March 8, 1949. G. LEISCHNER 2,463,782

METHOD AND APPARATUS FOR DRYING SOLID ARTICLES BY HEATING AND COOLING

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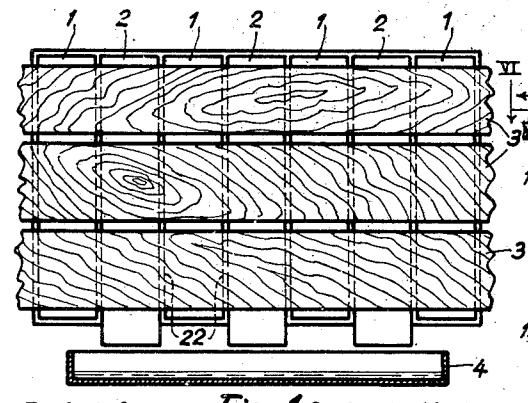


Fig. 1

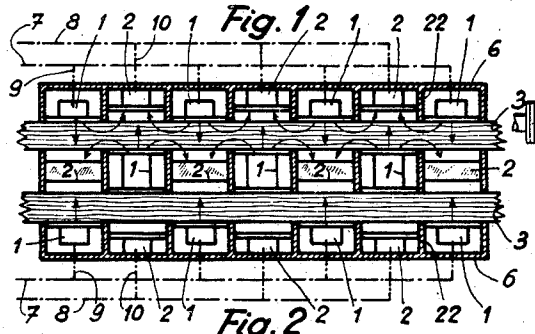


Fig. 2

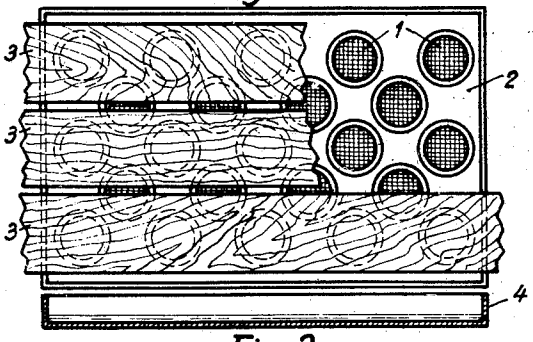


Fig. 3

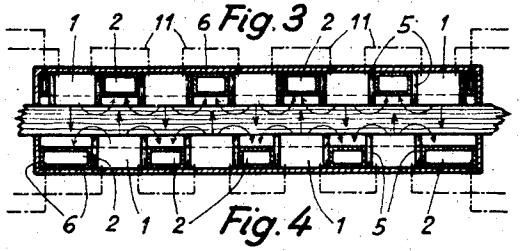


Fig. 4

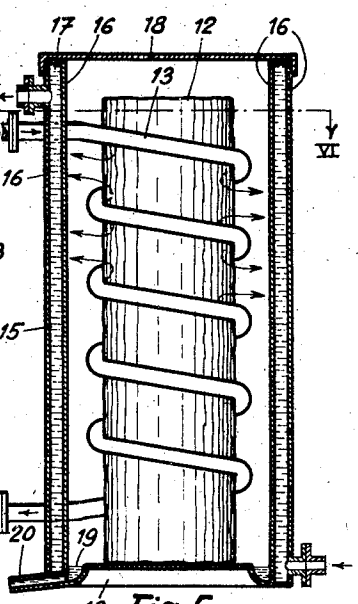


Fig. 5

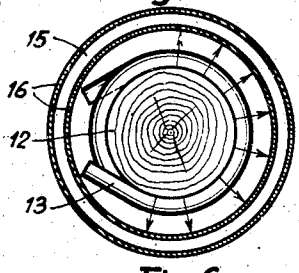


Fig. 6

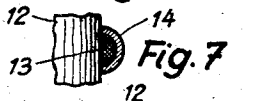


Fig. 7

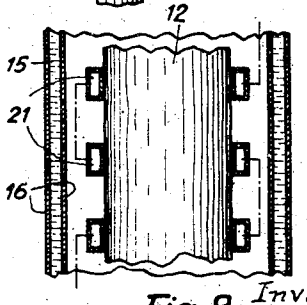


Fig. 8

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METHOD AND APPARATUS FOR DRYING SOLID ARTICLES BY HEATING AND COOLING

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5 Claims. (Cl. 34—13.4)

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This invention relates to a method for drying solid goods, for instance wood, in which the goods to be dried are exposed to temperature differences. Methods of this kind have already been described by the inventor in his pending application Serial No. 498,335, filed August 12, 1943, now abandoned. According to these methods on the one face of the goods only heating elements and on the other face only cooling elements were provided, while the expelled moisture flowed off from the heating to the cooling elements.

If these known methods are, for instance, used to dry timber and these latter are brought in the form of boards between a layer of heating elements and a layer of cooling elements, the boards, on their one face, are heated and, on their other face, cooled. In this way, the distribution of water in the timber is changed in that the water is concentrated on the side of the cooling elements. The timber swells up on the side of high humidity, and shrinks on the other, dry side. The timber is thereby warped, and cracks may occur.

This drawback can be obviated if the boards to be dried are turned several times, so that the two outer surfaces of each board are alternately in contact with the heating elements. In this way the direction of diffusion of the water in the timber is changed several times and a warping of the boards prevented. However, this drying method presents the disadvantage of heat losses, since the cold surfaces of the boards, on each inversion, must be heated, and the warm surfaces cooled before the diffusion process can again begin. Besides this, the inversion requires additional work and waste of time.

The aim of the invention is to overcome these disadvantages and to this end, according to the method of this invention, adjacent parts of the goods to be dried are exposed to the influence of heating elements and of at least one cooling element in such a manner that said elements act alternately on adjacent surface sections of the goods to be dried.

Another object of the invention is the provision of an improved apparatus for drying solid goods.

The accompanying drawings illustrate, by way of examples and in a schematic way, different apparatuses for carrying out the method according to the invention all the apparatuses shown being suitable only for drying pieces of wood.

In the drawing Fig. 1 is an elevation (partly in section) of an apparatus for drying wooden boards and

Fig. 2 is a horizontal section through this first embodiment of the invention;

Fig. 3 is an elevation (with parts broken away) of a portion of another example; and

Fig. 4 is a horizontal section through this second embodiment of the invention.

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Fig. 5 is a vertical section of an apparatus for drying round timber; and

Fig. 6 is a horizontal section taken on line VI—VI of Fig. 5;

Fig. 7 is a cross section on an enlarged scale through a heating element of the apparatus shown in Fig. 5, and

Fig. 8 is an upright section of a part of another apparatus for drying blocks and round timber.

The drying apparatus shown in Figs. 1 and 2 designed for drying wooden boards comprises heating elements 1 and cooling elements 2 which are alternately arranged on either face of the boards 3 to be dried. The heating and cooling elements on both faces of the boards are placed in reverse order, so that a heating element on the one side lies opposite a cooling element on the other side. The active surface of the cooling elements 2 is located at a certain distance from the boards 3 so that condensation water may flow off between the boards and the cooling surface. The heating elements 1, however, make contact with the boards in order to obtain a good heat transmission. The heating elements 1 might, however, also be placed at a distance from the boards 3 to be treated so that an air gap exists between the latter and the elements 1, through which heat is transmitted by radiation. In such a case it is advisable to polish the surface of the heating elements 1 turned towards the boards 3 in order to augment reflected radiation. The cooling elements 2, however, lie always at a distance from the boards. The arrows in Fig. 2 indicate the direction of the temperature drops between heating and cooling elements. These arrows show that the heating elements 1 and the cooling elements 2 act alternately on adjacent surface sections of the boards 3 which results in a substantially uniform separation of moisture in all directions and in a flowing off of the moisture from points of higher temperature towards points of lower temperature.

As illustrated in Fig. 1, the cooling elements 2 extend towards the bottom so that the moisture separated from the boards 3 drops in a liquid state into a receiver 4 located below the elements. An insulation casing 6 prevents heat from being exchanged between the apparatus and the surrounding air, while heat-insulating walls 22 render a direct heat exchange between heating and cooling elements 1 and 2 impossible.

The apparatus shown in Fig. 2 is designed for drying simultaneously two rows of boards. It is evident that in lieu of wood boards also other solid goods of similar shape could be dried. The heating and cooling elements arranged between the two rows of boards have active surfaces on either side so that they act simultaneously on both rows of boards. There are thus three groups

of elements. The heating and cooling elements located on the same face of the boards 3 form together a battery. The apparatus could also comprise more than three such batteries so as to permit of correspondingly more wood boards being dried simultaneously.

In the embodiment shown in Figs. 3 and 4 the cooling elements 2 have the shape of plates with bores in which the heating elements 1 are lodged. These heating elements project beyond the active surface of the cooling elements 2. They are surrounded by heat-insulating rings 5 preventing direct heat exchange between the elements 1 and 2. In order to prevent as far as possible heat exchange with the surrounding air, an insulation casing 6 is provided. Here too, as in Fig. 2, the heating and cooling elements respectively, lying on the same side of the goods form a battery, the mutual distance between these batteries being adjustable. The heating elements might have polished active surfaces and be disposed at a distance from the goods to be dried, so that the heat radiates towards the goods. The active surface of the heating elements might also be designed as concave mirror reflectors, e. g. as parabolic mirrors.

It is advantageous to mount the heating elements 1 inserted into the rings 5 on springs in order to guarantee a good contact with the boards or other goods to be dried. In Figs. 3 and 4 the heating elements are round; they might, however, have any other shape. In the receiver 4 the condensation water dropping from the cooling surfaces is stored.

Fig. 4 shows a device for drying only one row of boards. As the apparatus shown in Figs. 1 and 2, the one shown in Figs. 3 and 4 may, likewise be equipped with more than two batteries of elements.

In order to increase the heat exchange, the active surface of the elements may be enlarged, for instance, by corrugation or by the provision of ribs.

Owing to the resistance in the air gap between the cooling elements and the goods to be dried, heat transmission per surface unit from these goods to the cooling elements is smaller than from the heating elements to the goods which are in direct mutual contact. For this reason the heating elements can be smaller than the cooling elements. This allows more heating and cooling elements to be provided on the same surface, and thus, with the same total surface, a greater quantity of moisture to be eliminated per time unit than if the heating elements were of the same size as the cooling elements.

The heating and cooling elements of each battery may, for their supply with heating and cooling medium respectively, be interconnected in different ways. The single elements may, e. g., be provided with an inlet and an outlet branch and these branches may be connected to a main. The single elements of a battery may be connected in parallel or in series. In Fig. 2 a parallel connection is schematically indicated in chain-dotted lines. At one end of the apparatus branch pipes 9 and 10 respectively connect a supply line 7 and 8 respectively with the heating elements 1 and cooling elements 2 respectively, while at the other end of the apparatus similar branch pipes lead to respective outlet collecting conduits. In Fig. 4 a series connection of the heating elements 1 is indicated in chain-dotted lines 11, whilst the dash lines indicate in this Fig. 4 a series connection of the cooling elements 2. The same connections might, of course, also be used in Fig. 2 instead of the parallel connection of the heating and cooling elements.

Figs. 5, 6, and 7 show an apparatus in which, for instance, whole, fresh trunks of trees are dried. The heating elements form together a heating body 13 of helicoidal shape surrounding the trunk 12. The active inner surface of this body makes intimate contact with the outer surface of the trunk in order to obtain a good heat transmission. As seen in Fig. 7, the outer surface of the body 13 is provided with a heat-insulating layer 14, so that heat can only be radiated towards the trunk 12. The latter, together with the heating body 13 applied to it, is surrounded by a cooling element constituted by the cylindrical casing 15 of a container. This casing is double-walled. A cooling medium flows through the hollow space 17 between the walls 16. The cooling element 15 acts in the intervening spaces defined by the single turns of the heating body 13 (said turns constituting the heating elements) on the trunk 12. In order to avoid heat losses said container is closed at both ends by covers 18. The water issuing from the surface of the trunk 12 is condensed on the cooled casing 15, flows hereupon towards the bottom and is collected in the channel 19 wherefrom it flows off through a pipe 20. The arrows in Figs. 5 and 6 show that adjacent parts of the trunk to be dried are exposed to temperature differences of unequal direction, so that the moisture is eliminated uniformly in all directions and deformation of the trunk is prevented.

In Fig. 8 several ring shaped heating elements 21 are provided in lieu of a single heating element of helicoidal shape. Otherwise the design of the apparatus corresponds to that shown in Fig. 5.

Instead of helicoidal or ring-shaped heating bodies, flat heating elements of the kind shown in Figs. 3 and 4 could be applied to the surface of the trunk 12. Such heating elements may be designed as reflectors placed at a certain distance from the piece 12 to be dried and radiating heat against the trunk 12.

If, for instance, small heating elements having the shape of plates are used, such elements must be pressed against the outer surface of the trunk 12 by strong springs in order to secure an intimate contact between them and the surface of the trunk. It would, besides, be advantageous to provide the contact surface of these elements with teeth, points or grooves. The heating elements are mounted so as to be adjustable radially to the piece 12, in order that their position may be adapted to the thickness of the body to be dried. All parts of these heating elements which do not enter into contact with the body 12, are insulated in order to avoid heat losses.

What I claim is:

1. Drying apparatus particularly for wooden boards, comprising in combination at least two rows of heating and cooling elements, said heating and cooling elements being arranged in the longitudinal direction of each of said rows alternately side by side, a heating element of one of said rows being arranged opposite a cooling element of the other row, and vice versa, each two rows defining an intervening space adapted to the size of the goods to be dried and intended to be inserted between two rows, and means for supporting the boards between the rows in spaced relation from the cooling elements.

2. Drying apparatus particularly for wooden

boards, comprising in combination at least two rows of heating and cooling elements, said heating and cooling elements being arranged in the longitudinal direction of each of said rows alternately side by side, a heating element of one of said rows being arranged opposite a cooling element of the other row, and vice versa, the active surfaces of said cooling elements being set back with regard to the active surfaces of said heating elements, and said two rows defining an intervening space adapted to the size of the goods to be dried and intended to be inserted between two rows, and means for supporting the boards between the rows in spaced relation from the cooling elements.

3. In a method for drying solid members, such as wooden boards, consisting in exposing the members to be dried throughout their entire length to the influence of at least two opposed rows of heating and cooling elements by inserting said members between such rows, said heating and cooling elements arranged in the longitudinal direction of the rows having all substantially the same length, and a heating element of one of said rows being arranged opposite a cooling element of the other row, and vice versa; and bringing said heating elements into contact with the members to be dried, while the latter remain spaced from the cooling elements.

4. Drying apparatus, particularly for drying wooden boards, comprising in combination at least two opposed rows of heating and cooling elements all having substantially the same length and defining an intervening space adapted for the size of the boards to be dried and intended to be inserted between two such rows, said heating and cooling elements being arranged in the longitudinal direction of each of said rows alternately side by side, and a heating element of one of said rows being arranged opposite a cooling element of the other row, and vice versa; and an insulating casing enclosing all of the said heating and cooling elements and having transverse partitions, the end walls of said casing and its partitions being provided with openings adapted to the size of the boards to be inserted between two of said rows, the inserted boards being maintained in the required position by said end walls and transverse partitions, and the active surfaces of said cooling elements being set back relative to the active surfaces of said heating elements, so that the cooling elements are spaced from the boards inserted between two rows of heating and cooling elements.

5. Drying apparatus according to claim 4, in which means are provided for interconnecting adjacent heating and cooling elements of each row to a battery.

GEORG LEISCHNER.

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