Aug. 3, 1965 R. K. BANISTER ETAL 3,198,501

APPARATUS FOR HEATING TUBULAR METAL GOODS

Filed April 10, 1963 3 Sheets-Sheet 1

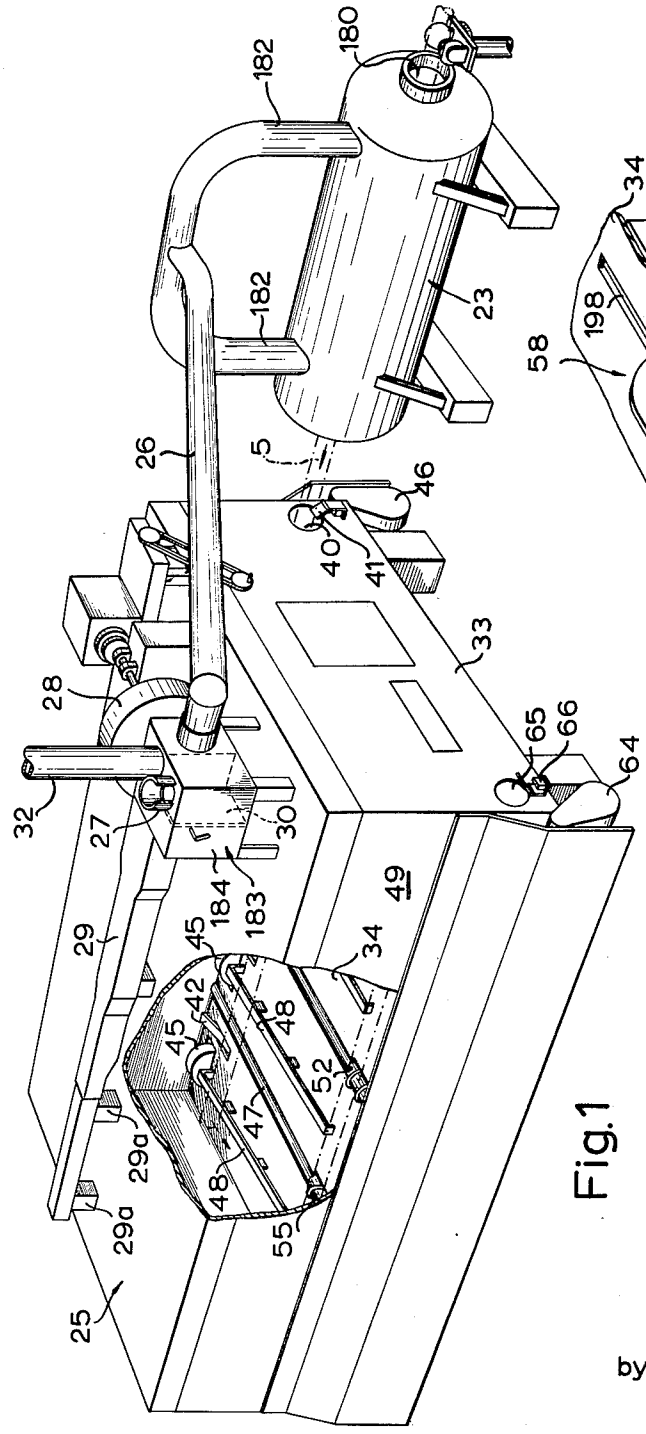

Fig.1

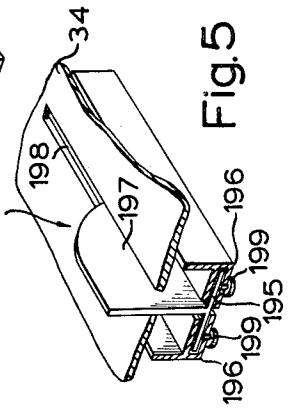

Fig.5

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Filed April 10, 1963 3 Sheets-Sheet 2

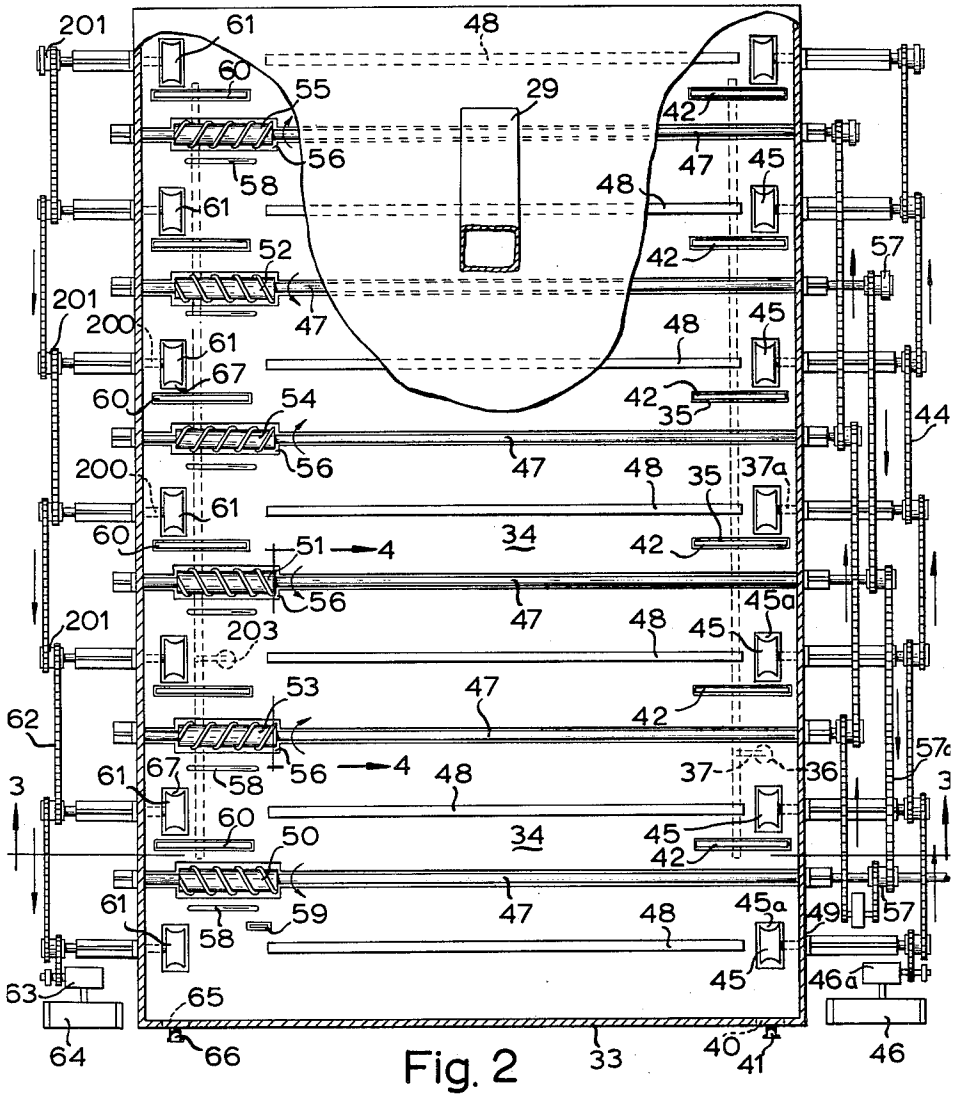

Fig. 2

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APPARATUS FOR HEATING TUBULAR METAL GOODS

Filed April 10, 1963 3 Sheets-Sheet 3

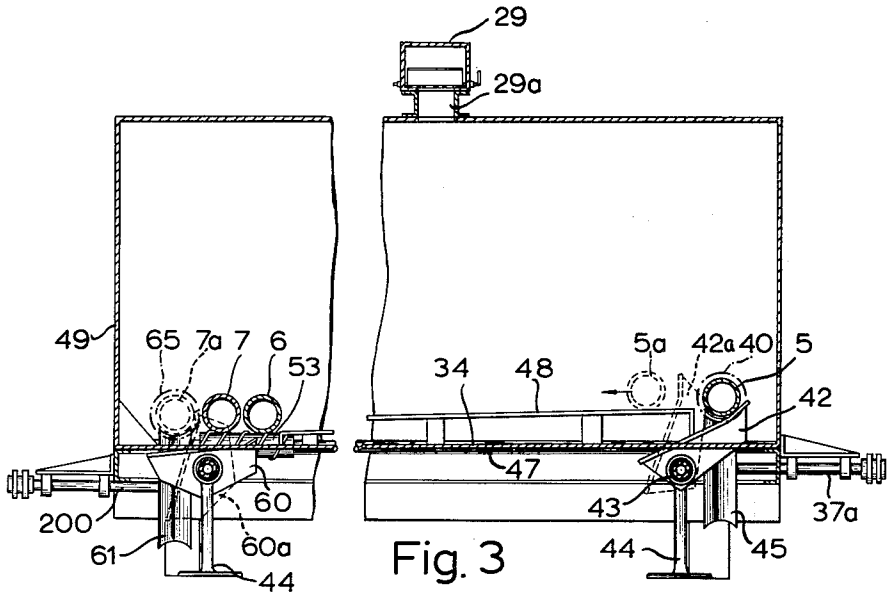

Fig. 3

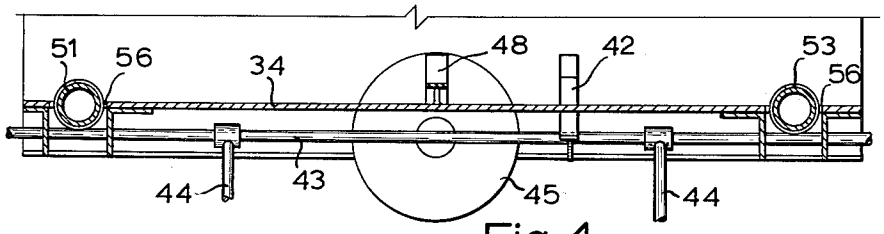

Fig. 4

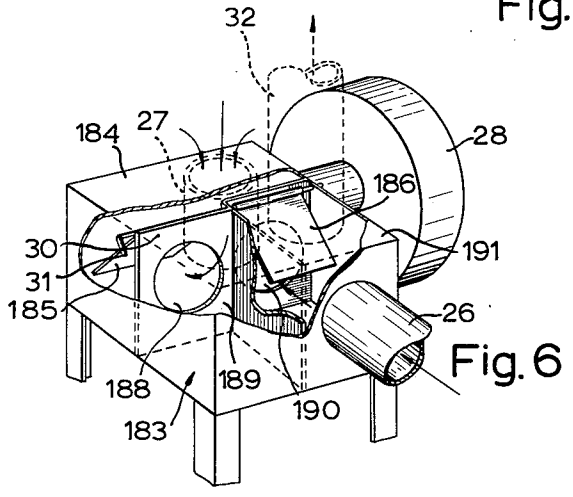

Fig. 6

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3,198,501

APPARATUS FOR HEATING TUBULAR METAL GOODS

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3 Claims. (Cl. 263—36)

This is a continuation-in-part of Serial No. 250,705, filed January 10, 1963 for Pipe Coating Process, the common subject matter herein being directed to an improved apparatus for heating elongated articles such as pipe and the like to a predetermined temperature and retaining the pipe at the desired temperature until required for subsequent processing.

This invention relates to an apparatus for coating tubular goods. It is particularly directed to an apparatus for coating rod, pipe and the like elongated articles.

In the heating of rod, pipe and the like tubular metal goods for coating said goods with a synthetic resin, for example, it is imperative that the surface to be coated be heated to a closely controlled temperature above the melting point of the resin to be applied and held at that temperature until the coating operation has been completed.

Heretofore, difficulty has been encountered in heating a plurality of said metal goods to the desired coating temperature in the short period of time permitted in a continuous coating process and holding said goods at the said coating temperature for continual delivery from the heating apparatus of the heating goods, one at a time, to the coating mechanism.

It is, therefore, an important object of the present invention to provide an apparatus for heating tubular metal goods to a predetermined temperature and maintaining the metal goods at said temperature until required for subsequent treatment.

It is another important object to provide an apparatus for heating a plurality of elongated articles rapidly to a predetermined temperature and holding said goods at the desired temperature until required for subsequent processing.

Another object of the present invention is the provision of an apparatus for heating at least the exterior surface of tubular metal goods uniformly to a predetermined temperature.

These and other objects of the present invention and the manner in which they can be obtained will become apparent from the following description, reference being made to the accompanying drawings, in which:

FIGURE 1 is a perspective view, partly cut away, of the furnace and oven of the present invention.

FIGURE 2 is a plan view of the holding oven of the present invention;

FIGURE 3 is a vertical section taken along the line 3—3 of FIGURE 2;

FIGURE 4 is a vertical section taken along the line 4—4 of FIGURE 2;

FIGURE 5 is a perspective view of the limit switch assembly illustrated in FIGURE 2; and

FIGURE 6 is an enlarged perspective view, partly cut away, of the duct damper and blower illustrated in FIGURE 1.

Like reference characters refer to like parts throughout the description and the drawing.

Inasmuch as a description of much of the mechanical construction and operation of the parent application is not necessary for a complete understanding of the divisional subject matter herein presented, only that part which is necessary is described hereinbelow.

With reference to the drawings, the embodiment of the invention illustrated comprises a furnace 23 having a longitudinal passageway 180 extending therethrough. The interior of furnace 23 preferably is maintained at a temperature of about 3000° F. which is sufficient to heat 4 inch diameter metal pipe, travelling through passageway 180 at a velocity of about 50 feet per minute, to about 250° F. We have found a 5,000,000 B.t.u. furnace of the conventional barrel type fired by propane to provide a satisfactory source of heat. It will be understood, however, that a heat source may be provided by natural gas, infra-red radiation, induction heating and the like means.

With the use of combustible materials such as propane and natural gas, the hot flue gases exhausted from preheating furnace 23 by exhaust stacks 182 are collected in duct 26 and conducted to box 183 for blending in compartment 184 with air introduced by way of inlet stack 27 under the suction of blower 28. The blended gases are distributed the length of the oven 25 by a main duct 29 which communicates a plurality of ducts 29*a* positioned in the roof of the oven with the discharge outlet of blower 28. A damper 30 having a pair of flaps 185 and 186 disposed at right angles to each other, as illustrated with reference to FIGURE 6, regulates the inflow of air from stack 27 into compartment 184 through port 188 of compartment 189 and the flow of hot flue gases through port 190 of compartment 191 into compartment 184. The hot flue gases in excess of that required to heat oven 25 are exhausted by exhaust stack 32.

The rotation of damper shaft 31 and hence the disposition of flaps 185 and 186 which control the inflow of cool air and hot flue gases is controlled by an iron constantine thermocouple positioned within the oven and connected to an indicating potentiometer controller. As thermocouple controllers are well known in the art, it is believed unnecessary to describe the said controller herein. The hot gases blown into oven 25 through ducts 29*a* pass down through the interior of the oven and escape by way of a plurality of openings formed in the oven floor, as will be described in detail hereinbelow.

With reference now to FIGURES 1, 2 and 3, the pipe 5 exiting from furnace 23 enters oven 25 by way of opening 40 formed in the front wall 33 of the oven which is in alignment with the axis of passageway 180 of said furnace. Immediately prior to entering opening 40, the forward end of the pipe depresses an upwardly biased, normally open limit switch 41 which controls the operation of kickers 42 equidistantly mounted on shaft 43 for pivotal movement thereon. Shaft, 43, which extends subtantially the length of the oven 25, is journalled for rotational movement below the oven floor 34 in supports 44; kickers 42 being adapted to extend upwardly through openings 35 in the floor for pivotal movement therethrough. A double-acting pneumatic cylinder 36, connected by means of a crank assembly 37 to shaft 43 below oven floor 34 and actuated by means of an electrical, solenoid-operated pneumatic valve system well known in the art, is adapted to retract kickers 42 into a pipe receiving position when limit switch 41, electrically connected to the solenoid of the pneumatic valve, is opened and to pivot one end of kickers 42 upwardly when said limit switch is closed. Therefore, upon depression of switch 41 by a pipe entering the oven, the kickers 42 are retracted into a pipe receiving position.

Each pipe is conveyed into the oven by 15-inch diameter concave rollers 45 seated in floor openings 45*a* and carried by rotatably mounted shafts 37*a* which are connected by chains 44 to drive motor 46 and gear reducer 46*a* for rotation thereby. The pipe is thus conveyed into the oven by means of rollers 45 until rearward end of the pipe clears limit switch 41 permitting the

switch to be biased upwardly into its closed position energizing the solenoid-operated valve which introduces air to cylinder 36 for actuation of kickers 42. Kickers 42 in pivoting upwardly through floor openings 35 to the position indicated by numeral 42a raise the pipe from rollers 45, as illustrated most clearly by FIGURE 3, and roll the pipe onto transverse gravity feed rails 48 where the pipe travels partially across the oven onto a plurality of cross feed screws for continued controllable movement across the oven. Oven loading is preferably continued until the transverse gravity feed rails 48 are loaded with a single depth of pipe.

To neutralize any possible axial movement to the pipe as it is conveyed across the oven on the transverse screws, each adjacent cross feed screw is rotated in the opposite direction. For example, as illustrated by FIGURES 2 and 4, screws 50, 51 and 52 can be rotated in clockwise direction and screws 53, 54 and 55 rotated in a counterclockwise direction, thereby cancelling any axial movement of the pipe. The two groups of screws are reverse threaded with a three inch pitch and rotated in opposite directions to thus convey the pipe evenly across the oven, the rearward end of the pipe being continuously positioned in the oven at a point about six inches from front wall 33. Each of screws 50 through 55 are mounted on shafts 47 which are journalled for rotation in side walls 49 of the oven. Screws 50 through 55 are seated in transverse openings 56 formed in the floor 34 of the oven such that the screws extend partly below the plane of the floor. Sprocket wheels 57 secured to the exterior projecting ends of shafts 47 are rotated by chains 57a which are driven by a prime mover, not shown.

A plurality of adjustably mounted pipe stops 58, illustrated in detail by FIGURE 5, are positioned substantially co-extensive with a limit switch 59 to arrest the transverse movement of each pipe as it reaches the discharge side of the oven. Each of pipe stops 58 comprises a base 195 adapted for slidable movement in the grooves of opposed flanges 196 secured to the underside of oven floor 34. Vertical arm 197, formed integral with base 195, projects above the plane of floor 34 through slot 198 formed therein. By adjusting base 195 within flanges 196 and locking the base by set screws 199, arm 197 of each pipe stop 58 can be positioned as desired. Limit switch 59 is actuated by abutment of the pipe to de-energize the motor which drives cross feed screws 50–55; thus effectively preventing jamming of the pipe.

The length of pipe abutting stops 58 on cross screws 50–55 is positioned for lifting by kickers 60 onto 15 inch concave rollers 61 which are journalled for rotation below oven floor 34 and extend upwardly through floor openings 67. The rollers 61 rotatably mounted on shafts 200 having sprocket wheels 201 driven by chains 62 are operatively connected to clutch and gear reducer assembly 63 and motor 64 for conveyance of pipe out of the oven through exit opening 65. Kickers 60, actuated by a pneumatic cylinder and crank arrangement 203 of the type as described hereinabove with reference to kickers 42, are controlled by a limit switch 66 which is normally biased in an upward position closing the electrical circuit to a solenoid valve which regulates air flow to said cylinder 203. The pipe, while exiting from oven 25 through wall opening 65, engages switch 66 which controls the solenoid operated valve admitting air to cylinder 203 for retracting kickers 60. As soon as the exiting pipe clears switch 66, the switch is biased upwardly into its closed position actuating said pneumatic cylinder to pivot kickers 60 to the position indicated by numeral 60a, thereby lifting the next pipe onto rollers 61 for discharge from the oven. As limit switch 59 is released by removal of the abutting pipe, the cross screws motor means are energized actuating cross screws 50–55 which advance the next pipe carried thereon to abut stops 58 and open switch 59.

As the pipe length is positioned on the oven outlet rollers 61, the clutch controlling the speed of gear reducer 63 is manually engaged to axially drive the pipe out of the oven at a predetermined speed.

Upon the forward end of the pipe being discharged reaching a predetermined position, as described in detail in our parent application, the clutch incorporated in assembly 63 is manually disengaged and rollers 61 function as idler rollers until the said clutch is subsequently reengaged for propelling the next length of pipe out of the oven.

The retention time required to convey each pipe into, across and out of oven 25, preferably about 15 minutes, has been found sufficient for heating at least the exterior surface of the pipe to the oven temperature. For the subsequent coating of pipe with a synthetic resin, the oven temperature will be in the range of from 400° F. to 600° F., the temperature being dependent on the melting point of the resin to be applied. For example, a pipe surface temperature of about 415° F. has been found desirable for the coating of epoxy resin onto said surface whereas a temperature of about 400° F. has been found satisfactory for the coating of pipe with polyethylene resin and a temperature of about 600° F. has been found satisfactory for the coating of pipe with polyester resins.

In operation, each length of pipe is conveyed, one at a time, through preheater furnace 23 which is maintained at a temperature of about 3000° F. for rapid heating of the pipe to a temperature of about 250° F. In that the final coating temperature of the pipe is controlled by the temperature of the holding oven, the temperature of the pipe exiting from furnace 23 is not critical. Subsequent to preheating in furnace 23, the pipe 5 is conveyed into holding oven 251 and received on rollers 45 while kickers 42 are retracted into their pipe-receiving position by the depression of switch 41 which is engaged by the incoming pipe. As soon as the rear end of the incoming pipe clears switch 41, the switch returns to its normally upwardly biased position actuating kickers 42 which pivot upwardly through floor openings 35 to lift and roll pipe 5a onto transverse rails 48. In that rails 48 are sloped towards the center of the oven, pipe 5a rolls by gravity onto cross feed screws 50–55 to join pipes 6 for continued intermittent conveyance across the oven to discharge rollers 61. The rotation of screws 50–55 is controlled by a limit switch 59 which de-energizes the screw drive motor upon a length of pipe 7 abutting said switch. Switch 59 is located substantially co-extensive with pipe stops 56 such that pipe 7 will be positioned for engagement by kickers 60. Limit switch 66 located at outlet opening 65 is adapted to be depressed by the pipe exiting from the oven causing kickers 60 to be retracted to their pipe-receiving position. Upon the rear end to its normally clearing switch 66, said switch returns to its normally upwardly biased position actuating kickers 60 which pivot upwardly through floor openings 67 to lift pipe 7 onto rollers 61, as indicated by numerals 60a and 7a. Rollers 61 immediately convey pipe 7a out of the oven through wall opening 65, thereby depressing switch 66 to retract kickers 60 while the next pipe is advanced by screws 50–55 to its discharge position. The operation of rollers 61 is controlled by a manually operable clutch assembly 63 which connects the drive motor 64 to sprocket chains 62 such that said rollers positively propel pipe out of the oven for the initial stage of the pipe discharge and said rollers function as idler rollers for the latter stage of the pipe discharge.

It will thus be apparent that, apart from the manual engagement of the drive motor 64 with rollers 61, the method of conveying pipe through the preheater furnace 23 and holding oven 25 is substantially automatic. The temperature control within the oven is closely controlled by a thermocouple connected to an indicating potentiometer controller which in turn controls the regulation of air and hot flue gases blended to obtain the desired oven temperature and introduced to the oven at intervals along its length by blower 28. The heated air and

flue gases introduced at the top of oven 25 exhaust by way of the plurality of openings 35, 45*a*, 56, 67, 198 and the like formed in the oven floor 34. Thus an even distribution of the heating medium throughout the oven is ensured.

The furnace and oven shells preferably are provided with a covering of heat insulating material and refractory materials, where necessary, to cut down on heat losses.

Although the apparatus of the present invention is described with respect to the coating of pipe, it will be understood that this example is by way of illustration only and that metal rod, tubular goods and elongated articles other than pipe can be treated by this invention.

The present invention provides a number of important advantages. Rod, pipe and the like tubular metal goods can be quickly and positively heated to a predetermined temperature by means of apparatus which is substantially automatic in operation. The apparatus provides a storage capacity for the retention of metal goods until required for subsequent treatment while ensuring the metal surface to be coated is uniformly maintained at the desired coating temperature of the resin to be applied.

It will be understood, of course, that modifications can be made in the embodiment of the invention described and illustrated herein without departing from the scope of the invention as defined by the appended claims.

What we claim as new and desire to protect by Letters Patent of the United States is:

1. An apparatus for heating elongated articles which comprises, in combination, a preheating furnace; a holding oven; first conveyor means for moving said articles axially, one at a time, through said furnace for a rapid preheat into said oven; second conveyor and storage means for receiving said articles from said first conveyor means for moving said articles in parallel side-to-side relation across said oven, said second conveyor means comprising at least two elongated screws extending parallel to but spaced from each other partly across the oven and in the direction of movement of the articles across the oven, each of said screws being rotatable in a direction opposite to the other and having a thread pitch opposite to the other; means for transferring said articles from said first conveyor means to said second conveyor means actuable by switching means adapted to be engaged by incoming articles; switching means for regulating the travel of said second conveyor means adapted to be engaged by articles carried on said second conveyor means; third conveying means for moving said heated articles axially, one at a time, out of said oven; means for transferring said articles from said second conveyor and storage means to said third conveyor means actuable by switching means adapted to be engaged by outgoing articles; and means for automatically controlling the temperature of the oven such that said oven is maintained at a uniform desired temperature.

2. An apparatus for heating metal rod, pipe and the like elongated articles to a predetermined temperature comprising a preheater furnace; a holding oven; first conveyor means for moving said articles axially, one at a time, through said furnace for a rapid preheat into said oven; second conveyor and storage means for receiving said articles from said first conveyor means for moving said articles in parallel side-to-side relation across said oven, said second conveyor means comprising at least two

elongated screws extending parallel to but spaced from each other partly across the oven and in the direction of movement of the articles across the oven, each of said screws being rotatable in a direction opposite to the other and having a thread pitch opposite to the other; at least two rails extending parallel to but spaced from each other extending from said conveyor means to said screws, said rails being inclined from the horizontal towards said screws; means for transferring said articles from said first conveyor means to said second conveyor means actuable by switching means adapted to be engaged by incoming articles; switching means for regulating the travel of said second conveyor means adapted to be engaged by articles carried on said second conveyor means; third conveying means for moving said heated articles axially, one at a time, out of said oven; means for transferring said articles from said second conveyor and storage means to said third conveyor means actuable by switching means adapted to be engaged by outgoing articles; and means for automatically controlling the temperature of the oven such that said oven is maintained at a uniform desired temperature.

3. An apparatus for heating metal rod, pipe and the like elongated articles to a predetermined uniform temperature comprising, in combination, a preheater furnace; a holding oven; first conveyor means for moving said articles axially, one at a time, through said furnace into said oven at one side thereof; second conveyor and storage means for receiving said articles from said first conveyor means for moving said articles in parallel side-to-side relation from one side of said oven to the other side, said second conveyor means comprising at least two elongated screws extending parallel to but spaced from each other partly across the oven, each of said screws being rotatable in a direction opposite to the other and having a thread pitch opposite to the other; at least two rails extending parallel to but spaced from each other extending from said conveyor means to said screws, said rails being inclined from the horizontal towards said screws; means for transferring said articles from said first conveyor means to said second conveyor means actuable by switching means adapted to be engaged by incoming articles; switching means for regulating the travel of said second conveyor means adapted to be engaged by articles carried on said second conveyor means; third conveyor means for moving said heated articles axially, one at a time, out of said oven; means for transferring said articles from said second conveyor and storage means to said third conveyor means actuable by switching means adapted to be engaged by outgoing articles; and means for controlling the temperature of the oven such that said oven is maintained at a uniform desired temperature.

References Cited by the Examiner

UNITED STATES PATENTS

1,593,351	7/26	Paige	263—6 X
2,296,806	9/42	Buckholdt	263—8
2,583,764	1/52	Buckholdt	263—8 X
2,792,206	5/57	Wagner	266—3
2,880,844	4/59	Vogeli	214—1

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