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(54) **CONTINUOUS CURING OR DRYING INSTALLATION FOR SHEET METAL STRIP**

KONTINUIERLICHE AUSHÄRTUNGS- ODER TROCKNUNGSANLAGE FÜR STAHLBLECH

INSTALLTION POUR LE DURCISSEMENT OU LE SÉCHAGE DE BANDES MÉTALLIQUES EN CONTINU

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Description

Technical Field

[0001] The invention relates to the field of treatment of sheet metal strip, and especially to a continuous drying or a curing oven followed by a cooling system for processing coated sheet metal strip. The invention describes continuous curing or drying installations for sheet metal strip, including cooling systems in it, as well as methods of operation of such installations. Examples of application are in the production process of grain oriented electrical steel, in the production process of non-grain oriented electrical steel and in producing coil coated sheet metal strips (made out of e.g. steel or aluminium).

Background Art

[0002] Sheet metal strip can be coated in a continuous curing or drying installation. After - single or double sided - coating of the sheet metal strip, the coating is cured or dried in a continuous curing or drying installation. The sheet metal strip needs to be cooled inline after the drying or curing oven prior to coiling or reeling the sheet metal strip.

[0003] The cooling is performed by means of cooling air in a cooling system installed downstream of the continuous curing or drying oven. In a range of specific prior art cooling systems several consecutive cooling chambers are provided along the length of the cooling system. The sheet metal strip goes consecutively through each of the cooling chambers. Each of the cooling chambers has a fan to extract air out of the cooling chamber from at the sheet metal strip and evacuates that air; and another fan is installed to blow fresh cooling air onto the sheet metal strip in that specific cooling chamber. Such cooling systems achieve highly efficient cooling.

[0004] However, the installations and especially the cooling systems of the prior art have a number of drawbacks.

[0005] US4299036A discloses an oven for drying of a coating - e.g. paint. The oven has a series of separate and isolated chambers which are horizontally aligned and sealed from each other and the ambient atmosphere and through which a continuous element is passed for treatment by heated gas within the chambers. The oven - which can comprise a cooling section - is provided with means for circulating heated gas to the chamber of the oven last-to-be-encountered by the element and cascading such heated gas successively through the other chambers to the first chamber to be encountered by the traveling element, or in an upstream direction relative to the travel of the element.

Disclosure of Invention

[0006] According to a first aspect of the invention a method is provided as in claim 1. The installation comprises a continuous curing or drying oven, and downstream of it a cooling system. The cooling system comprises a number of consecutive cooling chambers along the direction of movement of the sheet metal strip. The cooling system comprises at least one fan. At least one of the at least one fans is provided for extracting air from in one cooling chamber, preferably from at the sheet metal strip, and for blowing the extracted air back onto the sheet metal strip in another cooling chamber than from where the air has been extracted. Preferably, the same fan is provided for extracting air from in one cooling chamber, preferably from at the sheet metal strip, and for blowing the extracted air back onto the sheet metal strip in another cooling chamber than where the air has been extracted.

[0007] Preferably, the installation comprises an inline coating station, for single or double sided coating of the sheet metal strip, whereby the continuous curing or drying oven is provided for curing and/or drying the coating applied in the coating station.

[0008] Preferably, the cooling system is set up in such a way that cooling air can be blown from both sides of the sheet metal strip. It is preferred when fans for extracting air from at the sheet metal strip and for blowing the air back onto the sheet metal strip to cool it, are connected with both sides of the sheet metal strip, hence, that both sides are cooled by means of air that is extracted from at the sheet metal strip.

[0009] Cooling systems according to the invention can be arranged for sheet metal strip that runs horizontally, and for sheet metal strip that runs vertically.

[0010] It is a benefit of the invention that efficient cooling of the sheet metal strip is achieved and thanks to the increased temperature of the extracted air when blowing it back onto the sheet metal strip, free water on dried and cured coatings is reduced. Free water can have negative effects on the quality of the coated sheet metal strip. This is especially critical in applications where magnesium oxide coatings have been applied in the production process of grain oriented electrical steel. Therefore, the invention allows to produce coated sheet metal strip of better quality.

[0011] Preferably, the fan is provided for blowing the extracted air back onto the sheet metal strip via a series of nozzles.

[0012] In a preferred embodiment a filter is installed in order to filter the air that is extracted by the fan from at the sheet metal strip. The filtration can be performed before the air is blown back by the fan onto the sheet metal strip. It is a benefit of this embodiment that it is prevented that dust (e.g. from the coating layer, e.g. from magnesium oxide comprising coatings) is blown back onto the sheet metal strip.

[0013] It is a possibility that multiple fans are used in the cooling system. Preferably, an arrangement with a filter or filtration system that is filtering extracted air prior to it being blown back on the sheet metal strip is provided for air that is extracted from the initial cooling chambers

of the cooling system, e.g. in the first cooling chamber. This is particularly beneficial where coatings can set free dust, as is e.g. the case when the coating is comprising magnesium oxide as is used in grain oriented electrical steel. The filter system takes care of it that dust is evacuated and not blown back onto the sheet metal strip.

[0014] In a preferred embodiment the fan is provided for blowing a mixture of air onto the sheet metal strip. The mixture comprises air extracted by the fan from at the sheet metal strip and newly taken ambient air. With ambient air is meant air that is taking from inside the building in which the production line is installed, or air that is taken from outside. Preferably the amount of newly take ambient air and the amount of extracted air can be controlled via appropriate means, e.g. to set the temperature of the air that is blown by the fan onto the sheet metal strip.

[0015] It is a benefit of this embodiment that the dust level of the cooling air can be controlled, as the air extracted from at the coated metal strip can contain dust from the coating.

[0016] It is another benefit that the temperature of the cooling air can be controlled, which can be set to reduce the moisture content of the coating of the sheet metal strip.

[0017] This way, the quality of the coating layer can be improved. This is e.g. of big importance when the coating on the sheet metal strip is a magnesium oxide comprising coating, as is e.g. used in grain oriented electrical steel (GOES).

[0018] In a preferred embodiment, the fan is driven by a frequency controlled drive.

[0019] In a preferred embodiment, the fan is provided for blowing the extracted air back onto the sheet metal strip in a cooling chamber upstream in the sheet metal strip production process from the cooling chamber where the fan is extracting air. By absorbing heat from the sheet metal strip, the extracted air is at a higher temperature than the ambient air. As the extracted air is blown back onto the sheet metal strip, it is at higher temperature than if "fresh" ambient air would be blown onto the sheet metal strip. In a further preferred embodiment, the effect of the increase of temperature is controlled, for control of the cooling ability of the cooling system, especially if the target temperature is low. This can particularly be the case in the last part of the cooling system. Therefore, it is preferred to use a cooling system, wherein the fan is blowing the air onto the sheet metal strip upstream in the process from where the fan is extracting air.

[0020] Alternatively, the fan can be provided for blowing the extracted air onto the sheet metal strip in a cooling chamber downstream in the sheet metal strip production process from the cooling chamber where the fan is extracting air. It is a benefit of this embodiment that free water in the coating layer is better prevented, which is important in magnesium oxide comprising coatings on grain oriented electrical steel.

[0021] In yet an embodiment, additional fans are provided that extract air from at the sheet metal strip and of which the extracted air is evacuated without being blown back onto the sheet metal strip. Preferably, such fans for extracting air from at the sheet metal strip and for evacuating it are located at the entrance of the sheet metal strip into the cooling system. This embodiment ensures that dust (e.g. from the coating layer) is evacuated from the coating layer and out of the production process in an effective way.

[0022] In yet an embodiment, extra fans are provided for blowing fresh ambient air (meaning air that is not extracted by a fan from at the sheet metal strip, but which is taken from inside or from outside the building) onto the sheet metal strip. It is beneficial when the extra fan or fans for blowing fresh ambient air in the cooling chambers are located at the exit of the cooling system, e.g. in the last cooling chamber. This embodiment ensures an increased efficiency of the cooling.

[0023] It is also especially useful for increased cooling efficiency when extra fans for blowing fresh cooling air are provided in cooling chambers at the entry (e.g. in the first cooling chamber) where the sheet metal strips enters the cooling system. Where extra fans are installed in the cooling system for only blowing fresh ambient air onto the sheet metal strip, preferably also additional fans are installed for only extracting air from at the sheet metal strip (and which are not blowing the air they extract back onto the sheet metal strip).

[0024] In an embodiment, the cooling system comprises at least four consecutive cooling chambers. A fan is provided for blowing fresh cooling air onto the sheet metal strip in the last cooling chamber. A fan is provided for extracting and evacuating air from inside the first cooling chamber. Preferably a fan is provided for extracting cooling air from in the last cooling chamber and for blowing it into the one but last cooling chamber.

[0025] In an embodiment of the invention, at least three fans are provided for extracting air, each from in a different cooling chamber, and for blowing the air back into another cooling chamber than from where the air has been extracted.

[0026] In a preferred embodiment, the cooling system comprises a fan for extracting air from in one cooling chamber and which is arranged to blow the air extracted by it into another cooling chamber, and is provided with a bypass to evacuate air instead of blowing it into that another cooling chamber. It is a benefit of this embodiment that a flexible cooling system can be built. It is possible to shut off one (or more) of the cooling chambers if one (or more) fans are provided with such a bypass.

[0027] In a preferred embodiment, the sheet metal strip enters the cooling system at a temperature of more than 100°C (preferably at between 120°C and 250°C, more preferably between 120°C and 180°C, for grain oriented electrical steel; or e.g. at between 160°C to 300°C for non-grain oriented electrical steel or in coil coating), and preferably below 250°C.

[0028] Preferably, the sheet metal strip is cooled by

means of the cooling system to a temperature of less than 90°C, preferably to a temperature between 40°C and 90°C and even more preferably to a temperature between 65°C and 80°C.

[0029] Preferably, the sheet metal strip is coiled after being cooled by means of the cooling system.

[0030] The continuous curing or drying method of the invention is used for processing sheet metal strip of grain oriented electrical steel (GOES), after coating it. The coatings are magnesium oxide comprising coatings used in the production of GOES. Typical width of sheet metal strip that is treated is between 0.75 meter and 1.60 meter. Typical line speeds are in the range of 80 - 120 meter per minute.

Brief Description of Figures in the Drawings

[0031]

Figure 1 shows a continuous curing or.

Figure 2 shows an embodiment in which the air extracted from at the sheet metal strip is filtered.

Figure 3 shows an embodiment in which a mixture or fresh ambient air and air extracted from at the sheet metal strip is blown onto the sheet metal strip to cool it.

Mode(s) for Carrying Out the Invention

[0032] Figure 1 shows a continuous curing or drying installation used for the method of the invention. Sheet metal strip 110 is coated, e.g. in the continuous curing or drying installation via a suitable coating station. The coating is dried and or cured in a continuous oven 120. With a continuous oven is meant that the sheet metal strip is running through the oven during which the coating is dried and or cured. The continuous oven can be any oven as known in the art, e.g. a hot air oven or an infrared oven comprising infrared emitters (e.g. gas fired infrared emitters) as known in the art.

[0033] The cooling system of the example comprises five consecutive cooling chambers 131, 132, 133, 134, 135. Fan 140 takes fresh ambient air and blows it through nozzles (not show on the figure) onto the sheet metal strip 110 in the last cooling chamber 135. Four fans 145 extract air from at the sheet metal strip 110 in the four last cooling chambers 132, 133, 134, 135 and each blow the extracted air through nozzles (not shown in the figure) onto the sheet metal strip 110 in the cooling chamber 131, 132, 133, 134 that preceeds the cooling chamber where the cooling air has been extracted. In the first cooling chamber 131 a fan 147 is installed that is extracting air from at the sheet metal strip 110 and which is evacuating the extracted air.

[0034] At the exit of the cooling system, the sheet metal strip 110 can be reeled in a coiling station 190.

[0035] Preferably, the cooling is performed from both sides of the sheet metal strip (figure 1 is only showing the cooling on one side). Fans can be installed at both sides of the sheet metal strip. Alternatively, a fan installed at one side of the sheet metal strip can, via appropriate ducting or piping, extract air from at both sides of the sheet metal strip from in one cooling chamber; and blow the air back to the sheet metal sheet at both sides of the sheet metal strip in another cooling chamber.

[0036] Figure 2 shows a detail of an embodiment. Air 205 is extracted from at the surface of sheet metal strip 210 via a hood 220 from in a first cooling chamber 207. The air is transported via piping 225 and lead through a filter 230. The filter has the function to remove dust out of the air, e.g. dust from the coating applied onto the sheet metal strip 210. A fan 240 realizes the extraction of air 205 and blows the air through further piping 235 through a hood 240 by means of nozzles 250 on the sheet metal strip in a second cooling chamber 209 downstream from where the air is extracted.

[0037] Figure 3 shows an alternative embodiment. Air 305 is extracted from at the surface of sheet metal strip 310 via a hood 320 from in a first cooling chamber 307. The air is transported via piping 325. Fresh ambient air 315 is taken (from inside or from outside the building) and mixed with the extracted air 305. The air mixture is transported via the action of fan 340, through piping 335. The air mixture 337 is blown onto the sheet metal strip 310 in a second cooling chamber 309 via a hood 340 and nozzles 350.

[0038] The invention has shown to improve the quality of the coated sheet metal strip. Application of the invention has shown to reduce free water on dried and cured coatings. A number of embodiments of the invention have shown further improved coating quality, via a reduction of dust in the coatings.

[0039] A number of examples and embodiments have been described. Combination of elements from examples and/or from embodiments may be made within the scope of the appended claims.

Claims

1. Method for continuous curing or drying coated sheet metal strip using a continuous curing or drying installation for coated sheet metal strip, comprising a continuous curing or drying oven (120), and downstream of said continuous curing or drying oven a cooling system,
   wherein the steel strip (110, 210, 310) is led through the continuous curing or drying oven and through the cooling system for being cured or dried and cooled;
   wherein the steel strip comprises a magnesium oxide comprising coating layer;

   - wherein said cooling system comprises a number of consecutive cooling chambers (131, 132, 133, 134, 135) along the direction of move-

ment of the sheet metal strip,
- wherein said cooling system comprises at least one fan (140, 240, 340, 145), **characterized in that** at least one (145, 240, 340) of said at least one fan is provided for extraction of air from in one cooling chamber and for blowing the extracted air back onto the sheet metal strip in another cooling chamber than where the air has been extracted;

and wherein the steel strip is provided for producing a grain oriented electrical steel.

2. Method as in claim 1; wherein said at least one of said at least one fan is provided for blowing said extracted air back onto said sheet metal strip via a series of nozzles (250, 350).

3. Method as in any of the preceding claims, wherein wherein a filter (230) is provided, wherein said filter is installed in order to filter said air that is extracted by said fan from at said sheet metal strip, and wherein said filtration is performed before said air is blown by said fan onto said sheet metal strip.

4. Method as in any of the preceding claims; wherein said fan (340) is provided for blowing a mixture of said extracted air and newly taken ambient air onto said sheet metal strip in order to cool said sheet metal strip.

5. Method as in any of the preceding claims, wherein said fan is driven by a frequency controlled drive.

6. Method as in any of the preceding claims; wherein said fan is provided for blowing said air back onto said sheet metal strip in a cooling chamber downstream in the cooling system from the cooling chamber where said fan is extracting said air.

7. Method as in any of the claims 1 - 5; wherein said fan is provided for blowing said air onto said sheet metal strip in a cooling chamber upstream in the cooling system from the cooling chamber where said fan is extracting said air.

8. Method as in any of the preceding claims,

- wherein the cooling system comprises at least four consecutive cooling chambers (131, 132, 133, 134, 135)
- wherein a fan (140) is provided for blowing fresh cooling air the sheet metal strip in the last cooling chamber,
- wherein inside the first cooling chamber a fan (147) is provided for extraction and evacuation of air.

9. Method as in claim 8, wherein a fan (145) is provided for extracting cooling air from in the last cooling chamber and blowing it into the one but last cooling chamber.

10. Method as in any of the preceding claims, wherein at least three fans (145) are provided for extracting air each from in a different cooling chamber, and for blowing it back into another cooling chamber than where the air has been extracted.

11. Method as in any of the preceding claims, wherein a fan is provided for extraction of air from in one cooling chamber and for blowing the air extracted by it into another cooling chamber, and wherein said fan is provided with a bypass to evacuate air instead of blowing it into said another cooling chamber.

12. Method as in any of the preceding claims, wherein the sheet metal strip enters the cooling system at a temperature of more than 100°C.

13. Method as in any of the preceding claims; wherein the sheet metal strip is cooled by means of said cooling system to a temperature of less than 90°C.

Patentansprüche

1. Verfahren zum kontinuierlichen Aushärten oder Trocknen eines beschichteten Blechbands unter Verwendung einer Anlage zum kontinuierlichen Aushärten oder Trocknen für ein beschichtetes Blechband, umfassend einen Ofen (120) zum kontinuierlichen Aushärten oder Trocknen und ein Kühlsystem stromabwärts des Ofens zum kontinuierlichen Aushärten oder Trocknen,
wobei ein Stahlband (110, 210, 310) durch den Ofen zum kontinuierlichen Aushärten oder Trocknen und durch das Kühlsystem geführt wird, um ausgehärtet oder getrocknet und gekühlt zu werden,
wobei das Stahlband eine Beschichtungsschicht umfasst, die Magnesiumoxid umfasst,

- wobei das Kühlsystem eine Anzahl an aufeinanderfolgenden Kühlkammern (131, 132, 133, 134, 135) entlang der Bewegungsrichtung des Blechbands umfasst,
- wobei das Kühlsystem zumindest ein Gebläse (140, 240, 340, 145) umfasst, **dadurch gekennzeichnet, dass** zumindest eines (145, 240, 340) von dem zumindest einen Gebläse zum Extrahieren von Luft aus einer Kühlkammer und zum Blasen der extrahierten Luft zurück auf das Blechband in einer anderen Kühlkammer als dort, wo die Luft extrahiert worden ist, bereitgestellt ist,

und wobei das Stahlband zum Erzeugen eines kornorientierten elektrischen Stahls bereitgestellt ist.

2. Verfahren nach Anspruch 1, wobei das zumindest eine von dem zumindest einen Gebläse bereitgestellt ist, um die extrahierte Luft über eine Reihe von Düsen (250, 350) zurück auf das Blechband zu blasen.

3. Verfahren nach einem der vorhergehenden Ansprüche, wobei ein Filter (230) bereitgestellt ist, wobei der Filter installiert ist, um die Luft, die durch das Gebläse extrahiert wird, von dem Blechband zu filtern, und wobei die Filtrierung durchgeführt wird, bevor die Luft durch das Gebläse auf das Blechband geblasen wird.

4. Verfahren nach einem der vorhergehenden Ansprüche, wobei das Gebläse (340) bereitgestellt ist, um ein Gemisch aus der extrahierten Luft und neu aufgenommener Umgebungsluft auf das Blechband zu blasen, um das Blechband zu kühlen.

5. Verfahren nach einem der vorhergehenden Ansprüche, wobei das Gebläse durch einen frequenzgesteuerten Antrieb angetrieben wird.

6. Verfahren nach einem der vorhergehenden Ansprüche, wobei das Gebläse bereitgestellt ist, um die Luft in einer Kühlkammer stromabwärts in dem Kühlsystem zu der Kammer, in der das Gebläse die Luft extrahiert, zurück auf das Blechband zu blasen.

7. Verfahren nach einem der Ansprüche 1-5, wobei das Gebläse bereitgestellt ist, um die Luft in einer Kühlkammer stromaufwärts in dem Kühlsystem zu der Kammer, in der das Gebläse die Luft extrahiert, auf das Blechband zu blasen.

8. Verfahren nach einem der vorhergehenden Ansprüche,

- wobei das Kühlsystem zumindest vier aufeinanderfolgende Kühlkammern (131, 132, 133, 134, 135) umfasst,
- wobei ein Gebläse (140) bereitgestellt ist, um frische Kühlluft auf das Blechband in der letzten Kühlkammer zu blasen,
- wobei innerhalb der ersten Kühlkammer ein Gebläse (147) zum Extrahieren und Evakuieren von Luft bereitgestellt ist.

9. Verfahren nach Anspruch 8, wobei ein Gebläse (145) bereitgestellt ist, um Kühlluft aus der letzten Kühlkammer zu extrahieren und sie in die vorletzte Kühlkammer zu blasen.

10. Verfahren nach einem der vorhergehenden Ansprüche, wobei zumindest drei Gebläse (145) bereitgestellt sind, um Luft jeweils aus einer anderen Kühlkammer zu extrahieren und um sie zurück in eine andere Kühlkammer zu blasen als dort, wo die Luft extrahiert worden ist.

11. Verfahren nach einem der vorhergehenden Ansprüche, wobei ein Gebläse bereitgestellt ist, um Luft aus einer Kühlkammer zu extrahieren und um die von ihm extrahierte Luft in eine andere Kühlkammer zu blasen, und wobei das Gebläse mit einer Umgehung bereitgestellt ist, um Luft zu evakuieren, anstatt sie in die andere Kühlkammer zu blasen.

12. Verfahren nach einem der vorhergehenden Ansprüche, wobei das Blechband bei einer Temperatur von mehr als 100 °C in das Kühlsystem eintritt.

13. Verfahren nach einem der vorhergehenden Ansprüche, wobei das Blechband durch das Kühlsystem auf eine Temperatur von weniger als 90 °C gekühlt wird.

Revendications

1. Procédé pour le durcissement ou le séchage continu d'une bande de tôle recouverte à l'aide d'une installation de durcissement ou de séchage continu pour une bande de tôle recouverte, comprenant un four de durcissement ou de séchage continu (120), et en aval dudit four de durcissement ou de séchage continu, un système de refroidissement,
dans lequel la bande d'acier (110, 210, 310) est amenée dans le four de durcissement ou de séchage continu et le dispositif de refroidissement pour être durcie ou séchée et refroidie ;
dans lequel la bande d'acier comprend de l'oxyde de magnésium comprenant une couche de revêtement ;
dans lequel ledit système de refroidissement comprend un certain nombre de chambres de refroidissement (131, 132, 133, 134, 135) consécutives le long de la direction de déplacement de la bande de tôle,
dans lequel ledit système de refroidissement comprend au moins un ventilateur (140, 240, 340, 145),
caractérisé en ce qu'au moins l'un (145, 240, 340) dudit au moins un ventilateur est prévu pour l'extraction de l'air à partir d'une chambre de refroidissement et pour souffler l'air extrait à nouveau sur la bande de tôle dans une autre chambre de refroidissement que l'endroit où l'air a été extrait ;
et dans lequel la bande d'acier est prévue pour produire un acier électrique à grains orientés.

2. Procédé selon la revendication 1, dans lequel ledit au moins un dudit au moins un ventilateur est prévu

pour souffler ledit air extrait à nouveau sur ladite bande de tôle via une série de buses (250, 350).

3. Procédé selon l'une quelconque des revendications précédentes, dans lequel on prévoit un filtre (230), dans lequel ledit filtre est installé afin de filtrer ledit air qui est extrait par ledit ventilateur de ladite bande de tôle, et dans lequel ladite filtration est réalisée avant que ledit air ne soit soufflé par ledit ventilateur sur ladite bande de tôle.

4. Procédé selon l'une quelconque des revendications précédentes, dans lequel ledit ventilateur (340) est prévu pour souffler un mélange dudit air extrait et de l'air ambiant nouvellement prélevé sur ladite bande de tôle afin de refroidir ladite bande de tôle.

5. Procédé selon l'une quelconque des revendications précédentes, dans lequel ledit ventilateur est entraîné par un entraînement contrôlé par fréquence.

6. Procédé selon l'une quelconque des revendications précédentes, dans lequel ledit ventilateur est prévu pour souffler ledit air à nouveau sur ladite bande de tôle dans une chambre de refroidissement en aval dans le système de refroidissement de ladite chambre de refroidissement où ledit ventilateur extrait ledit air.

7. Procédé selon l'une quelconque des revendications 1 à 5, dans lequel ledit ventilateur est prévu pour souffler ledit air sur ladite bande de tôle dans une chambre de refroidissement en amont dans le système de refroidissement, depuis la chambre de refroidissement où ledit ventilateur extrait ledit air.

8. Procédé selon l'une quelconque des revendications précédentes,
dans lequel le système de refroidissement comprend au moins quatre chambres de refroidissement (131, 132, 133, 134, 135) consécutives,
dans lequel un ventilateur (140) est prévu pour souffler l'air de refroidissement frais sur la bande de tôle dans la dernière chambre de refroidissement,
dans lequel, à l'intérieur de la première chambre de refroidissement, on prévoit un ventilateur (147) pour l'extraction et l'évacuation de l'air.

9. Procédé selon la revendication 8, dans lequel un ventilateur (145) est prévu pour extraire l'air de refroidissement de la dernière chambre de refroidissement et le souffler sur l'unique et dernière chambre de refroidissement.

10. Procédé selon l'une quelconque des revendications précédentes, dans lequel au moins trois ventilateurs (145) sont prévus pour extraire l'air, chacun à partir d'une chambre de refroidissement différente, et pour le souffler à nouveau dans une autre chambre de refroidissement différente de l'endroit où l'air a été extrait.

11. Procédé selon l'une quelconque des revendications précédentes, dans lequel un ventilateur est prévu pour l'extraction de l'air d'une chambre de refroidissement et pour souffler l'air extrait par ce dernier dans une autre chambre de refroidissement, et dans lequel ledit ventilateur est prévu avec une dérivation pour évacuer l'air au lieu de le souffler dans ladite autre chambre de refroidissement.

12. Procédé selon l'une quelconque des revendications précédentes, dans lequel :
la bande de tôle pénètre dans le système de refroidissement à une température supérieure à 100°C.

13. Procédé selon l'une quelconque des revendications précédentes, dans lequel la bande de tôle est refroidie au moyen dudit système de refroidissement à une température inférieure à 90°C.

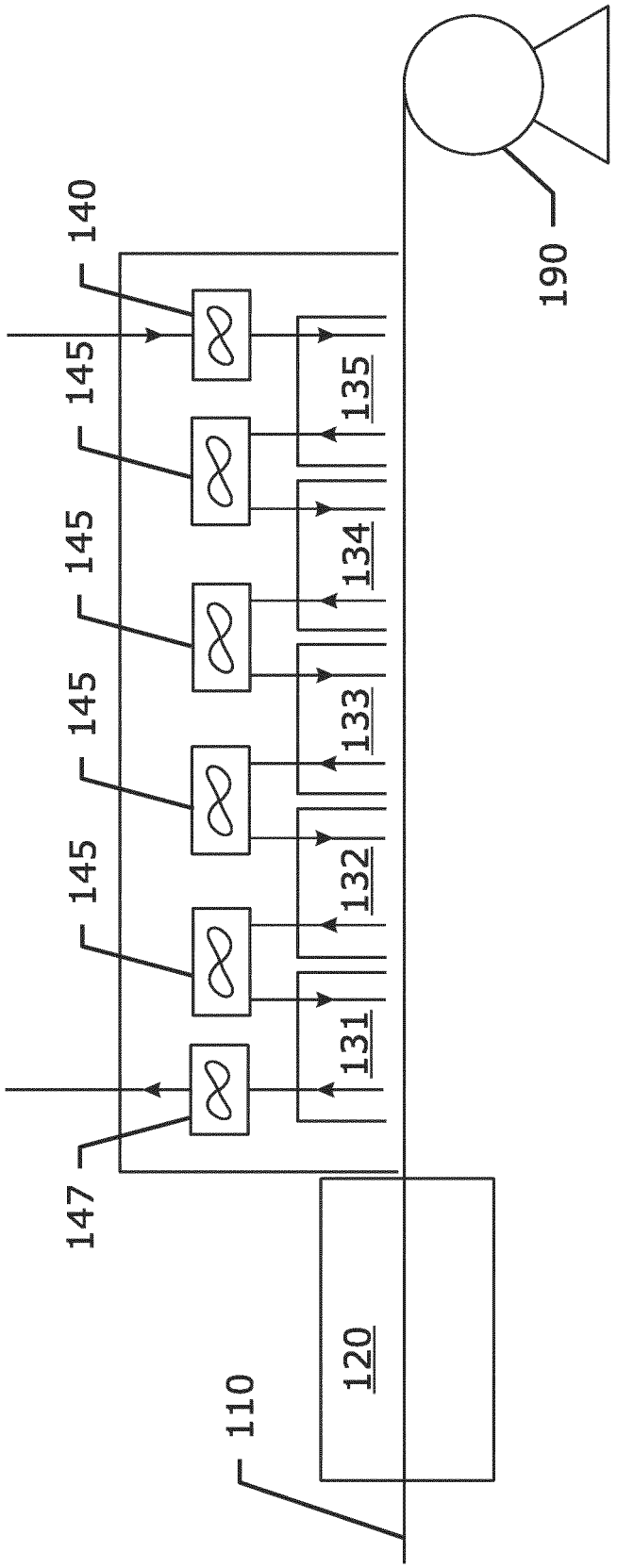


Fig. 1

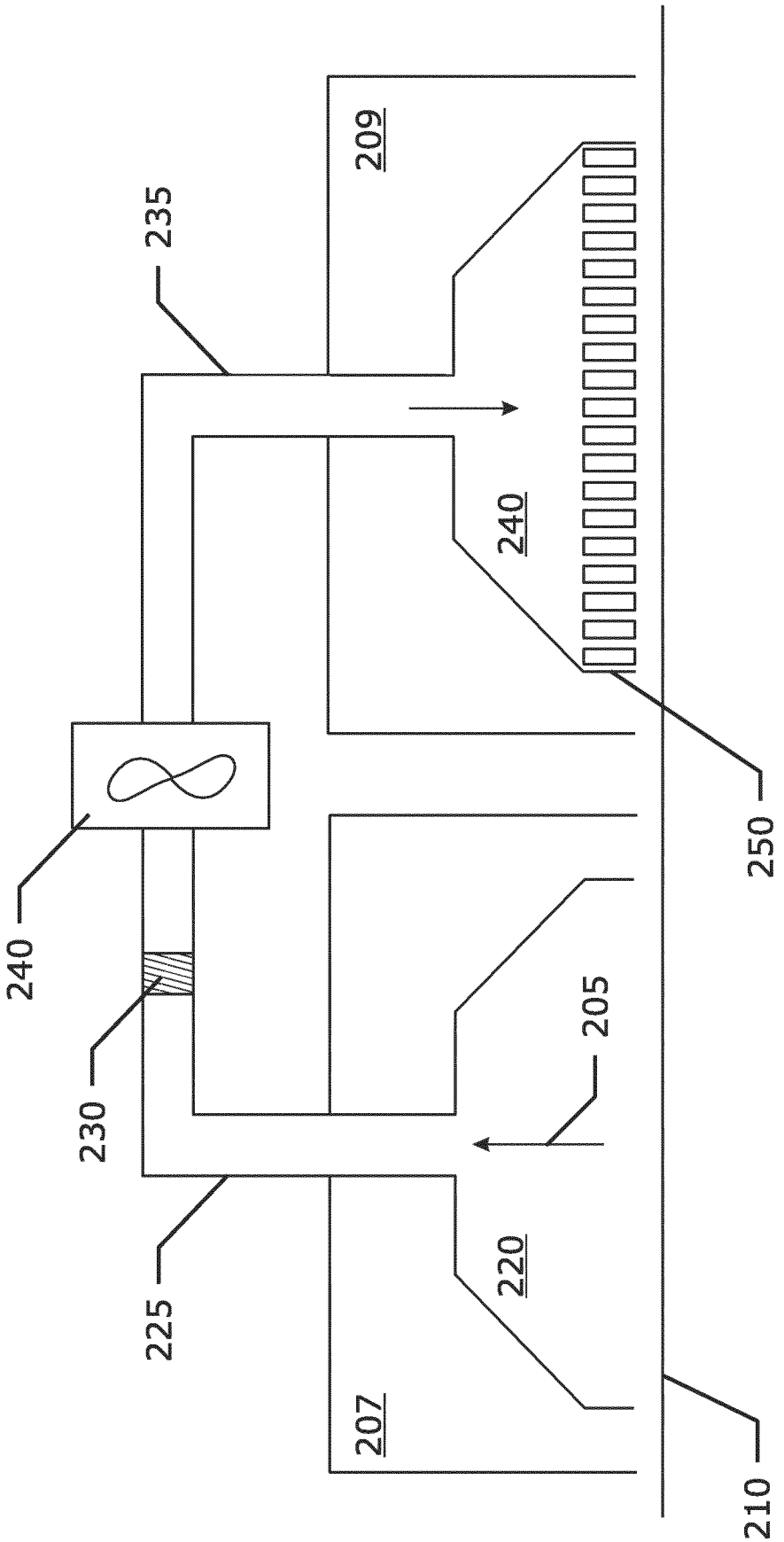


Fig. 2

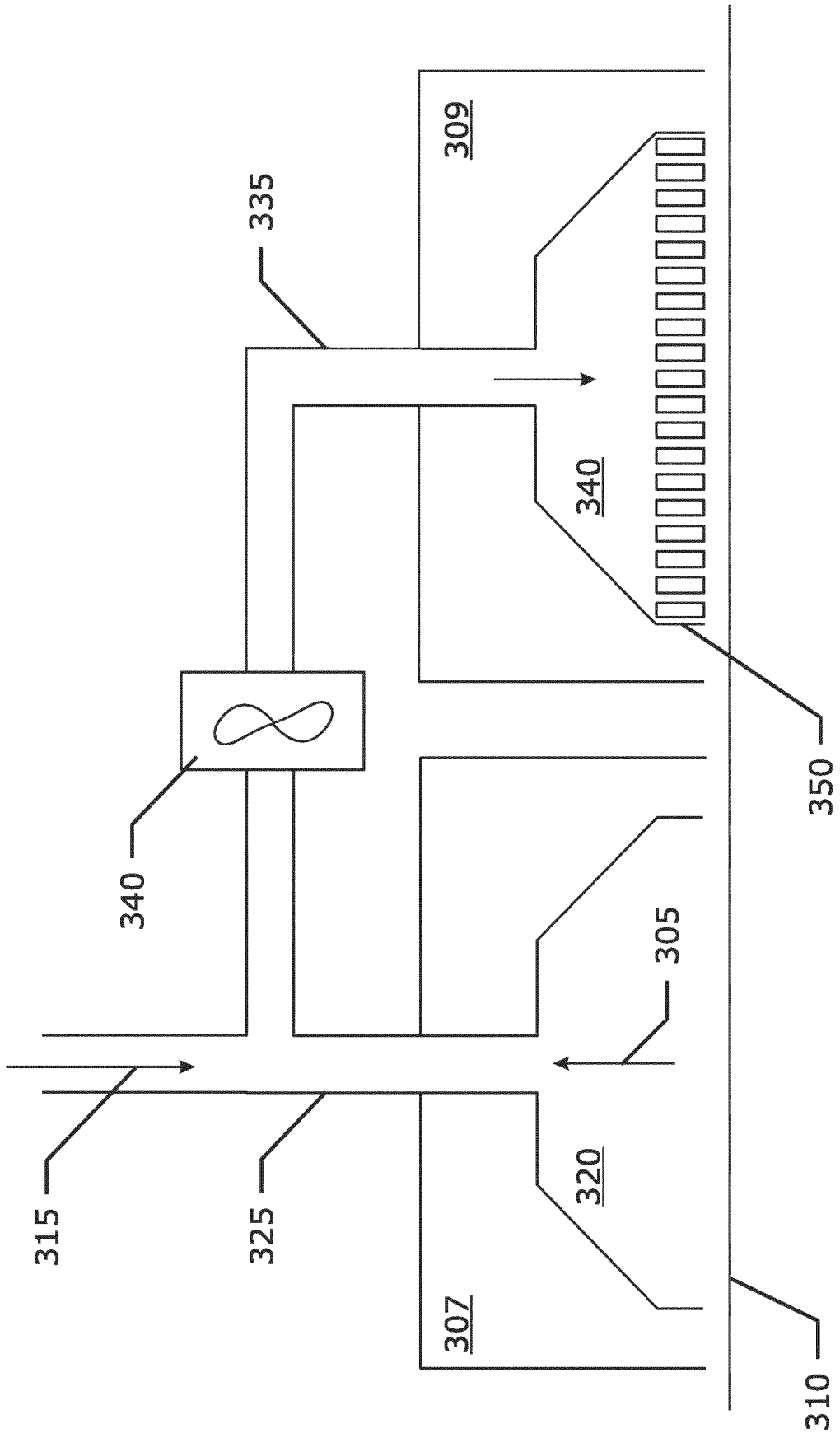


Fig. 3

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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