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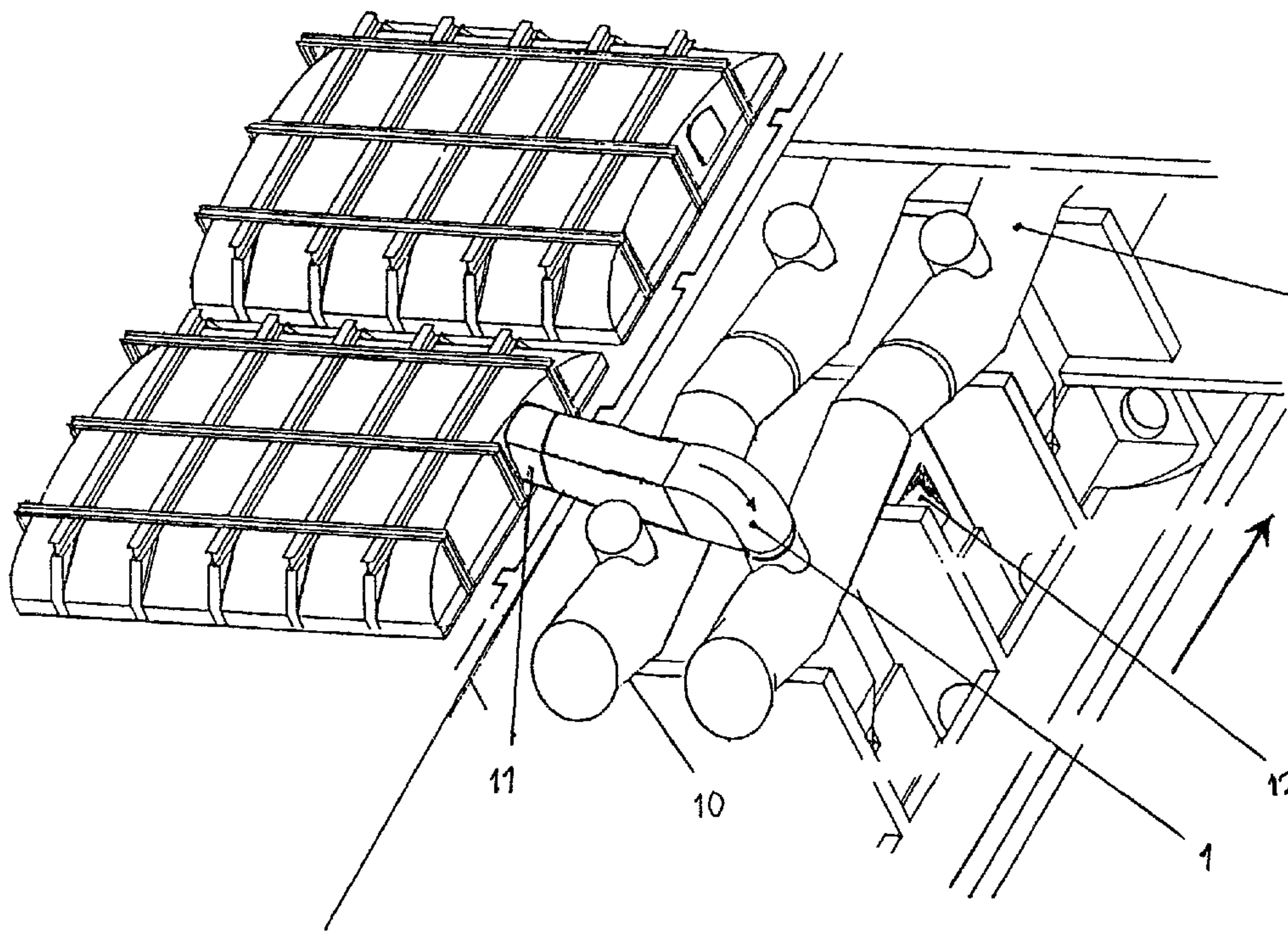

(57) Abrégé/Abstract:
A ring section furnace device for the calcination of carbon bodies consists of a number of serially connected chambers with or without lids on top. Each chamber contains a number of cassettes, the walls of which (2) have been fitted with vertical and/or horizontal flue gas channels and with a flue gas exhaust system from each chamber through a ring duct (10). The furnace is fitted with another, separately attached ring duct (13) and each of the chambers is fitted with a recovery device in the form of a lid, manifold, or a similar device with a closeable opening or joining pipe (11), which allows for exhaust removal of the air used for cooling the cassettes through a pipe connection (1) fitted between the other ring duct and the recovery device on the chamber.

Abstract

A ring section furnace device for the calcination of carbon bodies consists of a number of serially connected chambers with or without lids on top. Each chamber contains a number of cassettes, the walls of which (2) have been fitted with vertical and/or horizontal flue gas channels and with a flue gas exhaust system from each chamber through a ring duct (10).

The furnace is fitted with another, separately attached ring duct (13) and each of the chambers is fitted with a recovery device in the form of a lid, manifold, or a similar device with a closeable opening or joining pipe (11), which allows for exhaust removal of the air used for cooling the cassettes through a pipe connection (1) fitted between the other ring duct and the recovery device on the chamber.

The present invention relates to a ring section furnace device for the calcination of carbon bodies which consists of a number of serially connected chambers, each containing several cassettes, the walls of which have been fitted with vertical and/or horizontal flue gas channels and with a gas exhaust system through a ring duct.

For the production of carbon bodies for furnaces for aluminium electrolysis or electrometallurgical processes, special furnaces are used for thermal treatment (baking or calcination) of the carbon bodies.

The carbon bodies are produced in the required shape from a mixture of crushed coke or anthracite and a binding agent containing, for example, coal tar and pitch.

At room temperature this mixture of coke and binding agent is stiff, but it softens at temperatures above 120°C and releases low-volatile components from the binding agent. At prolonged heating to a maximum of 1300°C, the mass hardens and changes its physical properties such as electrical conductivity and resistance to oxidation.

Uncalcinated carbon bodies are often called "green carbon". Such green carbon can be of a considerable weight of several tonnes and of lengths of two metres or more. Special measures must be implemented in order to prevent deformation of the coal when it passes through a temperature area in which the coal is in its soft state.

The green carbon is placed in the furnace in deep shafts known as cassettes, which are built of fireproof brick. The gap between the coal and the cassette walls is filled with coke to support the coal. The coke gravel also serves to protect the coal from burning.

A number of cassettes are connected to each other in a so-called chamber. The walls between the cassettes are fitted with flue gas channels. Heat is transferred to the coal by the gases being passed through these channels.

Gases from one chamber are led via channels to the adjoining chambers. In this way the gases can be led through a number of serially connected chambers in a so-called combustion zone. The most frequently used fuels are oil or gas.

Flue gas discharge and burner equipment are moved from chamber to chamber.

A large furnace is often fitted with two rows with the chambers connected to each other as parallel rows. At the end of a chamber row the gas flows are connected with channels to the parallel chamber row. In this way the chambers form a ring. For this reason this type of furnace for baking carbon bodies is known as a ring section furnace.

A ring section furnace may contain several combustion zones in which the temperature is adjusted in accordance with a set programme. The first chambers in a combustion zone have low temperatures. After these follow chambers with higher temperatures, chambers for heat recovery and, as the final link in the combustion zone, the chambers in which the coal is cooled. Ring furnaces for thermal treatment of carbon bodies can be divided into two main categories; closed and open furnaces.

In a conventional closed design the space above each chamber is covered with lids. These are removed when the chambers are to be cooled with a subsequent insertion of green carbon after the calcinated carbon bodies have been removed.

Due to the special properties of the carbon bodies, it is necessary to avoid excessive temperature gradients during calcination which will result in cracks in the finished product. Each chamber must consequently be operated in accordance with an exact time and temperature programme.

Heat supply usually takes place in the first part of the zone, i.e. up to 600°C by using the gas heat from the last part of the combustion zone. At a later stage in the temperature interval from 600°C to the required maximum temperature (1200-1300°C), it becomes necessary to add heat through the above-mentioned combustion of gas or oil.

In the cooling part the cassette walls are cooled with air until the carbon bodies can be removed without any risk of oxidation. The furnace has been designed for maximum utilization of the heat which is absorbed by the cooling air by passing the surrounding air through 1-3 chambers during cooling and onwards into the combustion zone where it is used as combustion air.

The combustion zone is moved by moving the oil or gas burners from one chamber to the next. The frequency of this relocation is known as the heating progress and determines the combustion zone capacity.

As mentioned, it must also be possible for each chamber to be connected to an exhaust system when the chamber is to be connected to the combustion zone. This connection is generally established by fitting an exhaust pipe or manifold, possibly with a fan, between the chamber in question and a joining pipe at the exhaust duct surrounding the furnace. This exhaust duct is known as the ring duct and is kept under ventilating pressure by a main fan.

In the invention in question, for closed furnaces connection to the chamber takes place on the chamber lid itself. For open furnaces recovery devices in the form of manifolds are connected to openings in the part walls between the chambers.

In closed ring section furnaces several cassettes are built together in one chamber under a joint lid. In relation to the flue gases and the material which is to be calcinated, the cassettes in a chamber are connected in parallel, whereas the chambers are serially connected. There are horizontal flue gas channels in the room below the chamber, whereas there is free gas flow in the room below the chamber lid above the cassettes. The gas channels in the cassette walls connect the room below the chamber lid and the rooms below the chamber. In closed ring section furnaces the flue may be supplied either in separate vertical furnace shafts or preferably by the flue being added fully or in part to the room above or below the cassettes as shown in the applicant's own Norwegian patent no. 152029.

In closed furnaces without furnace shafts the channels in each cassette wall are divided into two by a dividing wall in the room below the cassettes. The flue gases are consequently led up through one half of the wall and down through the other half of the wall. In open furnaces the chambers are serially connected with parallel connection of flue gas flow above or below the individual chamber.

Before the gases reach the main fan, they normally pass through a purifying plant in which soot, tar fumes and other impurities are removed.

In order to increase the cooling speed for the carbon bodies in the cassettes, own cooling fans are used which either press or suck out the surrounding cooling air through the flue gas channels.

This cooling air cannot be led into the combustion zone in its entirety as it would disturb the pressure conditions and gas quantity balance in the system. It is consequently let out into the factory hall.

In this connection the chamber lids in the familiar design with closed furnaces are removed from the chambers to which cooling fans are attached. In open furnaces manifolds which press or suck cooling air through the cassette wall are fitted on the cassette walls and/or on the part walls between the chambers. This can only be done when the temperature in the cassettes has fallen below a certain level.

The cooling air which is let out in this way contains impurities such as SO_2, soot and ash components from the coke used. These impurities contribute to a deterioration of the working environment and increase polluting emissions into the environment.

The present invention provides in a ring section furnace including a plurality of serially connected chambers, each said chamber having a plurality of pits defined by walls having therein flue gas channels, and a main ring duct exterior of said chambers, whereby a heat treatment operation is conducted serially sequentially within said chambers on respective products to be loaded therein, during which operation each chamber sequentially is heated, during which flue gases therein are exhausted therefrom to said ring duct, and then is cooled by air introduced into said each chamber, during which said air absorbs heat, the improvement comprising: each said chamber having an outlet having connected thereat an exhaust device; an additional ring duct separate from said main ring duct; and means for, when a given said chamber is being heated, transferring flue gases exhausted therefrom through said outlet and said exhaust device thereof into said main ring duct, and for, when said given chamber is being cooled, transferring heated air therein to said additional ring duct.

For open furnaces a recovery device is fitted on the cassette wall and/or part wall by a joint manifold, which can be connected to the ring duct for cooling via a pipe connection or a similar device, whereas for closed furnaces a pipe connection is fitted between the existing lid and the ring duct. The separate ring duct is under ventilating pressure from a main fan.

With this solution the closed furnaces can be run through the entire cooling phase and the furnace charge can be kept under low ventilating pressure until the carbon bodies can be taken up. By having the cooling air led to the ring duct in both cases, polluting emissions into the working environment are avoided and the noise level in the hall building is considerably reduced.

In addition, this solution makes it possible to use a more simple arrangement for purification of the cooling air than those which have previously been known.

The cooling process is controlled automatically by the cooling air being led through the flue gas channels in the cassettes via the manifold/pipe connections with adjustable air dampers to the separate ring duct.

By applying such cooling process control, thermal shocks are avoided, i.e. temperature gradients in the fire-proof constructions which could lead to crack formation and deformation and, consequently, to increased maintenance.

Furthermore, the solution allows for a built-in heat recovery plant for recovering the heat contained in the cooling air.

For the closed furnace design direct exhaust from the lid has the effect that it becomes possible to eliminate the costs incurred in building a separate exhaust channel in each chamber or in the use of a separate manifold above the chamber.

In the following a more detailed description of the invention will be made by the use of an example for the closed furnace construction and with reference to the attached drawings in which:

Fig. 1 shows in perspective a chamber of conventional design with a separate exhaust channel to the ring duct (the lid is not shown).

Fig. 2 shows in perspective a chamber in accordance with the invention in which exhaust removal takes place via the lid.

Fig. 3 shows the situation in a combustion zone in connection with conventional cooling of carbon bodies.

Fig. 4 shows the situation in a combustion zone in connection with cooling of carbon bodies in accordance with the invention.

Fig. 1 shows a cross-section of a chamber of a ring chamber furnace in which cassette walls 2 and flue gas channels 3 are shown. Under the bottom of the cassettes a dividing wall has been constructed which divides the room below the cassettes into two. As a result of this the gases are led through the flue gas channels up through one group 7 and down into another group 8.

During operation a lid is placed on top of the chamber wall 9. This lid has not been shown, but it will ensure the necessary channeling of the flue gases.

From the room below the cassettes a channel (not shown) leads to the joining pipe 9a on the top of the furnace. In the conventional furnace design these are used for connecting the individual chamber to the ring duct 10.

Fig. 2 shows two chambers with lids in which the chambers' connection to the ring duct is fitted on the lid in accordance with the present invention. In the example shown in the figure, the chamber is being cooled and the lid is connected to the separate ring duct 13 via a pipe connection 1. During heating, the lid will be connected to the ordinary ring duct 10.

Fig. 3 shows a section of a combustion zone with conventional operation. The combustion zone is connected to the ring duct via the indicated pipe coupling 9a to chamber K2 in which the flue gases are sucked out. Chambers K2 and K3 are being heated by the flue gases, chambers K4-K7 are under combustion, indicated with burners 14, chambers K8-K10 are being cooled with the lids on, whereas chambers K11-K13 are under forced cooling without a lid.

The cooling air which contains various impurities and considerable quantities of heat is here led into the plant. Carbon is being loaded and unloaded respectively in chambers K1 and K14.

The combustion air to the combustion zone is supplied to the furnace by the cooling air pressed into chamber K11 being split and part of it led into chamber K10 and further on into the combustion zone as combustion air.

Fig. 4 shows a section of a combustion zone with an operating situation in accordance with the present invention and with the combustion chambers in the same phases as in fig. 3. Here the coupling of the ring duct 10 and the individual chamber is moved to the chamber lid itself by a joining pipe 11 being attached to the lid which can be opened and closed as required. The combustion air to the combustion zone is here supplied to chamber K10 through the joining pipe 11b on the lid.

The lids are kept on chambers K11, K12 and K13 which are under forced cooling, and exhaust is established from each chamber by connection to the separate ring duct via the joining pipes 11c. The pipe connection 1 between the ring duct and the lid is fitted with an air damper, which allows automatic control of the quantity of cooling air and the cooling process. The cooling air is let in through appropriately placed gates 12, see fig. 2, (which can be opened and closed) in the bottom of the chambers and/or in the pit walls.

CLAIMS:

1. In a ring section furnace including a plurality of serially connected chambers, each said chamber having a plurality of pits defined by walls having therein flue gas channels, and a main ring duct exterior of said chambers, whereby a heat treatment operation is conducted serially sequentially within said chambers on respective products to be loaded therein, during which operation each chamber sequentially is heated, during which flue gases therein are exhausted therefrom to said ring duct, and then is cooled by air introduced into said each chamber, during which said air absorbs heat, the improvement comprising:

each said chamber having an outlet having connected thereat an exhaust device;

an additional ring duct separate from said main ring duct; and

means for, when a given said chamber is being heated, transferring flue gases exhausted therefrom through said outlet and said exhaust device thereof into said main ring duct, and for, when said given chamber is being cooled, transferring heated air therein to said additional ring duct.

2. The improvement claimed in claim 1, wherein each said chamber has thereon a lid having therein the respective said outlet and from which extends the respective said exhaust device.

3. The improvement claimed in claim 1, wherein said means comprises a pipe leading from said exhaust device of said given chamber and selectively connectable to said main ring duct or said additional ring duct.

4. The improvement claimed in claim 3, wherein said pipe has therein an adjustable damper.

5. The improvement claimed in claim 3, wherein said pipe has therein at least one fan.

6. The improvement claimed in claim 1, wherein each said chamber further has a selectively operable gate for introduction of the air.

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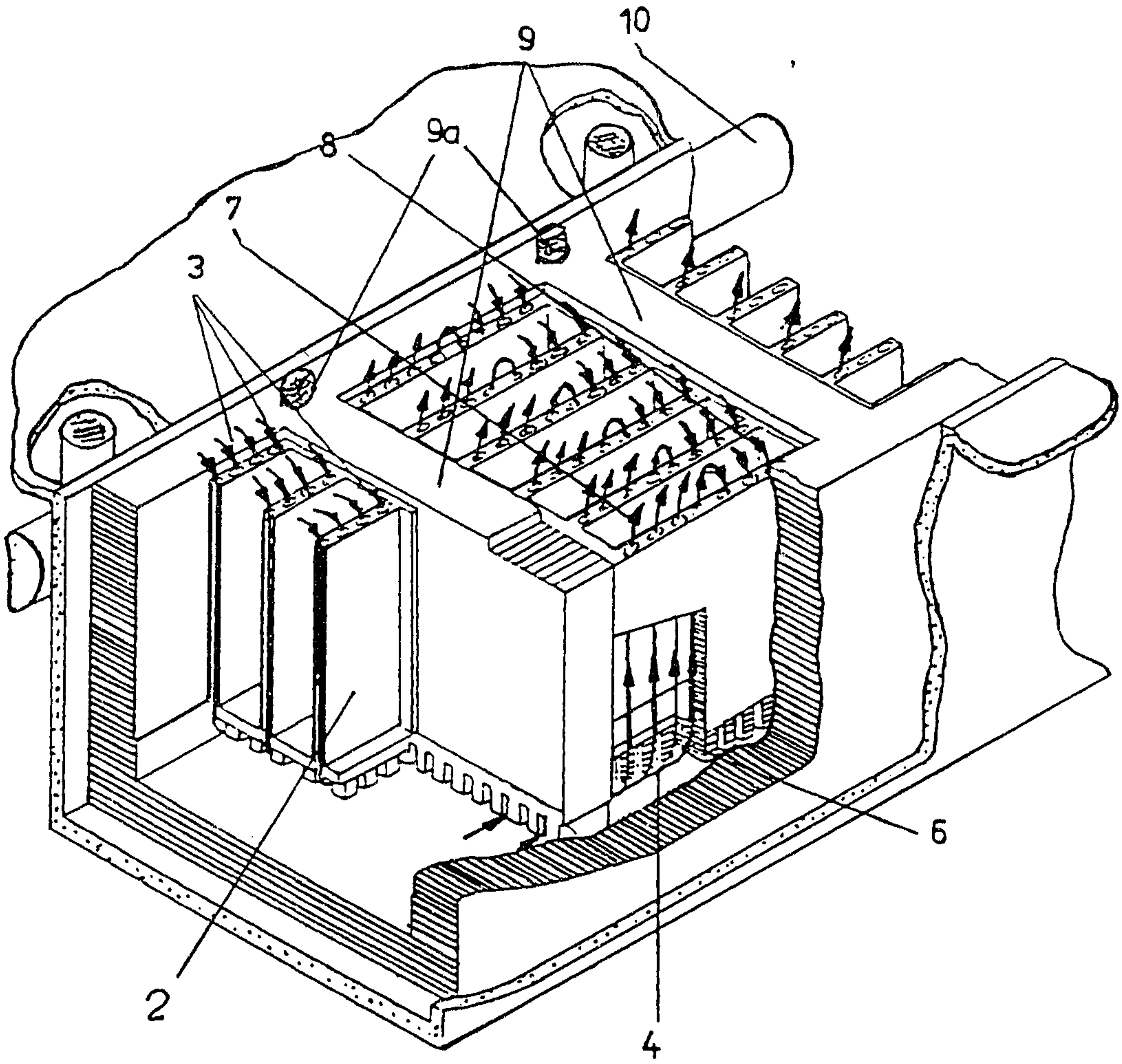

Fig. 1

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FIG.2

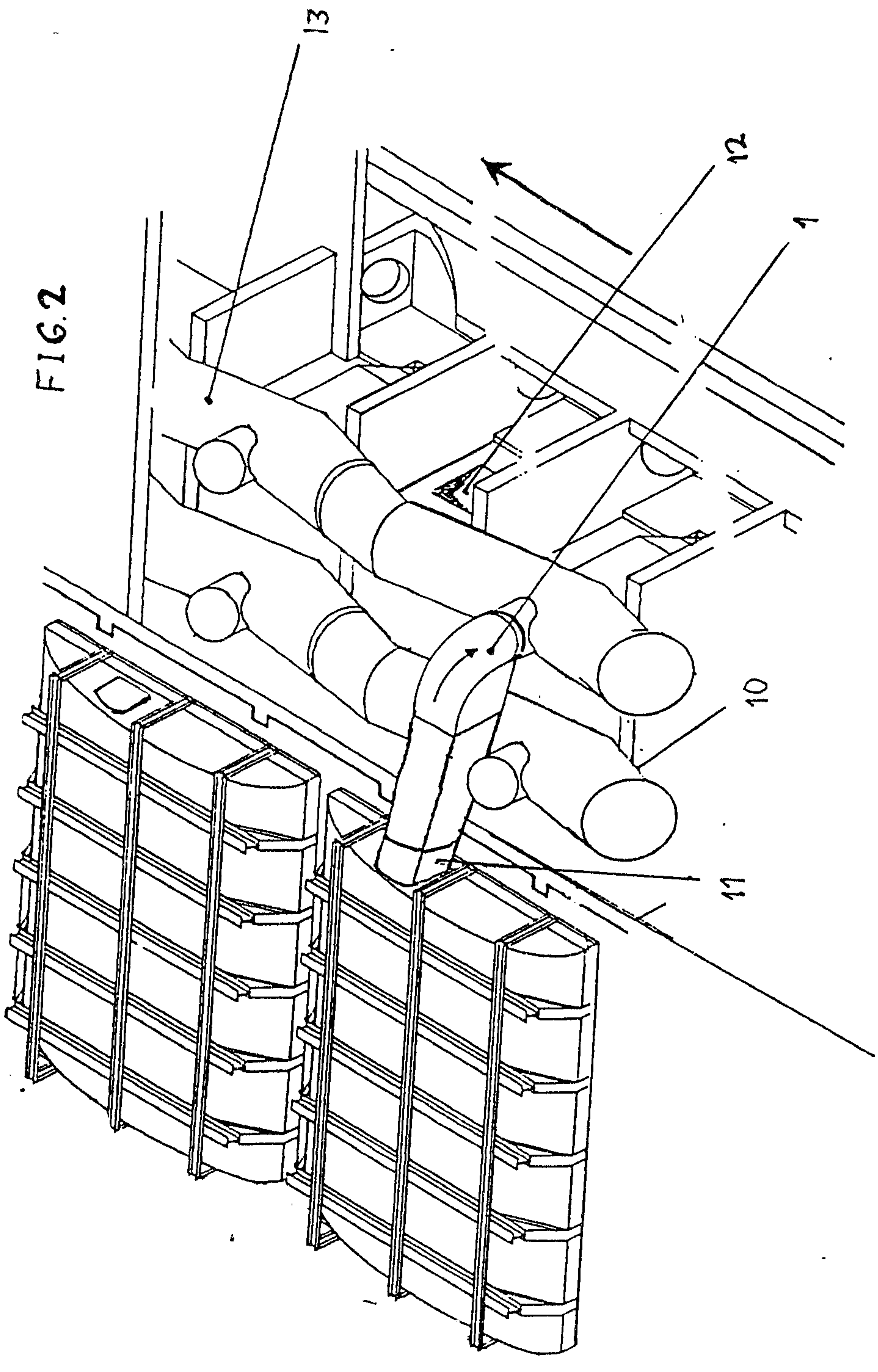

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FIG. 3

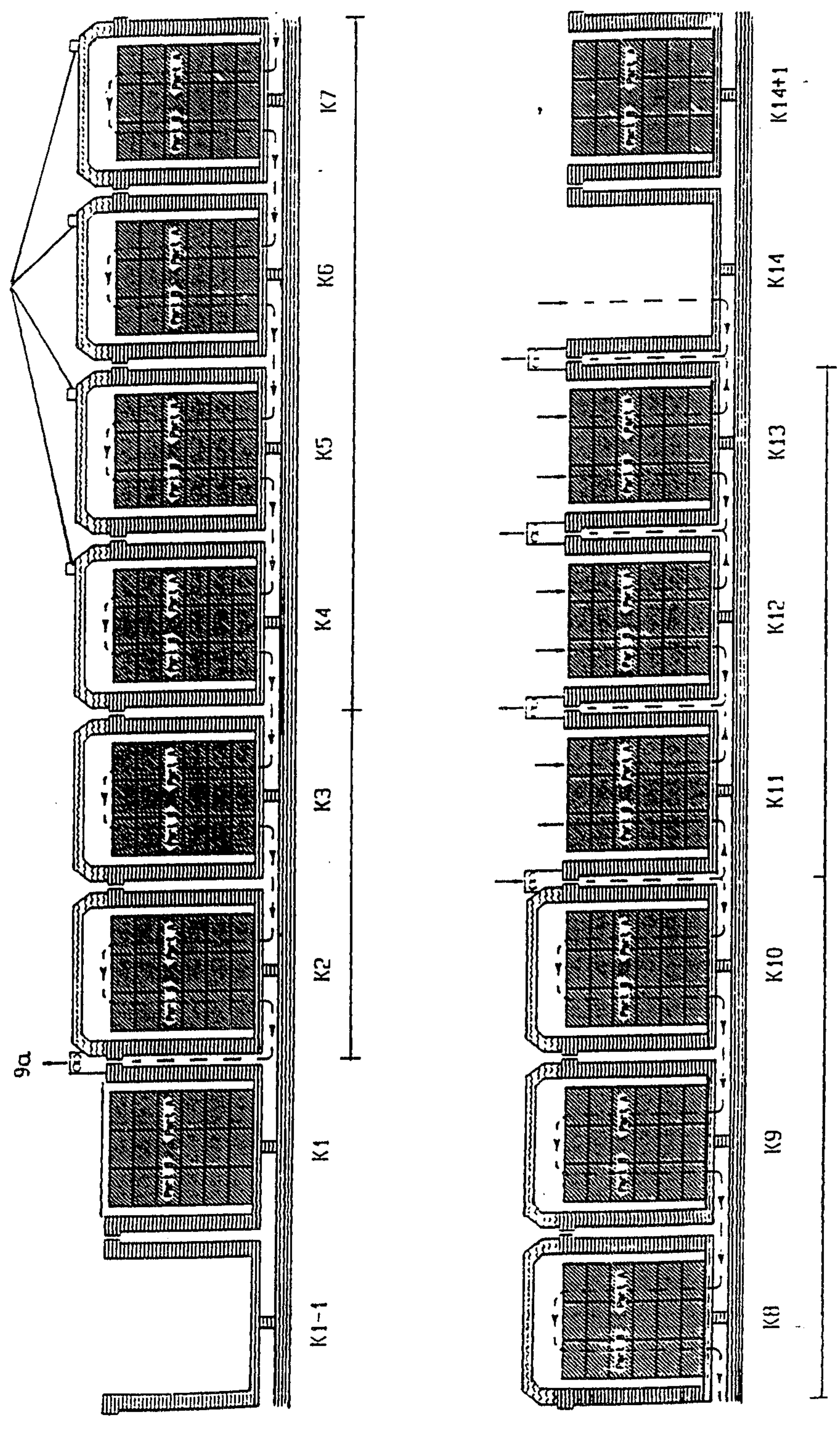

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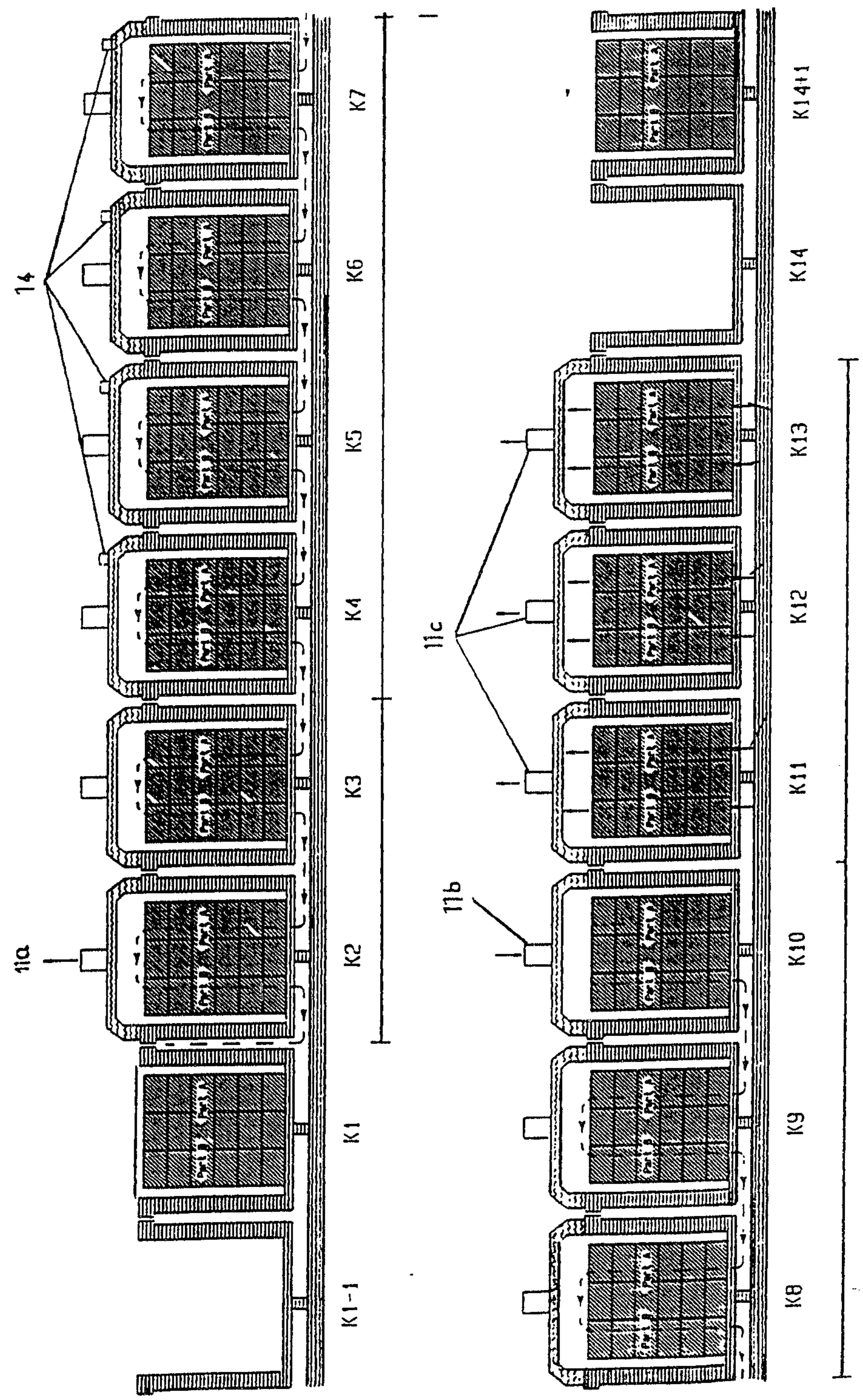
FIG. 4



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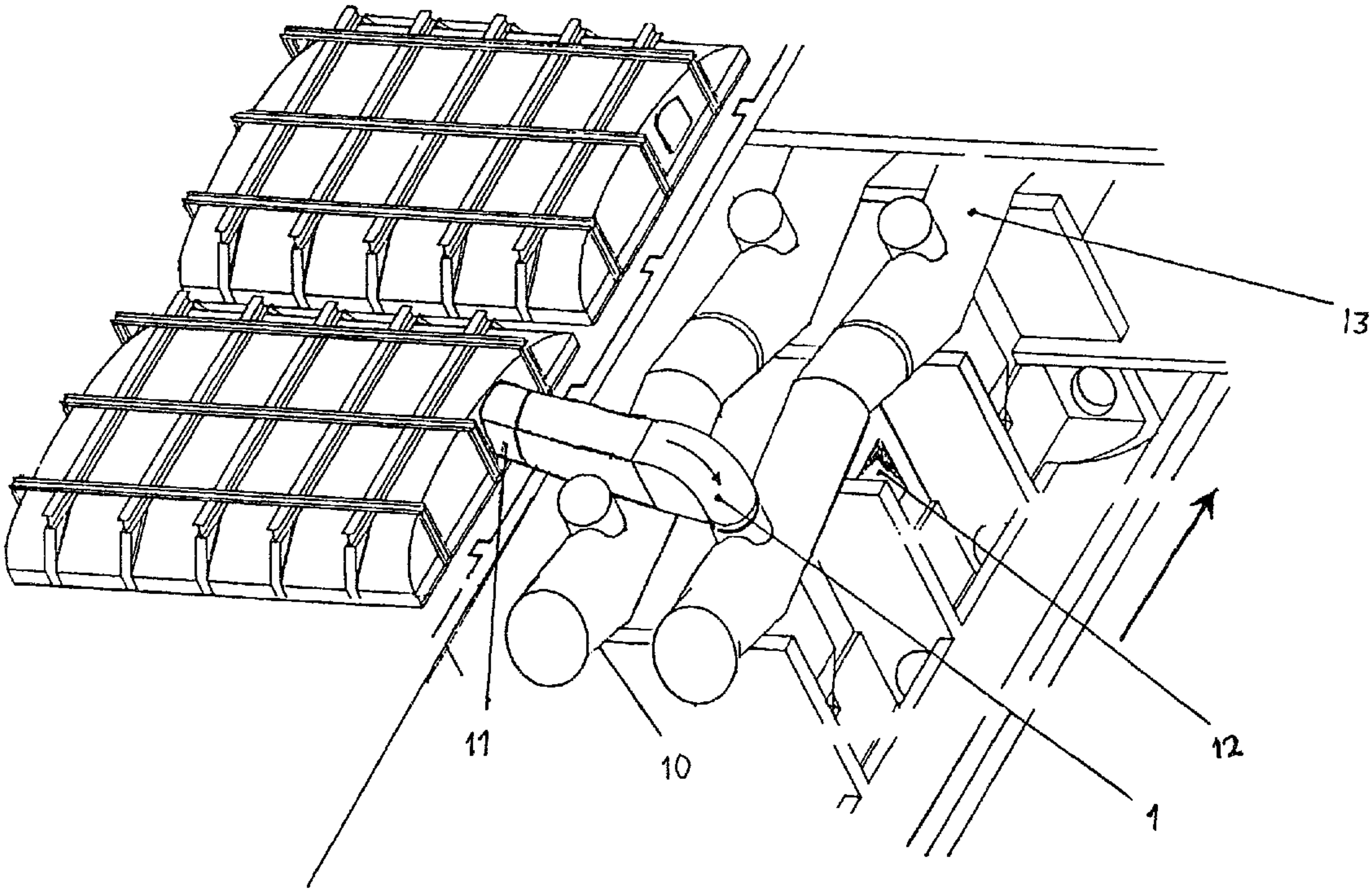

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