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⑤ Int. Cl.³: **C 21 D 9/00**

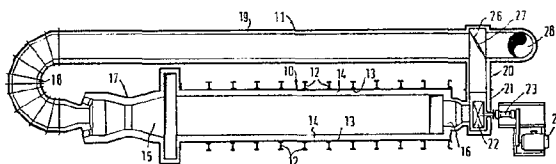
②② Date of filing: 21.01.80

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57) An installation (10, 11) for heating and cooling hot-rolled products comprising a pit (10) into which the products are put immediately upon leaving the rolling mill, a duct (11) connecting a gas inlet (15) to the pit (10) and a gas outlet (16) from the pit (10) and means (22) to circulate gas through the pit (10) and the duct (11) during cooling and heating of the products in the pit (10); means is provided for heating either the products directly or the gas.



P78.067/BT Heat Treatment of Metal Products

5 This invention relates to methods of and apparatus for the control of heating and cooling of metal products especially semi-finished products such as steel billets, bars and rounds. The purpose of such heating and cooling is to obtain desired physical properties in the product particularly to facilitate dividing the product into shorter lengths or machining it or both.

10 In conventional practice steel semi-finished products such as billets immediately after hot rolling are slow cooled in a refractory lined pit which is closed by a lid or lids. The purpose of such slow cooling is to prevent cracking and to produce a soft structure in the steel suitable for division. Alloy steels in particular need to be treated in this way.

15 For many steels merely slow cooling is not sufficient to produce an overall soft structure in the product and in conventional practice further processing in a separate annealing furnace is necessary after prior cooling on cooling beds or in slow cooling pits. Conventional annealing is
20 therefore both slow and wasteful of heat since the product has to cool first before it can be handled and transferred to the annealing furnace. The heat given out by the hot product is wasted since it will be appreciated that the products come off the rolling mill hot.

25 According to one aspect of the invention we provide an installation for the heat treatment of metal products comprising an elongated pit to receive the products, a removable lid for the pit, a gas inlet at one end of the pit, a gas outlet at the other end of the pit, a duct connecting the
30 inlet and the outlet and a means to circulate gas through the circuit comprising a pit and duct, and means to heat the products in the pit.

In such an installation, hot products will normally be laid into the pit and the lid placed in position. The temperature of the products could be equalised above the temperature of the critical range by circulation of heated
5 gases and thereafter cooling at a controlled rate could take place through the critical range to achieve a desired hardness.

Alternatively cold products could be laid in the pit, heated to a desired temperature by the heating means and then
10 subjected to a desired rate of controlled cooling.

The means for heating the products could be a burner associated with the inlet to heat the gas entering the pit or could be resistance or induction heating means associated with the pit to heat the products directly.

15 Preferably, the means to circulate the gas through the pit and the duct is a fan which is preferably located at the output end of the pit.

There may be valve means associated with the outlet from the pit and selectively operable to direct gases leaving the
20 pit to the duct or to the exhaust. There may be means adjacent the inlet operable to introduce cool gas, e.g. air, into the pit. Thus if rapid cooling is required, cool air may be introduced into the pit at the inlet and the valve means can be operated to discharge the cool air through the
25 exhaust at the outlet end of the pit thus avoiding cooling of the circulating duct. There may be flexible deflectors attached to the lid so as to extend downwardly from the lid to engage the upper surfaces of the products in the pit so as to provide obstruction to the free flow of gas between the
30 inlet and the outlet. The gas is thus forced to flow over and between the products rather than taking the path of least resistance between the inlet and the outlet which would be over the products if the deflectors were not provided. A

heat transfer is thus promoted between the gas and the products.

The deflectors may be chains or mesh carrying refractory materials such as, for example, asbestos wool.

5 The invention also includes the combination of a rolling mill for metal products, an elongate pit adjacent the exit from the rolling mill, means to transfer products directly from the rolling mill exit to the pit, a removable lid for the pit and means associated with the pit for heating
10 products therein.

By this arrangement, the desired heat treatment of the products can be effected in a single pit adjacent to the rolling mill exit and this saves handling in the manner described above.

15 The invention also includes a rolling mill for metal products having, adjacent the exit therefrom an installation as above described and means to transfer the products directly from the mill exit to the installation.

20 The transfer means may comprise an apertured rack to hold metal products at the exit from the rolling mill and a plurality of aligned grabs carried by a crane and arranged to engage the products in the apertures in the rack.

25 The invention also provides a method of heat treating metal products in an installation as described above comprising placing the products in the pit and heating them to a desired temperature.

30 The invention further provides a method of heat treating, hot-rolled products comprising placing them in an enclosure while still hot from the rolling mill, cooling the products by circulating gas between them and using the heat

rejected by the products to the gas to equalise the temperature of the products and to heat the enclosure and a gas circulating duct.

5 The method may include heating the products or the gas to equalise the temperature thereof before cooling. The method may include re-heating the products in the pit after initial cooling and then again cooling the products, the heating and cooling taking place while gas is being circulated between the products.

10 The method may include rapid cooling of the products in the pit by introducing cool air into the pit to flow between the products but preventing said cool air from circulating through the gas circulating duct.

15 The term "metal products" as used herein will be understood to refer to any metal semi-finished products and particularly but not exclusively to ferrous products such as steel billets, bars or rounds.

The invention will now be described in detail by way of example with reference to the accompany drawings in which :-

20 Figure 1 is a vertical section through an installation embodying the invention; and

Figure 2 is a horizontal section through the installation of Figure 1; and

25 Figure 3 is a diagram illustrating the relationship between the exit of a rolling mill and installation embodying the invention.

Referring first to Figures 1 and 2, the installation comprises a pit indicated generally at 10 and a recirculation duct indicated generally at 11. The pit comprises a frame-

work of structural steel some of the beams of which are indicated at 12 and this is lined with a steel lining 13 which in turn is lined with a lining of refractory material 14.

5 The pit is elongated and has an inlet for gas at one end indicated at 15 and an outlet for gas at the other end indicated at 16. The inlet and the outlet are connected by the recirculating duct 11. A burner section is indicated at 17 adjacent the inlet 15 and the duct comprises a hairpin
10 bend section 18 connecting the burner section 17 to a straight section 19. At its other end the straight part 19 of the duct is connected by a straight portion 20 to a fan housing 21 which is open to the outlet 16. A paddle type fan 22 is mounted in the fan housing on a shaft 23 and is driven
15 by an electric motor 24 via Vee belts 25.

At the junction between the duct portions 19 and 20 is a valve 26 pivotable about a vertical axis 27 between the position shown in which the duct parts 19 and 20 are in communication and another extreme position in which it is
20 inclined to the right in Figure 2 so as to place the duct part 20 in communication with the flue 28.

The floor of the pit has a slot 28 therein which leads to a waste gas flue 29 which in turn leads to a common flue 30 for a number of installations arranged side by side.

25 At the end of the pit adjacent to the inlet 15 there is a further slot 31 in the floor of the pit which communicates with a fresh air inlet 32 having a controlling flap valve 33.

30 The pit has a lid 34 which is made up on a steel frame and is lined with refractory material at 35. Flexible deflectors, one of which is shown at 36, extend from the lid so as to rest upon a supply of products within the pit, the products not being shown in the drawing.

Referring now to Figure 3, the exit from a rolling mill is indicated at 40 and comprises a roller table 41 and an adjustable stop 42. The exit from the rolling mill is located between two groups of installations similar to that described in relation to Figures 1 and 2, one of the groups to the left of the exit being indicated at 43 and the group to the right of the exit being indicated at 44. Running above the installations is an overhead crane indicated generally at 45 and moveable between the extreme positions indicated at 45a and 45b.

The crane comprises a number of grabs, one of which is shown at 46 and having a pair of jaws 47, 48 which are shown in their closed positions but which can retract into the grab body. Adjacent to the roller table is a rack 49 which is apertured at intervals along its length. It is to be noted that there is a table 50 and that the rack has a junction at 51 with the table. The products are pushed off the table over the junction 51 and into the rack 49. This is effected by a push-off mechanism 52.

The operation of the arrangement is as follows. The products are delivered from the rolling mill hot onto the roller table 41 until they engage the stop 42. The products are removed from the table singly or in groups by means of the push-off mechanism 52 so that a group of products accumulates in the apertured rack 49. The crane 45 then is moved over the rack and the grabs 46 are dropped down with the jaws 47 and 48 opened so that each grab is arranged in an aperture of the rack. The grabs are lowered until the jaws 47 and 48 of each grab can encircle the products in the rack and the jaws 47 and 48 are then closed and the grabs lifted to lift a group of products out of the rack. It will be seen that the products are supported at a number of positions corresponding to the number of grabs 46. The group of products is then moved by the crane to position over one of the pits and the grabs can be lowered as shown for example in

dotted lines at 46a to deposit the products in the pit. When the pit has the desired amount of products put therein, the lid of the pit is placed in position over the pit so that the flexible deflectors 36 rest on the top of the pile of products in the pit. The floor of a pit is made as a labyrinth and the effect of this and the deflectors is that, as will be described below, when gas is circulated through the pit and the circulation duct the gas is forced to flow between and around the products rather than taking the shortest path over the products or under them.

The temperature of the products will be equalised and this may require operation of the burner because the ends of the products will have cooled relative to the middle portions thereof. Once the ends of the products have been heated, the burner is turned off and the products are allowed to cool while gas is circulated through the pit and the recirculation duct by operation of the fan 22. The heat rejected from the products heats the pit and the recirculation duct.

There can be a number of different heat treatment procedures carried out. In the simplest procedure, after the temperature of the products has been equalised, the products are allowed to cool at a controlled rate while the gas is recirculated as described above. The controlled cooling will take place through the critical range of the steel and then rapid cooling will take place by allowing cool air to enter through the inlet 32 by opening the valve 33 but this air will be vented to the exhaust flue 28 by moving the valve 27 so as to connect the pit to the flue. The cool air thus does not cool down the recirculation duct which can be retained hot for the next load of products. If any waste gas is needed to be bled off during operation, this passes through the slot 28 a into the flues 29 and 30.

In an annealing procedure, the products are allowed to cool as before through the critical range. When they have

cooled through the critical range, the burner section is operated and the products are reheated through the critical range and are then held at a temperature above the critical range. During heating and holding, gas is recirculated
5 through the pit and the recirculation duct by the fan and the burners are operated as required to maintain the temperature. After the products have been held at the required temperature for the required time, they are cooled at a controlled rate by recirculating the gas through the pit and recirculation
10 duct without operation of the burner and then are rapidly cooled after they have been cooled below the critical range as described above.

In a still further cycle, the products can be rapidly cooled by letting cold air into the inlet 32 and exhausting
15 it to the flue 28 and then held at a comparatively low temperature for a desired time and then re-heated by operation of the burner section, held within the critical range, allowed to cool and then held just below the critical range and then rapidly cooled.

20 It will be appreciated that the installation can be used to provide a number of different heat treatment procedures.

CLAIMS

1. An installation for heating and cooling metal products, characterised by the provision of an elongated pit (10) to receive the products, a removable lid (34) for the pit, a gas inlet (15) at one end of the pit, a gas outlet (16) at the other end of the pit, a duct (11) connecting the inlet and outlet, means (22) to circulate gas through the circuit comprising the pit (10) and the duct (11) and means to heat products in the pit.

2. An installation according to claim 1 further characterised in that the heating means comprises one or more burners associated with the inlet (15) to heat the gas.

3. An installation according to claim 1 further characterised in that the means to heat the products comprises electrical resistance or induction heating associated with the pit (10) to heat the products directly.

4. An installation according to any one of the preceding claim further characterised in that the means (22) to circulate the gas comprises a fan.

5. An installation according to claim 4 further characterised in that the fan (22) is located adjacent the outlet (16) from the pit.

6. An installation according to any one of the preceding claims further characterised in that valve means (26) are associated with the outlet (16) and are selectively operable to direct gas leaving the pit (10) to the duct (11) and to exhaust (28).

7. An installation according to any one of the preceding claims further characterised by the provision of means (32) adjacent the inlet (15) to the pit operable to introduce cool gas into the pit.

8. An installation according to any one of the preceding claims further characterised by the provision of deflectors (36) extending downwardly from the lid (34) to engage the upper surfaces of products in the pit.

5 9. A combination of an installation as claimed in any one of the preceding claims with a rolling mill for steel products, characterised in that said installation is adjacent to the exit from the rolling mill and the combination includes means (45) to transfer products directly from the
10 rolling mill exit (40) to the pit (10) of said installation.

10 10. A combination of a rolling mill for metal products, and an elongated pit adjacent to the exit to the rolling mill, characterised in that means (45) are provided to transfer the products directly from the rolling mill exit
15 (40) to the pit (10), a removable lid (34) for the pit and means associated with the pit for heating products therein.

20 11. A combination according to either of claims 9 or 10 further characterised in that the transfer means further includes an apertured rack (49) to hold products at the exit (40) from the rolling mill and a plurality of aligned grabs (46) carried by a crane (45) and arranged to grip the products in the apertures of the rack and transport the products from the rack to the pit (10).

25 12. A method of heat treating metal products in an installation as claimed in any one of claims 1 to 8 characterised by the steps of placing the products in the pit (10) and heating the products to a desired temperature.

30 13. A method of heat treating hot-rolled metal products in an installation as claimed in any one of claims 1 to 8 characterised by the steps of placing the products in the pit (10) while still hot from a rolling mill, cooling the products by circulating gas over them and using the heat

rejected from the products to the gas to equalise the temperature of the products and to heat the pit (10) and the gas circulating duct (11).

14. A method according to claim 13 further characterised by the step of heating the products or the gas to equalise the temperature thereof before cooling.

15. A method according to either one of claims 13 or 14 further characterised by the step of re-heating the products in the pit (10) after initial cooling and then cooling again while re-circulating gas over the products.

16. A method according to any one of claims 13 to 15 further characterised by the step of rapidly cooling the products in the pit (10) by introducing cool air into the pit to flow over the products therein but preventing said air flowing through the re-circulating duct (11).

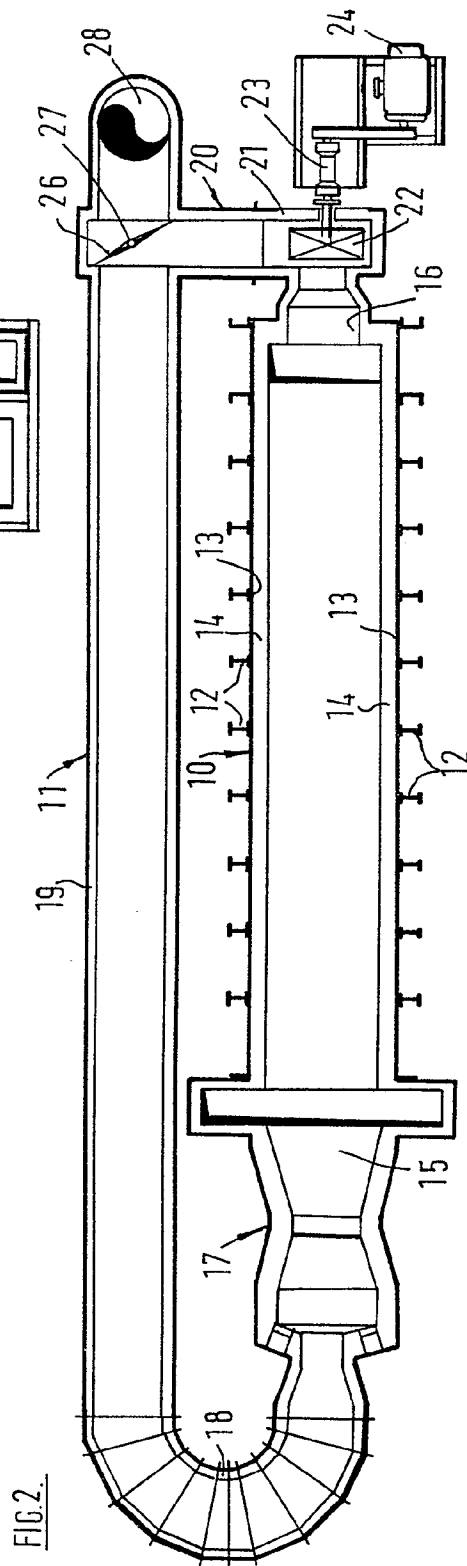
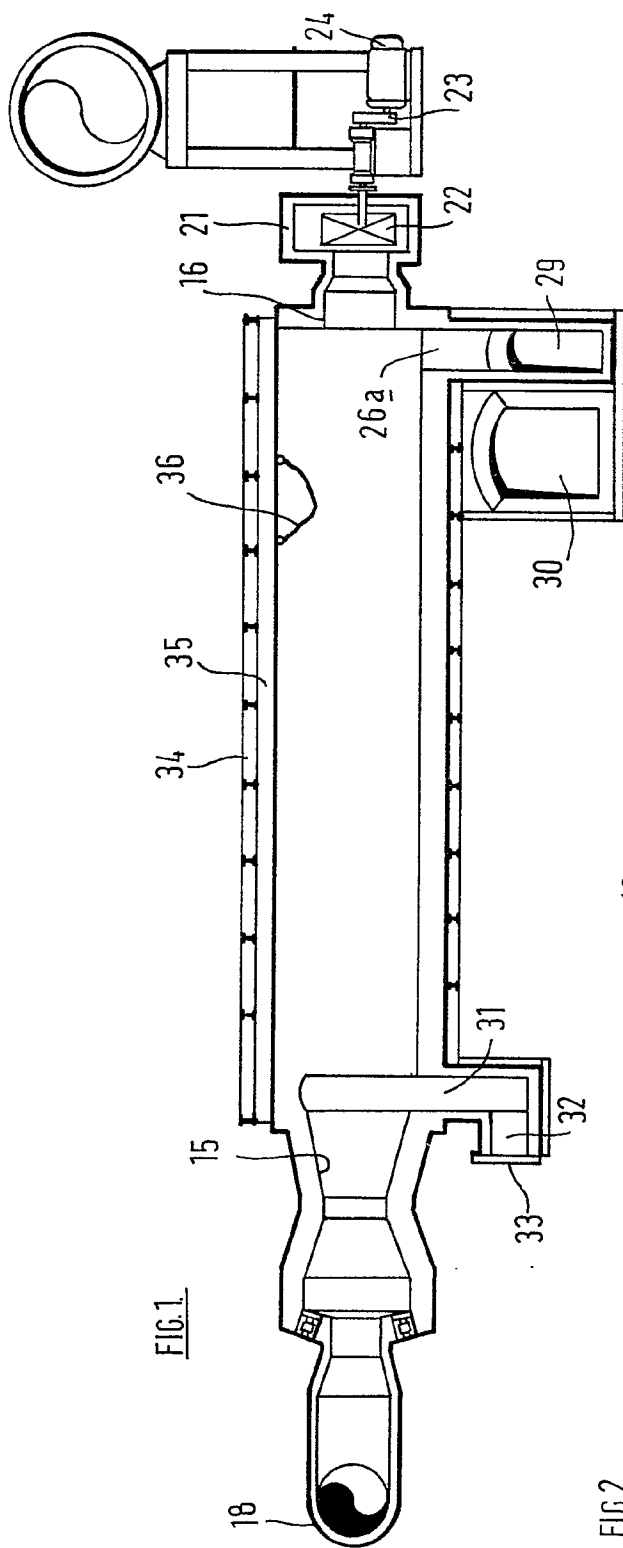
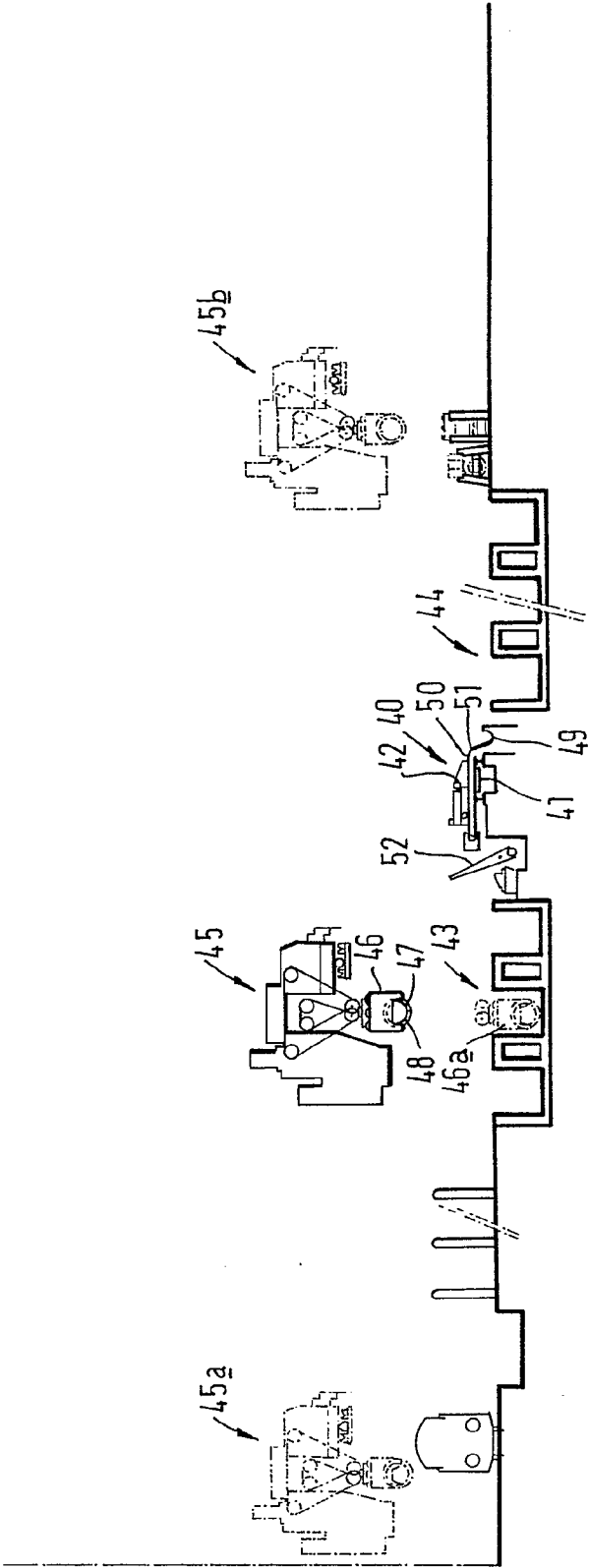


FIG. 3.





European Patent
Office

EUROPEAN SEARCH REPORT

0018059

Application number

EP 80 30 0183

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. CL3)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
A	<u>DE - C - 433 279</u> (SIEMENS) --		C 21 D 9/00
A	<u>DE - C - 488 450</u> (REISCHACH & CO.) --		
A	<u>DE - C - 722 948</u> (AEG) --		
A	<u>FR - A - 860 311</u> (CURRAN BROTHERS et al.) --		
A	<u>FR - A - 932 145</u> (HEURTEY & CIE) --		
A	<u>GB - A - 930 063</u> (STEEL COMP. OF WALES) --		C 21 D 9/00
A	<u>US - A - 2 277 592</u> (SALEM ENGINEERING) --		
A	<u>US - A - 2 619 341</u> (SUNBEAM CORP.) --		
A	<u>US - A - 3 470 624</u> (HISPANO-SUIZA) --		
A	<u>US - A - 4 032 365</u> (CATERPILLAR TRACTOR) ----		
			TECHNICAL FIELDS SEARCHED (Int. CL3)
			CATEGORY OF CITED DOCUMENTS
			X: particularly relevant A: technological background O: non-written disclosure P: intermediate document T: theory or principle underlying the invention E: conflicting application D: document cited in the application L: citation for other reasons
			&: member of the same patent family, corresponding document
X The present search report has been drawn up for all claims			
Place of search	Date of completion of the search	Examiner	
Berlin	06-05-1980	SUTOR	