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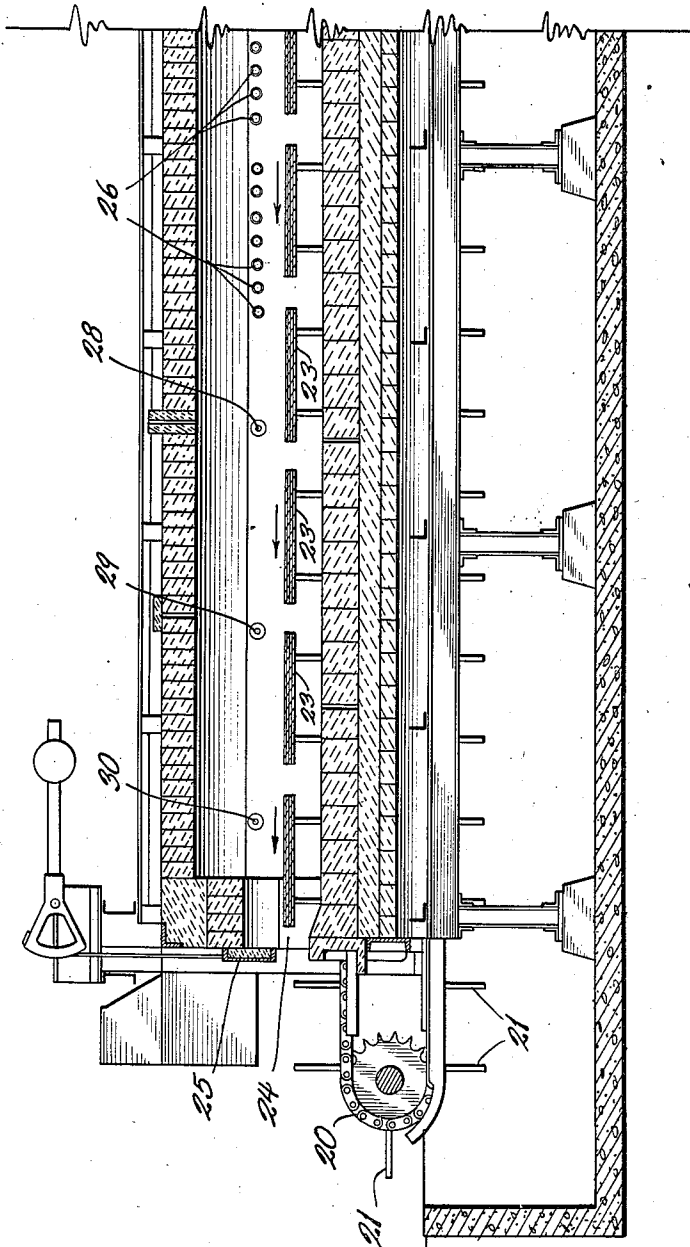
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1,999,832

COOLING CHAMBER OF HEAT TREATING FURNACES

Filed Sept. 14, 1934

6 Sheets-Sheet 1



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COOLING CHAMBER OF HEAT TREATING FURNACES

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6 Sheets-Sheet 2

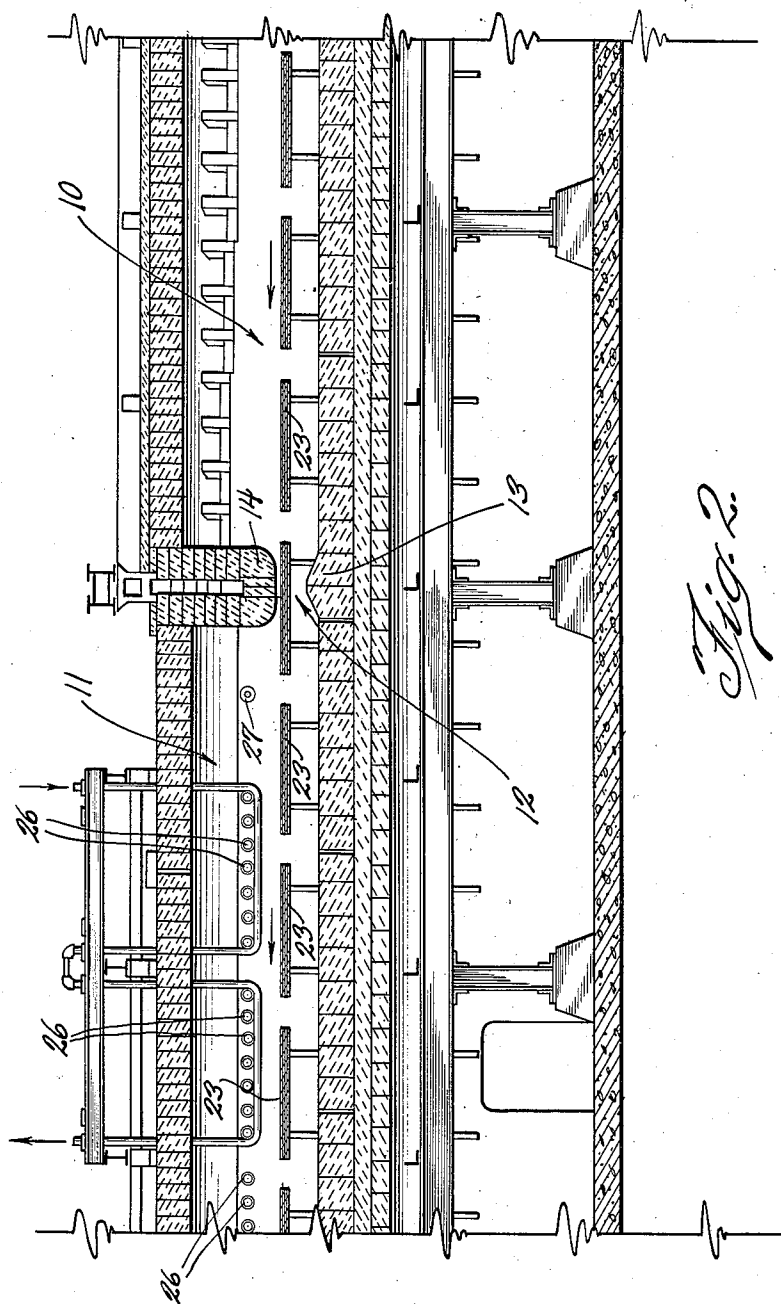


Fig. 2.

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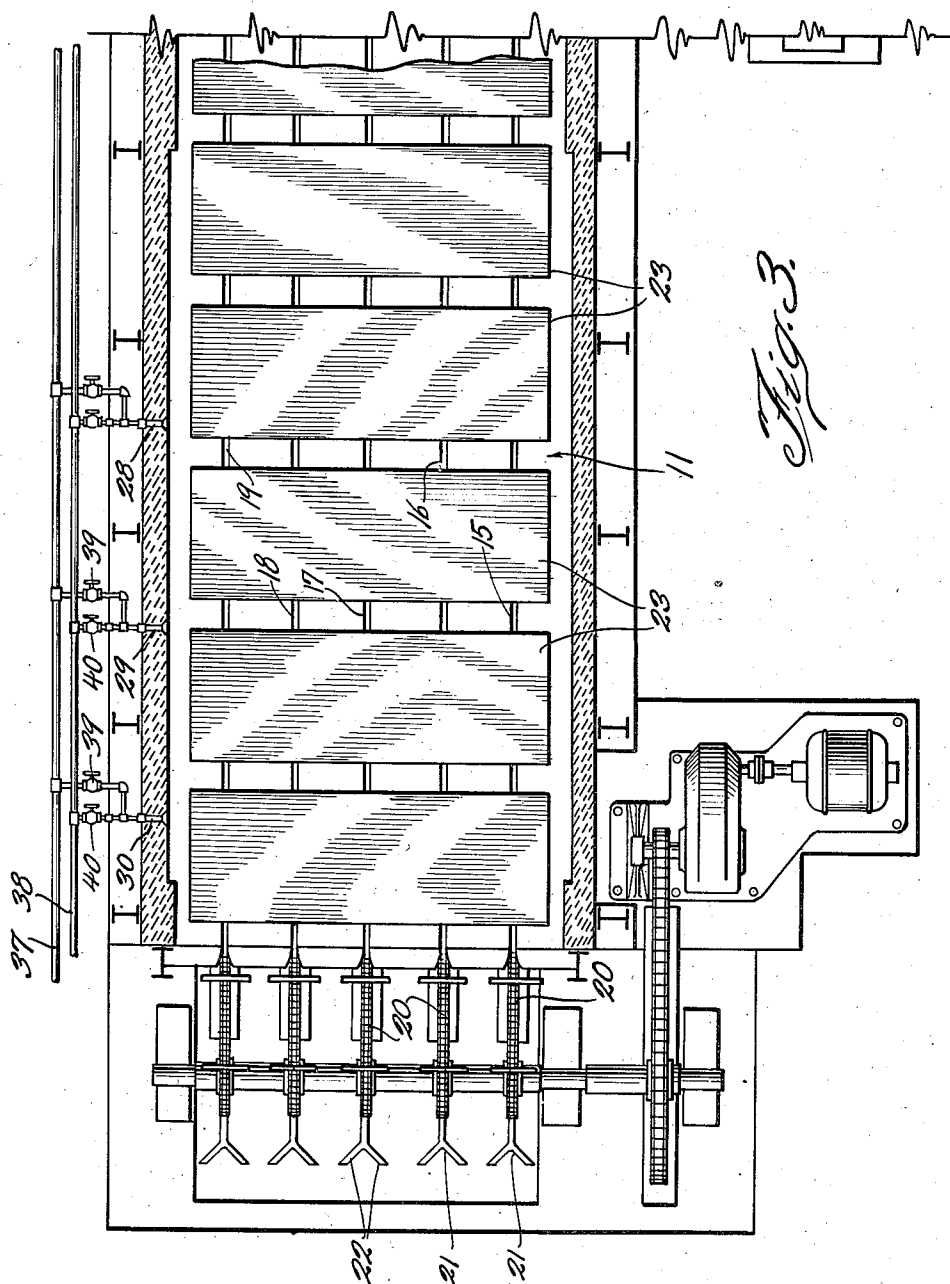
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COOLING CHAMBER OF HEAT TREATING FURNACES

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6 Sheets-Sheet 3



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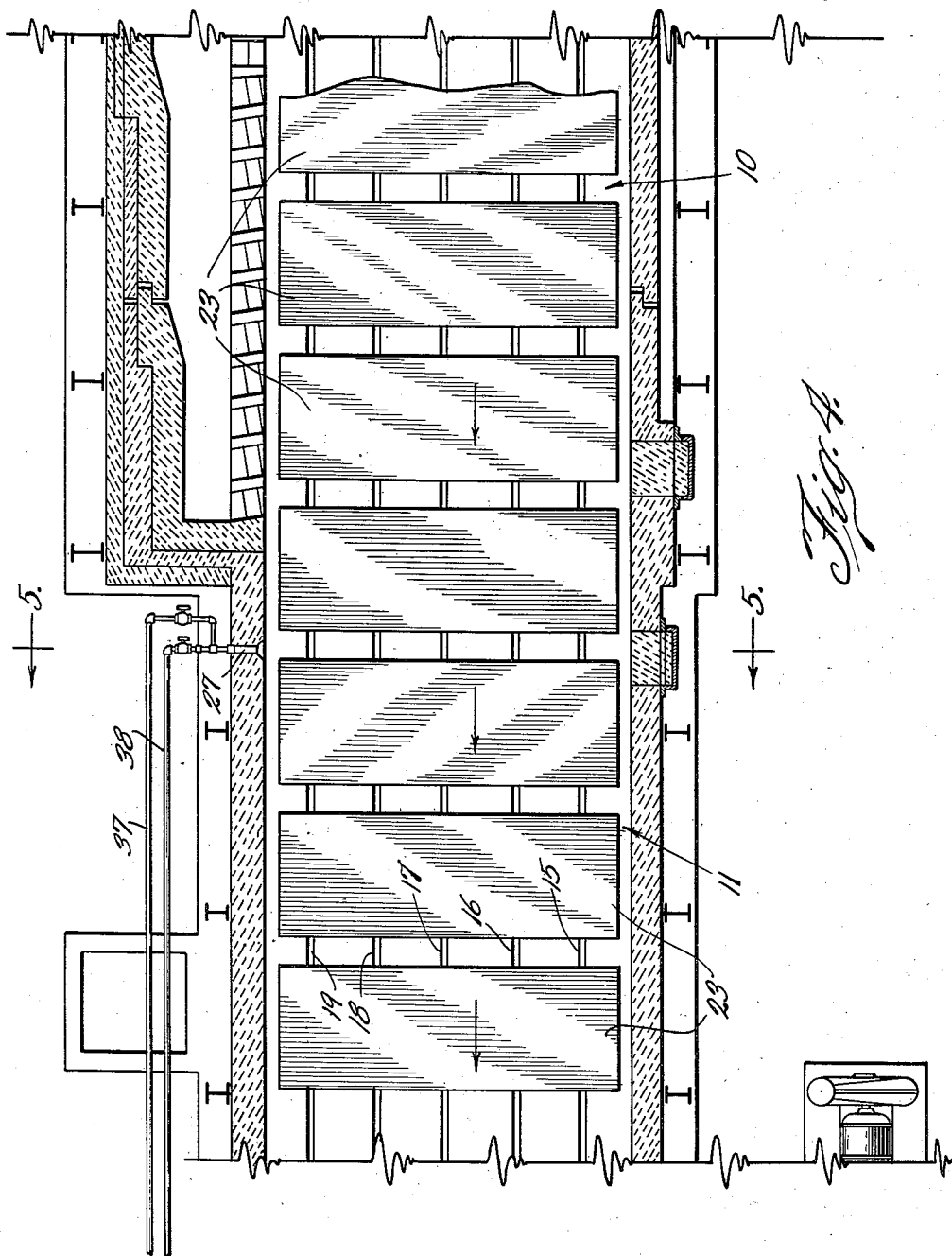
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COOLING CHAMBER OF HEAT TREATING FURNACES

Filed Sept. 14, 1934

6 Sheets-Sheet 4



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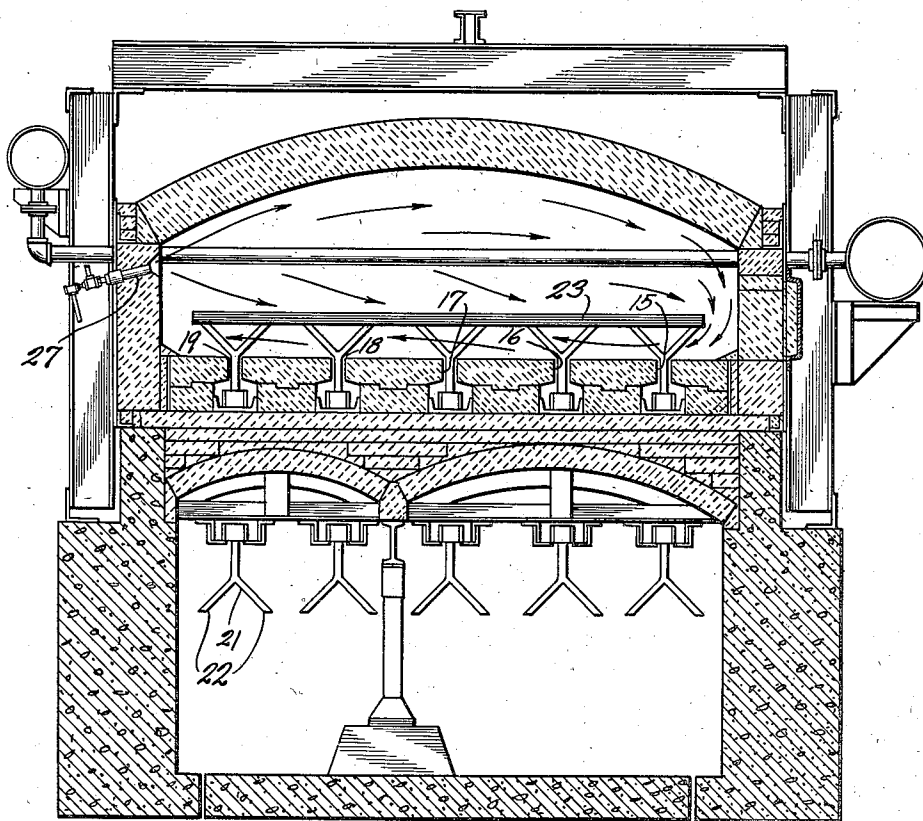
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COOLING CHAMBER OF HEAT TREATING FURNACES

Filed Sept. 14, 1934

6 Sheets-Sheet 5

Fig. 5.



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COOLING CHAMBER OF HEAT TREATING FURNACES

Filed Sept. 14, 1934

6 Sheets-Sheet 6

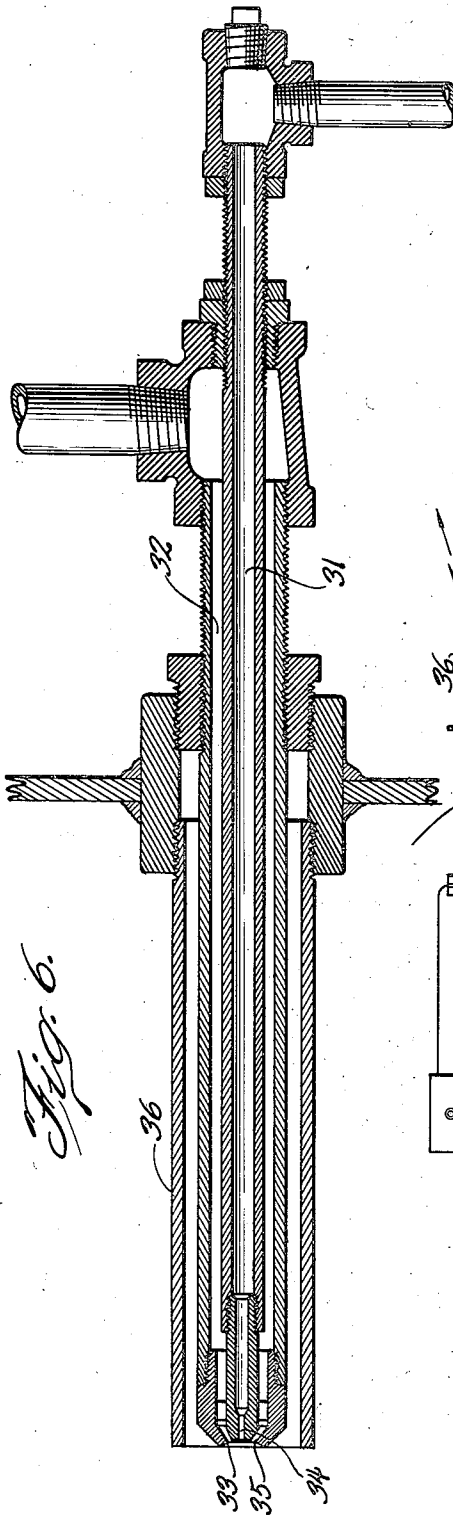
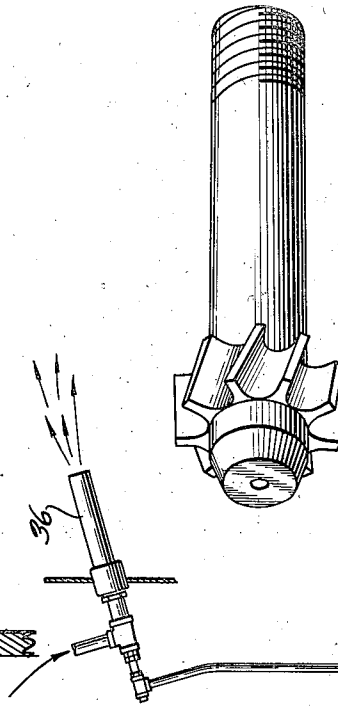


Fig. 6.



1. *Fig.*

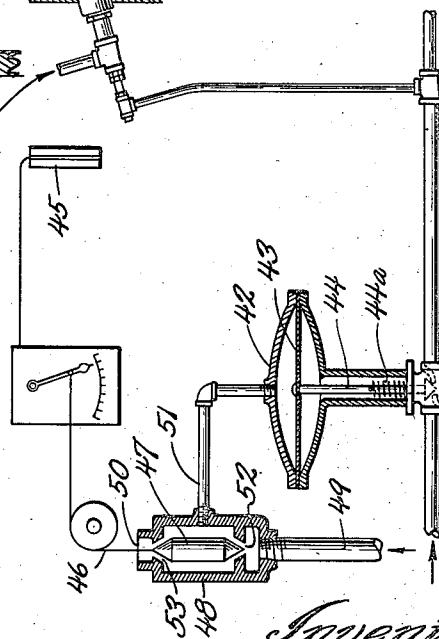


Fig. 8.

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UNITED STATES PATENT OFFICE

1,999,832

COOLING CHAMBER OF HEAT TREATING
FURNACES

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Application September 14, 1934, Serial No. 744,003

18 Claims. (Cl. 263—8)

This invention has reference to improvements in cooling chambers of heat treating furnaces and the like, that is, furnaces for subjecting metal sheets and other objects to normalizing or annealing temperatures for relieving the metal of internal stresses and strains, and also for producing in the metal such other advantageous results as follow from the normalizing or annealing operations. Usually the sheets or other objects are introduced into the cooling chamber of the normalizing or annealing furnace at a relatively high temperature, such for example, as eighteen or nineteen hundred degrees Fah., and as they pass through the cooling chamber of the furnace they have their temperature gradually reduced to, say twelve or thirteen hundred degrees Fah. The subsequent reduction of temperature to normal atmospheric temperature need not be under control since the action in the normalizing or annealing furnace serves to bring the temperature down below the critical point, and accurate control of the further reduction is not required.

One object of the present invention is to provide a cooling chamber wherein the temperatures at different points may be closely controlled, so as to ensure the desired continuous reduction of temperature from the entrance into the cooling chamber to the delivery point therefrom. This reduction of temperature is secured by the use of steam jets and water sprays introduced into the cooling chamber, the quantity of water so introduced at each point being so controlled that the cooling action thereof is proper to maintain the desired temperature at that portion of the normalizing or annealing furnace. These water jets or sprays may be introduced into the cooling chamber in any convenient manner, but preferably they are introduced by steam jets. The quantity of steam required for each water jet or spray is relatively small, and the control of water jet is conveniently secured by valving the water drawn into the nozzle, so as to increase or decrease the amount of water introduced, the steam flow remaining constant. Due to the high latent heat of evaporation of water, the water introduced at each jet or spray will absorb a very large amount of heat from the gases flowing through the cooling chamber of the furnace with corresponding reduction of the temperature of the said gases, so that a considerable cooling action is secured with only a relatively small amount of water introduced.

The water so introduced will flash into steam with the cooling action due to its high latent

heat of evaporation, and this steam will immediately become superheated due to the high temperature existing within the cooling chamber so that wet steam will not be present within such chamber, and thus no damaging action will be produced on the metal sheets or other objects therein. The temperature of the chamber even at the delivery end is sufficiently high to keep the steam in superheated condition up to the time of outflow from the chamber.

Usually the steam and water jets will be so located as to provide the cooling action in zones along the length of the chamber; and the number of jets in each of these zones may be correlated to the amount of cooling action which it is desirable to secure in that portion of the structure.

Another feature of the invention relates to the provision of an arrangement such that the water and steam jets will naturally flow or sweep through the chamber in the most advantageous manner with respect to the material being treated. This material is conveniently carried on brackets or stands which travel through the length of the furnace and cooling chamber; and the jets or sprays are so placed in the chamber wall or walls that the water and steam will flow and circulate over and around the said material, thereby subjecting the material to the desired action both above and below, and ensuring the proper cooling action on all portions thereof. In this connection, when the material is placed in the form of piles or stacks on the stands or brackets, it is especially desirable to ensure a flow of the water and steam such as to cause proper treatment of the lower portions of these piles, and this result is secured by the present arrangement in which the flow is such as to encircle these piles or stacks.

If desired there may be provided automatic means for controlling the valving of the water introduced into each or all of the jets or sprays, such means functioning according to the temperature within the cooling chamber, so that the amount of water drawn in by each jet or spray will vary from time to time as need be to maintain the desired temperatures within the various zones of the chamber.

Other objects and uses of the invention will appear from a detailed description of the same which consists in the features of construction and combinations of parts hereinafter described and claimed.

In the drawings;

Figure 1 shows a central vertical longitudinal

section through the cooling chamber of a normalizing or annealing furnace embodying the features of the present invention, at the delivery end thereof;

5 Figure 2 shows a continuation of Figure 1 towards the entry end thereof, and also includes a portion of the heating furnace from which the materials arrive into the normalizing or annealing furnace cooling section;

10 Figure 3 shows a plan section corresponding to Figure 1;

Figure 4 shows a plan section corresponding to Figure 2;

15 Figure 5 shows a vertical cross-section on the line 5—5 of Figure 4 looking in the direction of the arrows;

Figure 6 shows a longitudinal section through a form of jet or spray for introducing the water;

20 Figure 7 shows a perspective view of a portion of the tip of the arrangement of Figure 6; and

Figure 8 shows diagrammatically a simple arrangement for securing automatic temperature control for the jets or sprays.

25 In the drawings, the heating furnace extends to the right and is designated by the numeral 10. It may be of any suitable construction. The normalizing or annealing furnace cooling chamber is designated by the numeral 11. It reaches to the left from the heating furnace and the 30 sheets or other materials arriving from the heating furnace travel towards the left through the cooling chamber to the point of delivery. The heating and cooling chambers are relatively broad and shallow; and there is a weir 12 between the chambers, said weir being formed by the upwardly extending portion 13 reaching up from the floor, and the downwardly extending portion 14 reaching downwardly from the roof. I do not herein concern myself particularly with 40 the details of construction of the heating furnace, nor with the means for heating the same, since these features do not constitute any portion of the present invention.

45 Extending lengthwise of both the heating and cooling chambers there are the slots 15, 16, 17, 18 and 19. Beneath the floors of the heating and cooling chambers there are the conveyors 20 located in line with the slots just referred to, and these conveyors have connected to them the 50 brackets 21 which are of generally Y-shape. These brackets reach up through the slots 15, 16, 17, 18 and 19, and into the furnace chambers, so that the prongs or forks of these brackets stand up within the furnace chambers. The material to be treated is carried by the upwardly extending 55 arms 22 of these brackets, said material being conveniently placed on the brackets in piles as shown in Figures 1 and 2. In case said material is in the form of sheets, it is generally good practice to place a special sheet at the bottom of each pile to thereby protect the sheets being treated from abrasion or other injury by the bracket arms on which the piles are carried.

65 As the conveyors travel towards the left the brackets move to the left and carry the sheets or other material from the heating chamber through the weir and into the cooling chamber. This action is apparent from examination of Figure 2. Usually the sheets will be placed crosswise on the brackets, the chambers being broad 70 enough to accommodate the lengths of the sheets across the chambers, so that the sheets advance edge-on. The piles of sheets are designated by the numerals 23. When the sheets have completed their travel through the cooling chamber 75

they are delivered therefrom through the weir 24, the opening of which may be controlled by the gate 25.

5 A portion of the cooling action in the cooling chamber may be accomplished by the pipes or tubes 26 which are suspended from the roof of said chamber, and through these pipes or tubes may be flowed air for use in the heating furnace, so that said air performs a cooling action proportionate to the heat so recuperated for the furnace. This cooling action is, however, usually 10 insufficient, and the advantage of this action sometimes lies principally in the delivering of preheated air to the heating furnace.

15 The main feature of the present invention resides in the provision of means for introducing sprays or jets of water into the cooling chamber and under control, so that this so-introduced water will be vaporized by the heat of the chamber and the material therein and with corresponding abstraction of heat, and cooling. For this purpose I have placed one spray designated 27 in one wall of the cooling chamber close to the entering end, and a series of three additional 25 sprays designated 28, 29 and 30 in the wall of said chamber near to the delivery end thereof. Each spray is of the general form shown in Figure 6. It includes the central passage 31 through which the water is introduced, and the surrounding passage 32 through which the steam for the 30 jet is introduced. The water is delivered through the small central opening 34 and immediately meets the conical form steam jet delivered through the thin annular orifice 35, so that the water is immediately taken up by the steam 35 jet and atomized and delivered in the form of a long cone. Generally the control of the action is best performed by leaving the steam setting constant, and adjusting the amount of the water stream. The details of the form of the jets are 40 not necessarily important, since various forms of jets may be used for introducing the water into the cooling chamber, and therefore I do not deem it necessary to describe this jet in further detail. It is, however, in some cases desirable to provide 45 an outside or protective pipe 36 around the nozzle to protect the same from direct action of the heat in the chamber; or when the nozzle is built directly into the wall of the chamber this outside pipe 36 serves to provide the means for attaching 50 the nozzle into the wall.

Reference to Figure 5 in particular shows that the jets are directed upwardly somewhat so that the water delivered into the chamber is thrown 55 upwardly and across the chamber in the form of an arc. This carries said water over the upper portions of the piles of material, to the opposite side of the chamber. There the general current of flow or travel curves downwardly and returns beneath the piles of material towards the originating side of the chamber; so that ultimately 60 a large portion of this cool-stream of vaporizing water is caused to travel completely over and around the material, thereby subjecting the bottom portions of the piles to the cooling effect, and ensuring a well balanced cooling effect for the entire mass of material being normalized or annealed.

65 In the arrangement shown in Figures 3 and 4 there are provided the steam and water manifolds 37 and 38 respectively, which are in turn connected to the several sprays under control of the valves 39 and 40. By this arrangement it is possible to individually control the several jets, so that the cooling actions thereof at the differ- 75

ent locations may be controlled to give the desired effects.

In some cases it may be desirable to provide for automatic control of the several sprays. In such case each or all of the sprays may be placed under control of a thermostatic device, so that as the temperature rises in the cooling chamber the amount of water introduced will also rise, and so that a converse action will be produced in the case of falling of temperature within the chamber. Such an arrangement is shown diagrammatically in Figure 8. In this case the water line to the jet is under control of a valve 41, it being intended that the steam line shall remain at a constant setting. There is provided a diaphragm motor 42 the diaphragm 43 whereof is connected to the valve 41 by the rod 44. There is a weight 45 which tends to raise the valve to the full open condition, but when pressure is introduced on the top of the diaphragm it is forced down, lifting the weight and seating the valve to a proportionate degree. A spring 44a may be provided to supplement, or as a substitute for the weight.

There is provided a pyrometer or other temperature measuring device 45 at that point in the chamber where it is desired to effect the control, and which is affected by the spray in question. This pyrometer may be any suitable form, and the details thereof do not require illustration herein since they do not constitute any portion of the present invention.

This pyrometer includes a chamber wherein there is suitable heat responsive mechanism such that upon rise of temperature within the chamber a cord 46 will be proportionately released, whereas when the temperature falls this cord will be proportionately pulled back. This cord in turn is connected to a plunger valve 47 working within a chamber 48, there being an air inlet 49 at the lower portion of the chamber, and an air escape opening 50 at the upper portion of the chamber, and an air delivery connection 51 at one side of the chamber. Compressed air from any suitable source is delivered to the connection 49. When the plunger 47 is in its lowered position it closes a port 52 and opens a port 53. This discontinues the delivery of compressed air to the connection 51 and also permits said connection 51 to be vented. The connection 51 is in turn connected to the top face of the diaphragm, so that under these conditions the diaphragm is released, and the water valve opens fully. When the temperature conditions so change that the plunger valve 47 is raised, the escape of air from the connection 51 is proportionately cut off, and the compressed air connection 49 is permitted to deliver compressed air to a greater or less extent to the top face of the diaphragm, so that the water valve is correspondingly closed. Thus there is secured an automatic control of the water supply in accordance with the temperature conditions existing within the cooling chamber, increasing the water spray when the temperature rises, and decreasing the water spray when the temperature falls. As above stated the pyrometer may be of any suitable form, such as a Leeds & Northrup, or a Brown, or other suitable type.

It will be noted that the cooling and control thereof effected by the introduction of the water sprays serve also to prevent any abnormal or excessive rises of temperature, and also serve to prevent such rises of temperature suddenly, so that the tubes 26 of the recuperator are protected

against any excessive temperatures and therefore against any burning.

By introducing the water in the form of several sprays located at different positions in the length of the furnace I am enabled to introduce a total amount of water sufficient to produce the total desired cooling action but without such a concentration of water vapor at high temperature at any given point as might be injurious to the metal sheets or other objects at such location. Also, a considerable portion of the water is introduced at points or zones of such lowered temperature as will not cause any damage to the metal sheets due to the presence of such water vapor.

While I contemplate as being within the scope of my invention the use of any suitable form of spray or means for introducing the water into the cooling chamber of the normalizing or annealing furnace, still I wish to point out that a steam-actuated water spray is peculiarly adapted to the present work, and there is a peculiar combination thereof with the cooling chamber of the normalizing or annealing furnace. This is because the steam serves to ensure a constant atomizing action of the water and thus ensures that there will not be any drippage of atomized water or unatomized water into the chamber and onto the sheets or other materials being treated. Furthermore, the form of nozzle herein illustrated in Figures 5 and 6 is such that a small particle of dirt or other foreign matter cannot clog the nozzle since the nozzle openings are large and the power of the steam jet will at all times serve to cause particles of foreign matter to be carried out from the relatively large openings of the nozzle. Also, the steam spray is desirable since it is non-oxidizing and serves to carry and distribute the water to all portions of the space within the cooling chamber with consequent distribution of the cooling effect. It also serves to produce a current across the direction of travel of the sheets or other objects so as to carry its effect clear across the chamber, said current then turning downwardly beneath the sheets or other objects, towards the point of origin.

I wish to also point out that in some cases it may be desirable to place the steam supply for the jets or for each jet under thermostatic control, instead of placing merely the water supply under such control.

While I have herein shown and described only a single embodiment of the features of my present invention, still I do not intend to limit myself thereto except as I may do so in the claims.

I claim:

1. The combination with a cooling chamber of a furnace for heat treating metal objects, said furnace having means for transport of the metal objects through its length, of means for cooling and controlling the temperature within said cooling chamber, comprising means for introducing jets of water into the chamber transversely thereof and above the objects being transported there-through, to thereby absorb heat into the water and evaporate said water, substantially as described.

2. The combination with a cooling chamber of a furnace of the type described, said furnace having means for transport of metal objects lengthwise thereof, of means for cooling and controlling the temperature within said cooling chamber comprising means for introducing jets or sprays of water transversely of the chamber, and above the metal objects, said sprays flowing over the

metal objects and downwardly and back beneath the metal objects, substantially as described.

3. The combination with a cooling chamber of a furnace for heat treating metal objects, said furnace having a conveyor for transporting the metal objects lengthwise of the furnace, of a series of spray nozzles in the side wall of the cooling chamber, each nozzle being adapted for spray of a water jet transversely of the chamber, and the several nozzles being directed upwardly to thereby cause the sprays to flow upwardly and transversely of the chamber, whereby the sprays flow upwardly and across the chamber above the metal objects, and then flow downwardly and return below the metal objects, substantially as described.

4. The combination with a cooling chamber of a furnace for heat treating metal objects, said furnace having means for conveying the objects lengthwise thereof while supported above the furnace floor, of means for cooling and controlling the temperature of the cooling chamber, comprising a series of jets for water located in the wall of the chamber and directed upwardly and transversely of the chamber, and adapted to throw water sprays upwardly and across the chamber, whereby said sprays travel across the chamber above the metal objects, and return beneath the metal objects, substantially as described.

5. The combination with a heat treating chamber for metal objects, said chamber having means for transport of the objects lengthwise of the chamber and supported above the floor of the chamber, of means for controlling the temperature and effecting cooling action within the chamber, comprising a series of sprays for water located in the wall of the chamber and directed across the chamber, together with means for controlling the water jets according to the temperature existing within the chamber, substantially as described.

6. The combination with a heat treating chamber for metal objects, said chamber having means for transport of the objects through the chamber, of means for cooling and controlling the temperature within the chamber, comprising a series of sprays for water located at different positions lengthwise of the chamber and in different zones of control, each of said sprays being adapted to direct a spray of water across the chamber, together with means for controlling the several sprays individually to thereby control the cooling action in the different zones individually, substantially as described.

7. The combination with a chamber for heat treating metal objects, of means for controlling the temperature within the chamber and for effecting cooling action therein, comprising means for introducing jets of water into the chamber under control according to the temperature existing within the chamber, substantially as described.

8. The combination with a chamber for heat treating metal objects, of a series of water sprays located at different positions in the wall of the chamber, together with means for delivering to each of said sprays a supply of water according to the cooling action to be produced at the position of said spray, substantially as described.

9. The combination with a chamber for heat treating metal objects, and for cooling said objects under control, of means for lowering the temperature within the chamber comprising means for introducing into the chamber a series

of jets of water of controlled amount according to the cooling action to be produced at the position of each said jet, substantially as described.

10. The combination with a chamber for heat treating metal objects, and for cooling the same, of means for spraying into said chamber a fine spray of water to be evaporated by the heat of the chamber, to thereby lower and control the temperature within the chamber, substantially as described.

11. The combination with a heat treating furnace having a cooling chamber, and a recuperator within said cooling chamber and subject to the heat thereof, of means for controlling the temperature within the cooling chamber comprising means for introducing a spray of water into said cooling chamber to thereby prevent excessive temperatures in said chamber, and to maintain the temperature within said chamber under control, substantially as described.

12. The combination with a hot chamber and a recuperator subject to the heat thereof, said recuperator being composed of metal tubes, of means for controlling the temperature within the chamber to thereby control the temperature of the recuperator, comprising means for introducing a spray of water into the chamber to thereby control the temperature within the same, and thereby prevent excessive temperatures within said chamber, substantially as described.

13. The combination with a hot chamber and a recuperator subject to contact by the gases and heated by the heat of the gases, of means for controlling the temperature of said gases comprising means for introducing a spray of water into said gases to thereby prevent excessive temperatures in said gases contacting the recuperator and substantially as described.

14. The combination with a hot chamber and a metal tube recuperator subject to contact by the gases and heated by the heat of the gases, of means for controlling the temperature of said gases comprising means for introducing a spray of water into said gases to thereby prevent excessive temperatures in said gases contacting the recuperator and under control, substantially as described.

15. The combination with the cooling chamber of a heat treating furnace having means for transport of metal objects therethrough, of means for cooling said chamber and controlling the temperature thereof, comprising means for introducing a spray of water into said chamber including steam means for atomizing the water of said spray, whereby the water of said spray is atomized by the steam and drops of said water are prevented from forming and coming into contact with the metal objects within the chamber, substantially as described.

16. The combination with the cooling chamber of a heat treating furnace having means for transport of metal objects therethrough, of means for cooling said chamber and controlling the temperature thereof, comprising means for introducing a spray of water into said chamber at an elevation above the metal objects and including steam means for atomizing the water of the spray, whereby said water is fully atomized and the formation of drops of water is prevented, and whereby said water is prevented from dripping onto said metal objects, substantially as described.

17. The combination with a chamber of the type described, said chamber having means for trans-

port of metal objects therethrough, of means for cooling and controlling the temperature within said chamber comprising means for introducing jets or sprays of water into said chamber, substantially as described.

5 18. The combination with a chamber of the type described, said chamber having means for

transport of metal objects therethrough, of means for cooling and controlling the temperature within said chamber, comprising means for introducing a spray of water into said chamber under steam propulsion, substantially as described. 5

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