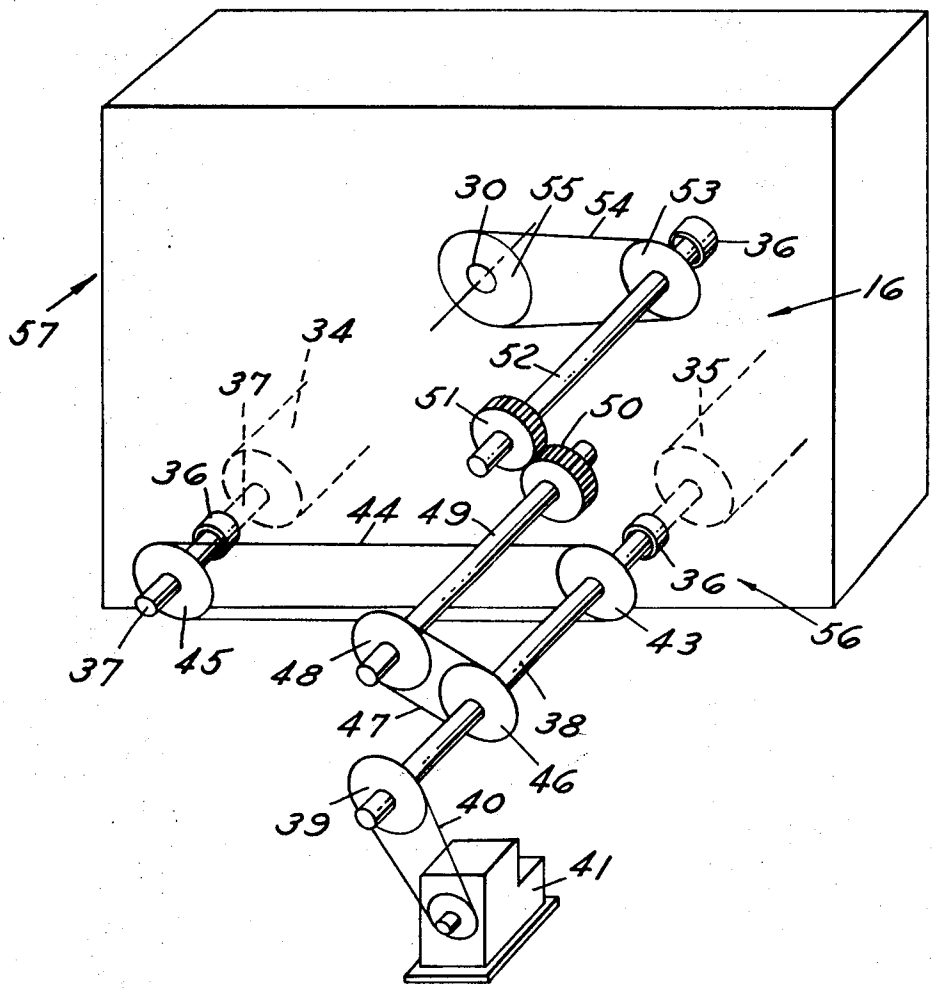


FIG. 3

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BARREL-TYPE BATCH GAS CARBURIZING FURNACE

Filed Oct. 20, 1969 5 Sheets-Sheet 4

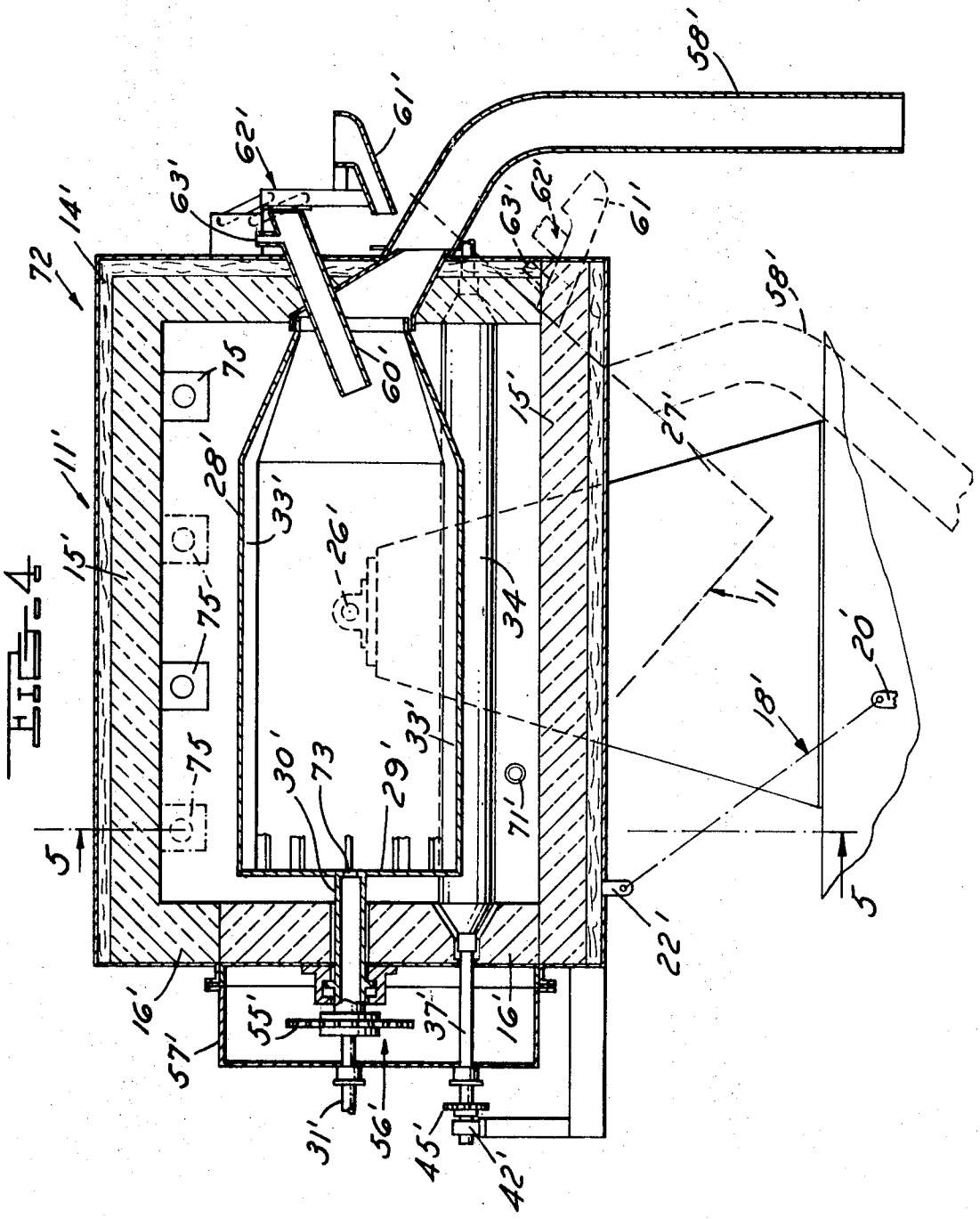


FIG. 4

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BARREL-TYPE BATCH GAS CARBURIZING FURNACE

Filed Oct. 20, 1969 5 Sheets-Sheet 5

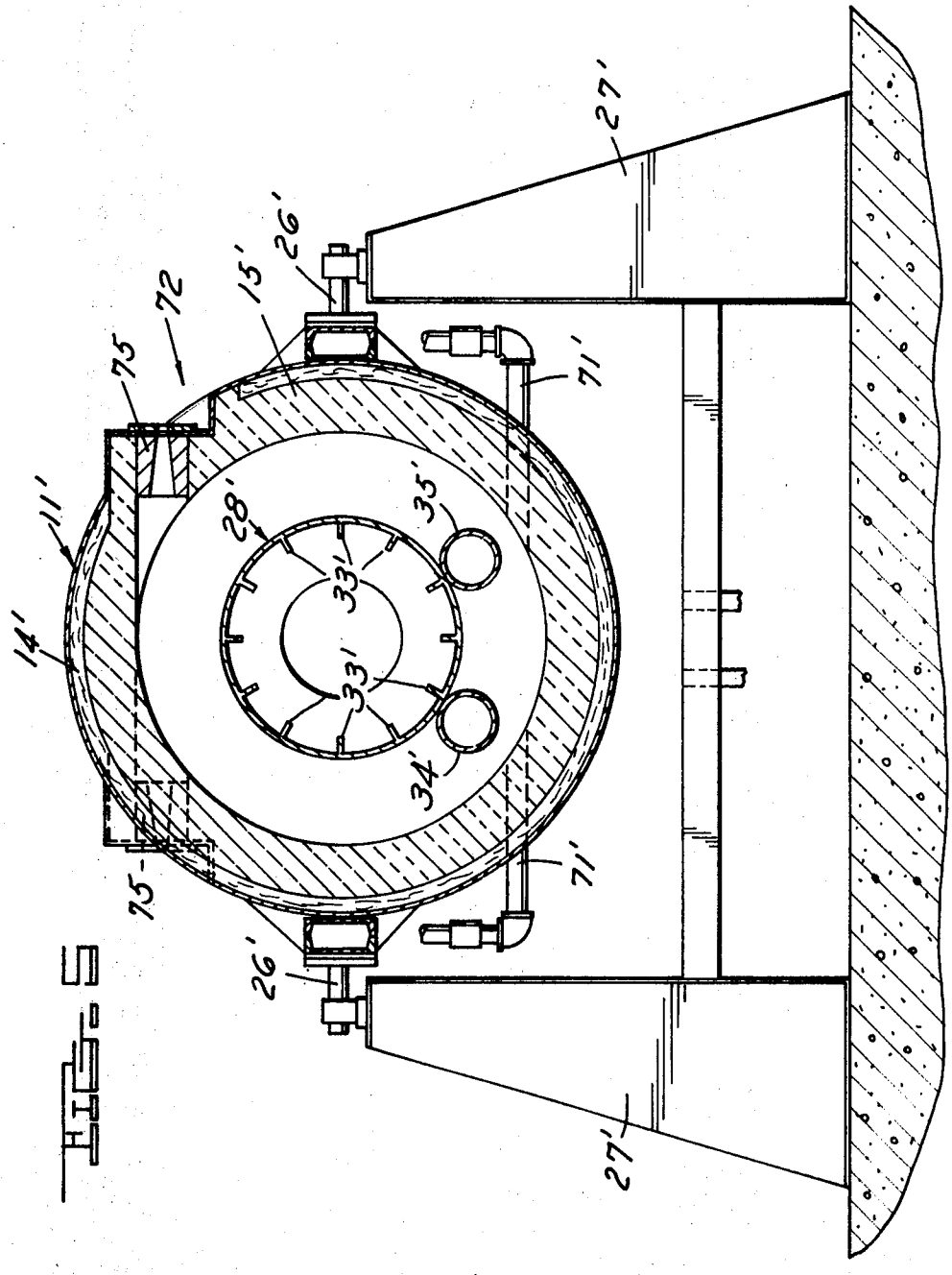


FIG. 5

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United States Patent Office 3,606,285 Patented Sept. 20, 1971

3,606,285

BARREL-TYPE BATCH GAS CARBURIZING FURNACE

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Filed Oct. 20, 1969, Ser. No. 867,460
Int. Cl. F27b 7/08
U.S. Cl. 263—34 19 Claims

ABSTRACT OF THE DISCLOSURE

A rotary barrel-type retort is positively driven, along with a pair of elongated supporting rollers cradling the same, by drive means disposed in the entirety thereof externally of a cylindrical furnace heating chamber in which the retort is concentrically located for rotation. Part loading and unloading chute components are at the same axial end of the heating chamber, with the retort being rotatively supported in part, in supplementation of its cradling support rollers, by a trunnion at the opposite axial end of the heating chamber. Means for rotating the retort are associated with the trunnion, in common with means for rotating the retort-supporting rollers; and in each case the retort and roller drive means are entirely external of the hot heating chamber. In one embodiment of the furnace direct firing gas burners discharge products of combustion into the heating chamber in a direction generally tangential of the retort. In another embodiment, U-type radiant heaters are employed. Atmosphere gas is introduced to the retort via an inlet passage in the retort journalling trunnion, emerging at the other retort end and flowing into the combustion chamber then out the furnace flues. A gas inlet is also contemplated in the part loading chute at a heating chamber end, supplementing the supply of atmosphere gas through the retort trunnion.

BACKGROUND OF THE INVENTION

(1) Field of the invention

The invention relates to the field of mass batch treatment of parts, for example gas carburizing, and more particularly, to apparatus of the barrel-type, into a rotatively driven retort of which the parts are charged and from which they are dumped after treatment, the retort being intensely heated in a sealed heating chamber in which it rotates coaxially. Specifically, gas carburizing is contemplated in an operation in which atmosphere gas is introduced into the retort during a cycle of treatment, the heating chamber and retort being tilted in a vertical plane including the retort's rotative axis to discharge the treated parts, as to a quench tank.

(2) Description of the prior art

The most pertinent prior art of which I am aware is represented by Holcroft Letters Patent No. 3,318,591 of May 9, 1967, the present invention relating to significant improvements of various sorts on that equipment, to be described.

SUMMARY OF THE INVENTION

The invention affords an improved rotary barrel or retort-type gas atmosphere furnace well suited for the mass heat treatment of relatively small parts. Pursuant to the invention a fixed cylindrical and substantially gas tight, thermally well insulated heating chamber is pivotally mounted by trunnion means on a pedestal-type base, and improved fluid cylinder means are provided for a tilting change of the chamber's inclination on the trunnion axis during the treating operation. A parts-

receiving, heating and treating retort is supported for powered rotation about an axis coaxial with that of the chamber, and the retort discharges upon being tilted downwardly, at the conclusion of the treatment, through unloading chute means at one end wall of the heating chamber. Pursuant to another improvement of the invention the retort is charged with parts or pieces to be treated at the same end wall of the chamber, which leaves the opposite end wall of the heating chamber available for the reception of hollow retort trunnion or journalling means acting in conjunction with roller supports on which the retort rests, these supports being similar to those shown in my patent.

Furthermore, both the retort trunnion and the supporting rollers are positively driven by chain-sprocket and gear type means disposed completely externally of the hot heating chamber and not subject to deterioration in the latter's gaseous atmosphere, rather than involving rotary rack-type retort drive means within the chamber, as in the case of the furnace of the patent identified above.

As a further advantage related to the journalling of the retort trunnion in the heating chamber end wall opposite the loading and unloading wall, the hollow trunnion affords access to the retort interior for tubular means for the introduction of atmosphere gas into the retort. In further accordance with the invention, this gas emerges from the retort adjacent the opposite, loading and unloading end of the heating chamber, thence out the furnace flue. Deposition of carbon on the retort-supporting rollers is prevented, in turn minimizing a tendency to slippage of the retort on the rollers.

It is also contemplated that a slight counterflow of atmosphere gas will be set up at the loading-unloading chute end of the combustion and/or heating chamber to assist in preventing the infiltration into the retort of combustion products from the chamber.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic view, in general, in vertical axial cross-section through a carburizing furnace in accordance with one embodiment of the invention, characterized in common with the other embodiment in that article charging and discharging stations are located at the same axial end of the heating chamber of the furnace, the view also showing improved fluid pressurized cylinder means for tilting the furnace chamber from a solid line to a dotted line position;

FIG. 2 is a view in transverse vertical section on line 2—2 of FIG. 1;

FIG. 3 is a highly schematic perspective view illustrating an improved external chain-sprocket and gear arrangement for driving the retort and its supporting rollers;

FIG. 4 is a view in axial cross-section, similar to FIG. 1, of a second embodiment of the invention, in which the furnace heating chamber is equipped with tangentially firing gas burners, a showing of other provisions, including means for tilting the heating chamber, being only very schematically shown in the interest of simplicity; and

FIG. 5 is a view in transverse vertical section on line 5—5 of FIG. 4.

DESCRIPTION OF PREFERRED EMBODIMENTS

A first embodiment **10** of the improved carburizing furnace of the invention is illustrated schematically in FIGS. 1 and 2, with its rotative drive arrangement being even more plainly shown in perspective in FIG. 3. This drive is common to the furnace **10** and the other furnace embodiment appearing in FIGS. 4 and 5. Both of these incoporate structural provisions which, insofar as the

composition of the furnace heating chamber, its rotary retort, the latter's roller supports, etc., are quite similar to corresponding components shown and described in my Letters Patent No. 3,318,591 identified above; and in connection with the heating chamber's radiant heaters, per FIGS. 1 and 2, the patent shows a very similar arrangement. Accordingly, in the interest of clarity and simplicity basic component features which are more fully illustrated and described in the patent will be but briefly referred to herein, the description being supplemented from time to time, nexus-wise, by reference to the patent.

The furnace embodiment **10**, like that of the patent, comprises a cylindrical heating chamber **11** made up of an external sheet metal casing **12** backed directly about its periphery and at one end wall **13** by layers of appropriate insulation material **14**, with the insulation in turn backed by fire brick **15**. The opposite axial end wall **16** of the heating chamber **11** is of fire brick telescoped within that chamber end; the wall **16** receives various structurally improved components to which certain aspects of the present application relate, as will be described.

FIG. 1 shows in solid line the normal horizontal operating condition of the furnace, generally designated **10**, and, in dotted line, its position as tilted to discharge the treated parts, which change of inclination is accomplished in the furnace of my patent designated above by electric motor, chain and sprocket means. Pursuant to one of the present improvements, this tilting change of inclination, and return to normal position, is now accomplished in both of the embodiments shown herein through the agency of considerably simpler, yet equally effective fluid power means.

As depicted in FIGS. 1 and 2, such means comprises an appropriate hydraulic cylinder **18** pivotally connected at **19** to a suitable fixed base support bracket **20**, the upwardly extending plunger **21** of this cylinder being pivoted to bracket means **22** fixedly depending from the cylindrical furnace wall. The furnace is medially journalled for tilting in a vertical plane including its axis by means as shown in my patent. Cylinder **18** may typically have a four-inch bore and a fifty-inch stroke, being a double acting unit for a positive operation in reversely changing the axial inclination of heating chamber **11**, and to this end having pressure lines **23**, **24** in communication with its respective capped ends. The control of the pressurization of the cylinder through these lines may be selectively effected through suitable timing means serving to reversibly control the action of appropriate valve means, not shown and not germane to the present invention, but of a type susceptible of automatic control consistent with continuous mass output operation. As in the case of the patented furnace, the present heating chamber **11** is pivotally mounted by diametral trunnions **26** midway of its axial ends on massive side floor pedestals **27**, these constituting a part of a base for the furnace structure.

The rotary barrel-type retort **28** of furnace **10** is mounted, pursuant to the present improvement, in quite a different manner than the corresponding retort of my patent, in view of the fact that the part loading and unloading provisions, hereinafter described, are located at a single axial end wall of the furnace, i.e., the right hand wall **13** as viewed in FIG. 1. Thus, the opposite or left hand end wall **29** of retort **28** is schematically shown as being axially provided with an elongated hollow cylindrical trunnion member **30**, appropriately joined gas-tight in any desired fashion to the remainder of the chamber, which trunnion extends through the fire brick end wall **16**, projecting a substantial distance outwardly thereof to receive retort drive means to be described. Tubular trunnion **30** at the same time affords access space receiving an externally supplied atmosphere gas tube **31** discharging to the interior of the retort at its axial midpoint, the tube **31** extending inwardly through an otherwise closed and sealed end wall **32** of trunnion **30**.

Retort **28** is internally ribbed longitudinally at **33** in the manner of the Holcroft patent.

The rotatively stable support provided for retort **28** by the elongated trunnion **30** is supplemented by elongated supporting rollers **34**, **35** located beneath and on either transverse side of the retort axis (the schematic showing of FIG. 1 being of course distorted in relation to the position of a supporting roller **34**). Rollers **34**, **35** are rotatably journalled appropriately in the opposite axial heating chamber walls **13**, **16**, as by sealed collar or bushing means **36** (FIG. 1); and reduced diameter stem extensions **37**, **38** at one end of the respective rollers **34**, **35** receive drive from a chain-sprocket and gear type arrangement or assembly schematically depicted in FIG. 3. This assembly effects a positive rotation of the retort cradling rollers **34**, **35**, as well as of the axially outwardly projecting, tubular retort trunnion **30**, the retort **28** being thus rotated uniformly regardless of any possible tendency to slip at the rollers.

With special reference to schematic FIG. 3, the drive extension **38** of the retort supporting roller **35** is shown as being longer than the corresponding extension **37** of roller **34**; and it has a sprocket **39** fixed thereon adjacent its outer end. This sprocket is driven by a chain **40** from a motor-reducer unit generally designated by the reference numeral **41**. Appropriate outboard bearings **42** (FIG. 1) journal the roller shaft extensions **37**, **38** outwardly of the bushings **36**.

In all cases, the chain and sprocket provisions, as described above and later, may of course be replaced by equivalent belt and pulley or like drive means, being immune to deteriorative heating chamber effects. The same is true as to equivalency in regard to certain gear means to be described.

Adjacent the heating chamber **11**, but still external thereof, the roller drive extension **38** has another sprocket **43** fixed thereon; and a power transmission chain **44** is trained about sprocket **43** and a sprocket **45** of the same diameter which is fixed on the drive extension **37** for the other supporting roller **34**.

At a point axially intermediate the sprockets **39**, **43** the roller extension **38** fixedly carries a third output sprocket **46**, which connects by a transmission chain **47** with a sprocket **48** secured on a jack shaft **49**. This shaft is appropriately journalled to rotate in the axial end wall **16** of heating chamber **11**; and it carries a drive gear **50** externally of the chamber. Gear **50** meshes with a similar gear **51** fixed on a shaft **52** which is journalled, as by an appropriate bushing similar to the bushing **36** journalling shaft **38**, in the end wall of heating chamber **11**. Just outwardly of the bushing **36** of shaft **52**, the latter fixedly carries a drive sprocket **53**, which is connected by a chain **54** with a somewhat larger diameter sprocket **55** fixed to the retort journalling extension **30**, the sprocket **55** being in the vertical plane of its driver **53** and external of the chamber wall.

The above-described external gear and chain-sprocket drive assembly of FIG. 3, generally designated **56**, is shown in FIG. 1 as having its components which are located directly adjacent chamber wall **16** housed in a casing **57** which may be ventilated.

It is at the heating chamber end wall **13** opposite the wall **16** that a fixed discharge chute **58** of the furnace is connected, in the manner of Pat. No. 3,318,591. It is at this same wall **13** that the main, downwardly extending part loading or charging chute **60** is mounted (in structure similar to the patent), the chute **60** being serviced by an auxiliary charge tube **61** insertable in its open end. Chute **61** is pivotally connected by a parallel arm linkage **62** to a bracket externally fixed on the end wall and, as operated by fluid motor, rack and gear or equivalent means (not shown but, such as are disclosed in my patent), the auxiliary chute **61** is movable from an operative position, shown in solid line in FIG. 1, to a retracted position ap-

pearing in dot-dash line, and vice versa. Also as shown in the patent, the main chute **60** will be closed by an appropriate door when chute **61** is retracted.

Pursuant to the present invention the chute **60** is provided with an upright fitting **63** which is adapted to be connected to the source of atmosphere gas, for example, a combination of carrier or generator and hydrocarbon components in the case of carburization, which source also supplies the atmosphere gas tube **31** at the opposite end wall **16** of the heating chamber. The gas thus fed to the interior of retort **28** emerges from the latter to the heating or combustion chamber at a slight annular clearance between the right-hand end (FIG. 1) of the retort and the receiving end of discharge chute **58**, the gas being then disposed of suitably through vent or flue provisions of the furnace. The secondary gas inlet at **63** tends to prevent infiltration into chute **60** of products of combustion from chamber **11**.

U-type radiant gas or oil heated tubes **65**, **66** and **67** are fixedly sustained within the heating chamber in any appropriate manner, for example, by side brackets **68** and hanger means **69**, these tubes extending through refractory packings **70** in the end wall **16** of chamber **11**. They are supplied at one leg thereof by air and combustible lines (not shown) and discharge through the opposite leg to the furnace flue. However, open firing of the chamber interior is also contemplated, i.e., direct firing.

Vent tubes **71** extend in opposite directions from a level adjacent the bottom of chamber **11**; these connect to the furnace flue system to dispose of the combination of combusted gaseous products. The discharge through the vent tubes **71'** includes the combustion product of the tangentially fired combustion medium and the spent atmosphere gas.

FIGS. 4 and 5 illustrate another embodiment **72** of the improved furnace featuring such firing, which embodiment is very similar to the embodiment **10** in many respects, including the dual atmosphere gas supply, the fluid cylinder provisions for tilting the heating chamber, etc. In the interest of simplicity, therefore, such tilting means has been only line-shown in FIG. 4. Other provisions which correspond to means illustrated in FIGS. 1, 2 and 3 are designated by corresponding reference numerals, primed.

Thus, the retort **28'** has a reduced diameter hollow cylindrical trunnion **30'** secured thereto and journalled in the furnace wall **16'**, a hole **73** in the retort end **29'** placing the retort in communication with the trunnion interior. An atmosphere gas inlet tube **31'** discharges into the interior of the trunnion member **30'**, which has a rotating journal in wall **16'**.

The drive of trunnion **30'** and barrel **28'** is through a chain-sprocket and gear system like that denoted **56** in FIG. 3. That is, it includes a sprocket **55'** secured on the trunnion, and the drive of the elongated extension **37'** of the retort supporting roller **34'** is through the agency of a sprocket **45'** on the roller extension, the latter having an outboard journal at **42'**. For other parts of drive assembly **56'** see FIG. 3.

In the embodiment **72** of FIGS. 4 and 5, direct or open firing as burners **75** are mounted in the cylindrical wall **15'** of the furnace, being disposed (FIG. 5) to fire substantially tangentially of the retort **28'**. They are staggered longitudinally on opposite sides of the furnace wall, the burning gas wrapping circumferentially about retort **28'** to produce a very intense but uniformly distributed heating of the retort interior.

The furnace adaptations **10** and **72** afford, in a most simple, efficient and structurally practical way, environments for the rapid, massively continuous heat treatment of metal parts of small or somewhat larger size. The cost of production of the furnace is diminished materially and assembly-wise by each and all of the above-emphasized improvements, without the slightest diminution of operational furnace efficiency and output.

What is claimed is:

1. A rotative barrel-type heat treating furnace, comprising a heating chamber having a retort journalled for rotation therein, said chamber and retort having means adjacent one axial end of the latter for both loading and unloading parts to be treated respectively into and out of a corresponding axial retort end, said retort being rotatively journalled by a retort trunnion part adjacent the opposite end thereof, and power transmitting parts disposed in the entirety thereof externally of said heating chamber for rotatively driving said retort.

2. A rotative barrel-type heat treating furnace comprising a heating chamber having a retort journalled for rotation therein, said chamber and retort having means adjacent one axial end of the latter for both loading and unloading parts to be treated respectively into and out of a corresponding axial retort end, said retort being rotatively journalled by a retort trunnion part adjacent the opposite axial end thereof, roller means coacting with said trunnion part for a stable rotative support of the retort in said heating chamber, and power transmitting parts disposed in the entirety thereof externally of said heating chamber for rotatively driving said retort.

3. A rotative barrel-type heat treating furnace, comprising a heating chamber having a retort journalled for rotation therein, and fluid pressure-powered means to tilt the chamber and its retort in a plane including the rotative axis of the retort, said chamber and retort having means adjacent one axial end of the latter for both loading and unloading parts to be treated respectively into and out of a corresponding axial retort end, said retort being rotatively journalled by a retort trunnion part adjacent the opposite axial end thereof, and power transmitting parts disposed in the entirety thereof externally of said heating chamber for rotatively driving said retort.

4. A rotative barrel-type heat treating furnace, comprising a heating chamber having a retort journalled for rotation therein, and fluid pressure-powered means to tilt the chamber and its retort in a plane including the rotative axis of the retort, said chamber and retort having means adjacent one axial end of the latter for both loading and unloading parts to be treated respectively into and out of a corresponding axial retort end, said retort being rotatively journalled by a retort trunnion part adjacent the opposite axial end thereof, roller means coacting with said trunnion part for a stable rotative support of the retort in said heating chamber, and power transmitting parts disposed in the entirety thereof externally of said heating chamber for rotatively driving said retort.

5. The furnace of claim **1**, in which said retort trunnion part receives means to introduce a treating medium through said part to the interior of the retort.

6. The furnace of claim **3**, in which said retort trunnion part receives means to introduce a treating medium through said part to the interior of the retort.

7. The furnace of claim **4**, in which said retort trunnion part receives means to introduce a treating medium through said part to the interior of the retort.

8. The furnace of claim **1**, in which said heating chamber is journalled for pivotal movement about a transverse axis and has fluid pressure-operated means to tilt the chamber about said axis.

9. The furnace of claim **2**, in which said heating chamber is journalled for pivotal movement about a transverse axis and has fluid pressure-powered means to tilt the chamber about said axis.

10. The furnace of claim **5**, in which said heating chamber is journalled for pivotal movement about a transverse axis and has fluid pressure-powered means to tilt the chamber about said axis.

11. The furnace of claim **1**, in which said heating chamber has further means at said one axial end there-

of to introduce treating medium to the interior of the retort.

12. The furnace of claim 5, in which said heating chamber has further means at said one axial end thereof to introduce treating medium to the interior of the retort through a part of the loading means.

13. The furnace of claim 7, in which said heating chamber has further means at said one axial end thereof to introduce treating medium to the interior of the retort through a part of the loading means.

14. The furnace of claim 1, and further comprising heating means for the interior of said chamber.

15. The furnace of claim 14, in which said heating means comprises direct firing burners staggered longitudinally relative to one another on opposite sides of the axis of rotation of the retort, said burners discharging product of combustion into said chamber substantially tangentially of said retort.

16. The furnace of claim 14, in which said heating means comprises U-shaped heat transfer members disposed in said chamber parallel to the axis of said retort.

17. A rotative barrel-type heat treating furnace comprising a heating chamber having opposite end walls, a rotatable retort having a main cylindrical body portion within said heating chamber between said end walls and having a coaxial extension projecting through one of said end walls to the outside of said heating chamber,

rollers beneath said cylindrical body portion for substantially the entire length for rotatably supporting said retort, first means outside of said heating chamber for rotating said rollers to thereby frictionally drive said retort in rotation and second means entirely outside of said heating chamber for rotating said projecting extension in timed relation to said rollers to thereby positively drive said retort in rotation.

18. A furnace according to claim 17 in which the end of said rotatable retort opposite said coaxial extension is entirely within the adjacent end wall of said heating chamber and means is provided for both loading and unloading through said adjacent end wall into and out of said retort.

19. A furnace according to claim 18 in which treating gas is introduced into the retort through said coaxial extension and additional treating gas is introduced at the loading end.

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JOHN J. CAMBY, Primary Examiner