

[72] Inventors **Horst Herne Dungs;**
Otto Jache; Gunter Piske; Karl-Heinz
Landfried; Karl-Heinz Knak, all of
Budingen, Germany

[21] Appl. No. **873,427**

[22] Filed **Nov. 3, 1969**

[45] Patented **Nov. 9, 1971**

[73] Assignee **Firma Carl Still**
Recklinghausen, Germany

[32] Priority **Nov. 2, 1968**

[33] **Germany**

[31] **P 18 06 588.8**

Primary Examiner—Carroll B. Dority, Jr.
 Attorney—McGlew and Toren

ABSTRACT: A device for the continuous production of lead plates for storage batteries includes a conveyor for moving the plates within a cabinet through a series of treatment containers and chambers including a washing tub, an impregnation tub, a drying chamber and a cooling chamber. The materials are treated in the drying and cooling chambers with an inert gas atmosphere and the plates are moved through these chambers while they are hanging or standing on hangers or arranged in a vertical position within the cabinets. The dryer for the negative plates has an inlet portion with a receiving opening or orifice which is immersed below the surface of the fluid of one of the washing or impregnation tubs to provide a sealing of this chamber against the escape of the inert gas. The cooling chamber and the drying chamber are located directly adjacent one another but separated by an air lock permitting passage of the plates or the cabinets containing them through the lock with automatic sealing. Preferably at the outlet of the drying chamber or cooling chamber an air lock is installed which is provided with baffle doors which are openable by contact of the cabinets therewith. The air lock chamber is provided with means for directing an inert gas into the chamber and for delivering the gas from the chamber. The outlet door is located so that it is hinged with its top edge at a level lower than the bottom edge of the inlet door to the chamber. The individual drying and cooling chambers employ the same inert gas for heating and cooling purposes, the gas being delivered in a closed cycle through heat exchangers which operate upon the gas to provide the desired temperature for the respective cooling and drying chambers.

[54] **DEVICE FOR THE CONTINUOUS PRODUCTION**
OF LEAD PLATES FOR STORAGE BATTERIES
 8 Claims, 3 Drawing Figs.

[52] U.S. Cl. **118/66,**
34/66, 34/212, 118/69, 118/73, 118/423, 136/33

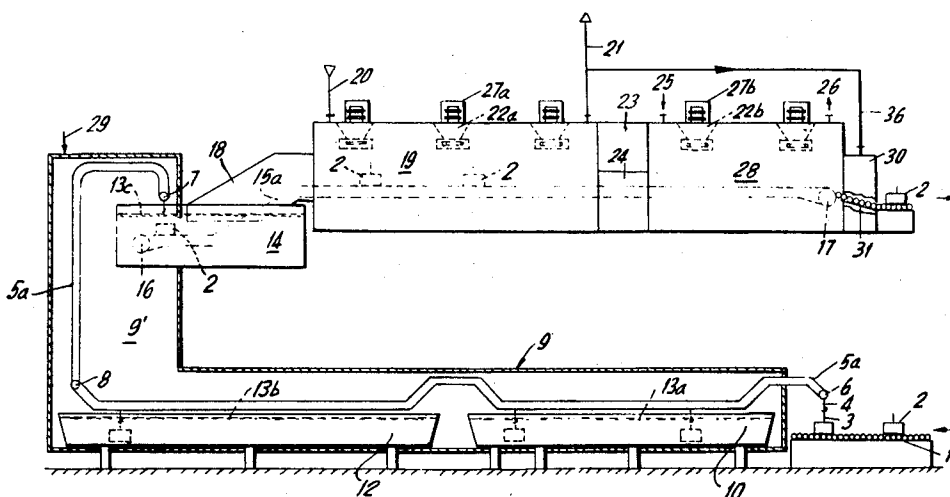
[51] Int. Cl. **B05c 11/00**

[50] Field of Search **34/61, 62,**
66, 90, 212, 216; 68/10, 20; 118/66, 69; 134/75,
76, 114; 136/33

[56] **References Cited**

UNITED STATES PATENTS

2,689,198	9/1954	Judd	34/66 UX
2,978,528	4/1961	Heap	134/114 X



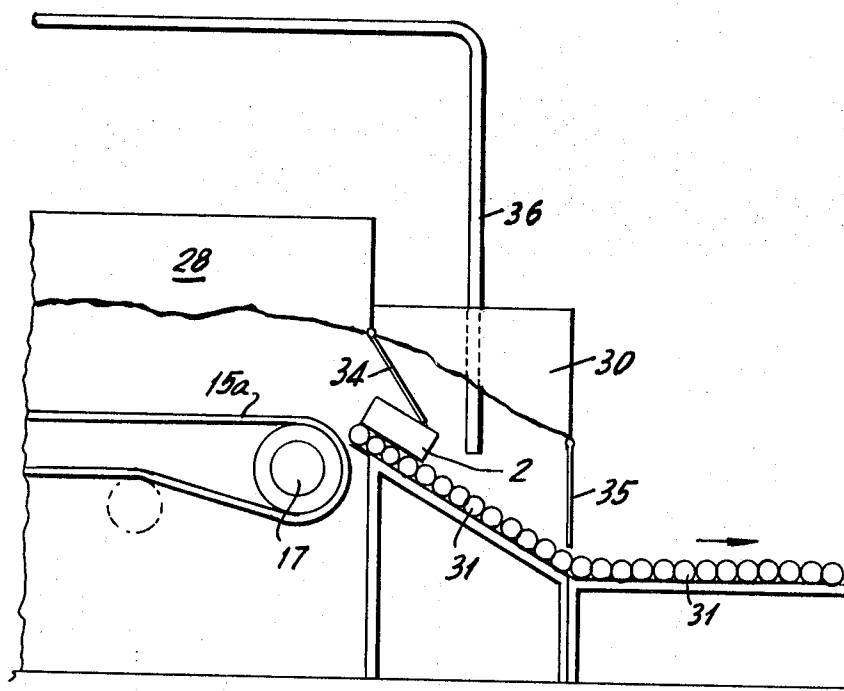


FIG. 2

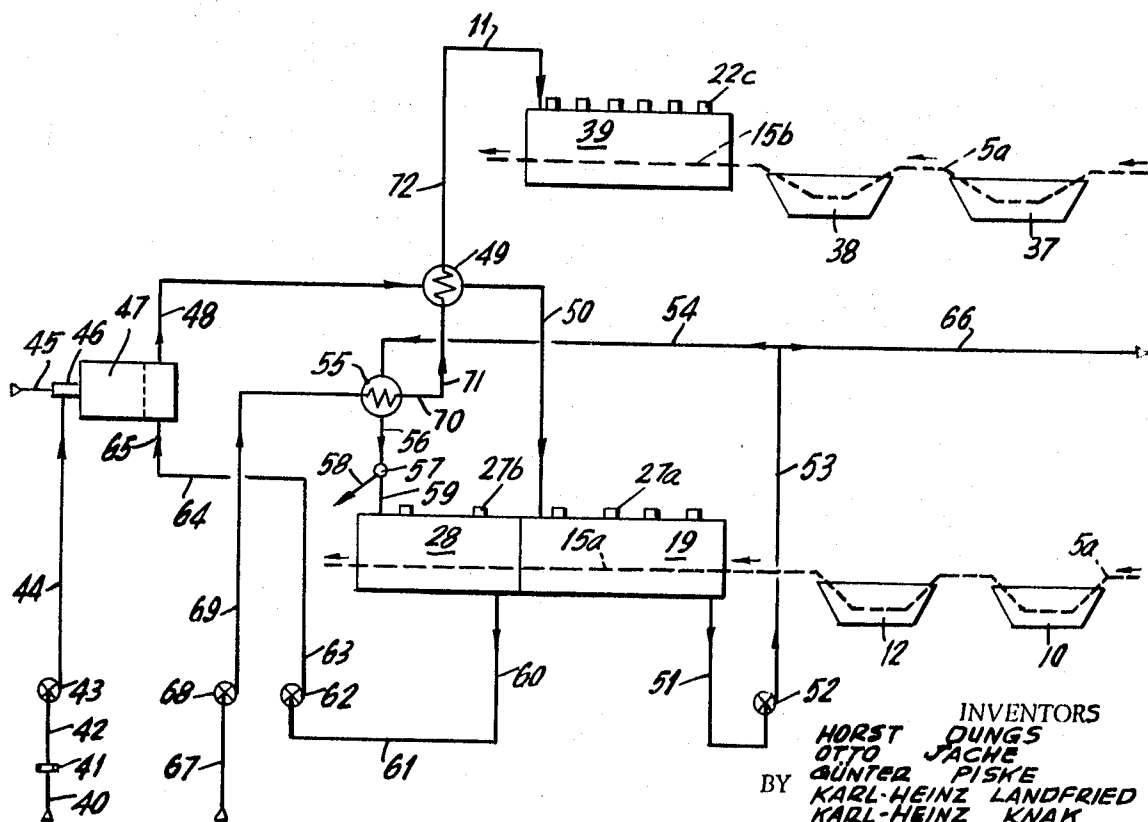


FIG. 3

INVENTORS
 HORST DUNGS
 OTTO JACHE
 GÜNTER PISKE
 KARL-HEINZ LANDFRIED
 KARL-HEINZ KNAK
 BY
 McBlaw & Torrey
 ATTORNEYS

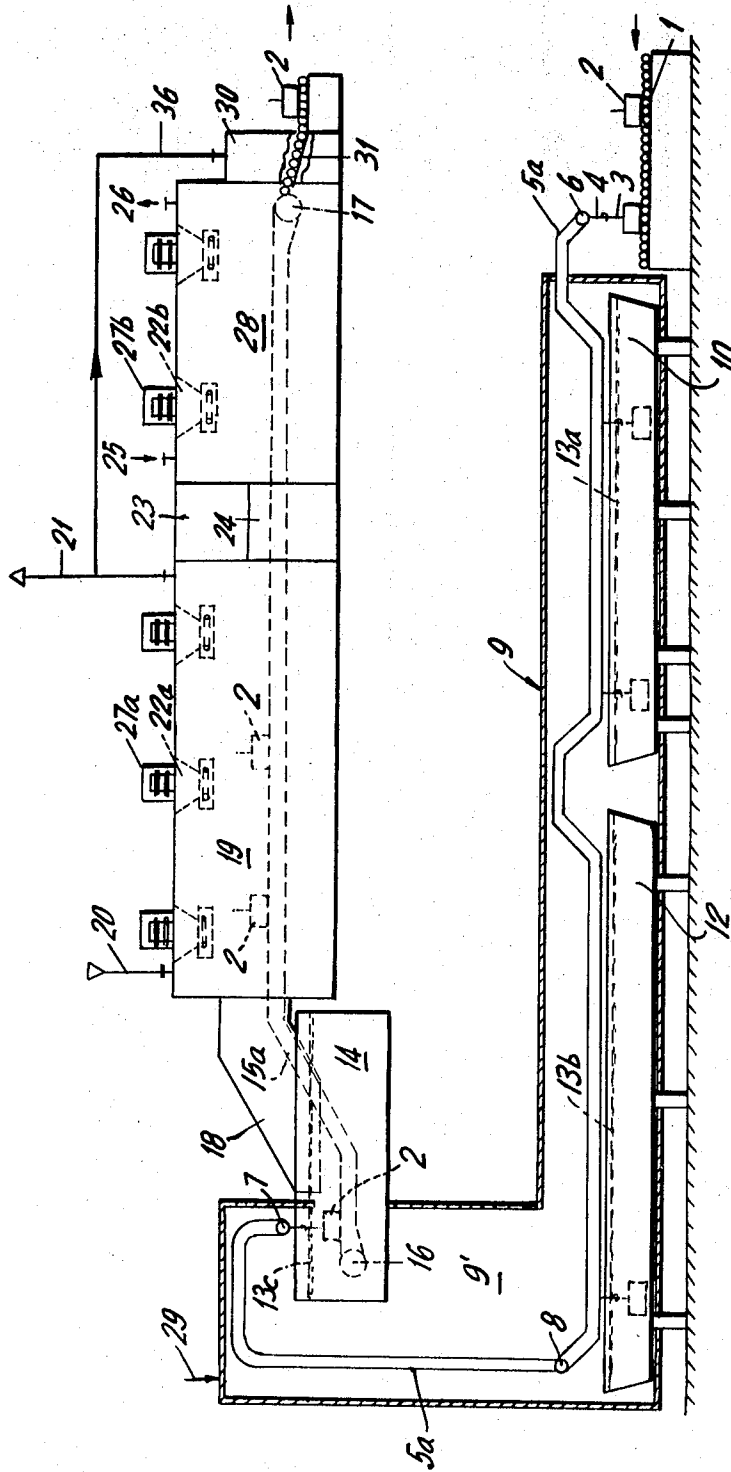


FIG. 1

INVENTORS
 HORST DUNGS
 OTTO JACHE
 BY GÜNTER PISKE
 KARL-HEINZ LANDFRIED
 KARL-HEINZ KNAK
 Mc Graw & Toren
 ATTORNEYS

DEVICE FOR THE CONTINUOUS PRODUCTION OF LEAD PLATES FOR STORAGE BATTERIES

SUMMARY OF THE INVENTION

This invention relates in general to the construction of continuous processing devices, and in particular, to a new and useful device for the continuous production of lead plates for storage batteries and for treating the plates in a series of washing and impregnating tubs and drying and cooling chambers.

Lead plates for storage batteries are treated after they are manufactured in various ways which depend upon whether they are installed in the accumulator or battery as a positive or as a negative plate. The washing out of the sulfuric gases that have formed with water, and the drying and cooling of the positive plates, whose active component consists of lead dioxide, do not present any particular problems. They are dried in a hot air current and cooled in the open atmosphere. The exclusion of oxygen of the air is not necessary here. The active component of the negative plates, however, being reactive and easily oxidizable in the form of elementary lead must be washed, impregnated, dried and cooled while the oxidation elements are excluded. The use of inert gases for drying and cooling the negative plates is known. In continuous plants the negative plates are hung or placed in cabinets or suspended from hangers and then conveyed through washing and impregnating tubs arranged in series and which are filled with the washing water and the impregnation fluid. Subsequently, the plates are moved through drying and cooling chambers both of which are filled with an inert gas. The cabinets for the conveyance of the plates are either hung on cables or placed on conveyor belts or roller tracks as they are moved through the various treatment stages. Nitrogen or carbon dioxide or a mixture of both are usually employed as an inert gases for the treatment and this is easily manufactured in the form of combustion exhaust gas. An effort is made to keep the inert gas requirements as low as possible and in order to diminish the losses of such gas, the drying and cooling chambers are provided with inlet air locks and outlet air locks. The known chamber air locks however, still allow considerable amounts of the inert gas to escape into the open atmosphere as the cabinets for the lead plates are moved into and out of the chambers while suspended on hangers. Such known devices therefore are expensive to operate in respect to the requirements for the supply of inert gas because both the drying and the cooling chamber must be charged with sufficient inert gas so that the oxidation of the negative plates will be definitely prevented. The danger of oxidation of the negative plates upon emerging from the cooling chamber is eliminated only when the temperatures of the plates are below 85° C. The known devices moreover, are expensive in regard to requirements for heating since there has been no possibility heretofore of making profitable use of the waste heat from the dryer in any point of the process.

In accordance with the present invention, there is provided a new and useful apparatus for the continuous washing out, impregnating and drying and cooling of formed lead plates for storage batteries when this process is to be carried out with the use of an inert gases and which does not have the disadvantages of the prior art. Such a device is characterized by the provision of a drying chamber for negative plates which is closed off on its entrance side by the fluid content of an impregnation washing tub so that the entrance side of the dryer possesses an absolutely tight seal and thus a special construction of air lock is not necessary.

According to a special construction of a device of the invention, the cooling chamber is located directly alongside the drying chamber and it includes walls which are of substantially the same dimensions and which are separated from the drying chamber only by an intermediate air lock so that losses of inert gases are also avoided at the exit of the dryer and the entrance to the cooler. The separation air lock located between the two chambers is provided with resilient sealing material which

bears against and conforms to the outline of the cabinet or the plates and limits the passage of gas from the drying chamber to the cooling chamber to a minimum amount. The transfer of gas at this location becomes very slight if the cabinets containing the lead plates are moved in succession through the air locks so that a following cabinet will not enter the lock before the previous one leaves it. In this way there is always a sealing off of the air passage between the drying and the cooling chambers.

In accordance with another embodiment of the invention, a special exit air lock is installed on the drying or cooling chamber. It comprises a chamber whose end walls are equipped with baffle doors and which are spaced apart as much as double the width of the cabinet containing the lead plates so that when the cabinet passes through the outer door is open only when the inner door is already closed. The outer and inner doors are also staggered in height such that the bottom edge of the inner door lies above the top edge of the outer door. In addition the chamber possesses an inlet and an outlet for the inert gas. The bottom of the air lock chamber can be constructed as a slanting roller trackway or the air lock may be constructed as a vertical air lock. An air lock constructed in this manner prevents the penetration of cold air from the outside into the interior of the drying or cooling chambers in a reliable manner. The inert gas requirement for the air lock is comparatively slight.

In a special arrangement of the apparatus the inert gas which is used to dry the negative plates is passed through appropriate heat-exchange elements so that it is capable of also providing the air for the cooling and separation of condensed moisture and for the cooling of the plates in a subsequent passage through a cooling chamber. This recirculating construction greatly diminishes the requirements for such an inert gas and to achieve such a construction the inert gas outlet pipe from the dryer is advantageously connected with the cooling chamber through a condenser and separator. In the cooling chamber the inert gas will again absorb heat and, as thus preheated, it is conveyed to a hot inert gas source and mixed with the freshly produced high-temperature inert gas and cycled back into the plant. A portion of the inert gas which has been once used is lead into a tunnel in which washing and impregnation tubs are installed in order to diminish the danger of oxidation. In a further development of the invention the heat of the inert gases coming out of the dryer for the negative plates is used to preheat the dry air for the positive plates. Installations for drying negative plates and one for drying positive plates are thus operated jointly and connected together by means of a heat exchanger into which the inert gas from the dryer for negative plates releases its heat to the dry air for the positive-plate dryer. Accordingly, it is an object of the invention to provide a device for the continuous production of lead plates for storage batteries in which the plates are to be delivered by conveyor means through washing and impregnation tubs and drying and cooling chambers which are subjected to an inert gas atmosphere, and wherein the dryer for the negative plates has an inlet which is located below the surface of the fluid of one of the washing or impregnating tubs in order to minimize the amount of oxygen which will pass into the dryer with the inert gases.

A further object of the invention is to provide a drying chamber and a cooling chamber for treating lead plates which are located alongside each other and are separated by an air lock for the passage of the plates and which advantageously included baffle doors which open by contact with the articles being passed therethrough in succession so as to insure that inert gas does not pass out through the lock.

A further object of the invention is to provide a combined plant for the treating of positive and negative lead storage plates and wherein the plan includes a dryer and a cooling chamber which are provided with inert gases for the treatment of the negative plates, the gases being circulated through a heat exchanger for preheating the gases for operating the drying and cooling chambers of the positive plates.

A further object of the invention is to provide a device for the continuous production of lead plates for storage batteries which is simple in design, rugged in construction, and economical to manufacture.

The various features of novelty which characterize the invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, its operating advantages and specific objects attained by its use, reference should be had to the accompanying drawings and descriptive matter in which there are illustrated and described preferred embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

In the Drawings

FIG. 1 is a schematic side-elevational view of a plant for washing out, impregnating, drying and cooling of negative plates for storage batteries as constructed in accordance with the invention;

FIG. 2 is an enlarged fragmentary elevational view of a portion of the apparatus indicated in FIG. 1; and

FIG. 3 is a schematic side-elevational view similar to FIG. 1 of another embodiment of the invention.

GENERAL DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawings in particular, the invention embodied therein as indicated in FIGS. 1 and 2 comprises a treatment plant for newly formed negative plates of lead storage batteries which are positioned within containers or cabinets and moved over a roller trackway 1 in a direction of the arrow as shown in FIG. 1. The battery plates are moved with their broad side erect and for this purpose the cabinets 2 hold them in this manner. The cabinets 2 include hinged hangers 3 which engage with hooks 4 of cable 5a which is trained to run around guide rollers and driving rollers 6, 7 and 8 to convey the cabinets 2 upwardly and into a housing 9 which terminates in a tunnel portion 9' at one end. Within the housing 9 in accordance with the invention are arranged a wash tub having a liquid level 13a and an impregnation tub 12 having a liquid level 13b which are located such that the container is moved downwardly below the level of each tub in succession and then moved upwardly in the tunnel portion 9'.

The tunnel portion 9' is charged by a nozzle 29 with an inert gas that is sluiced out of another plant operation for example it may be removed from the combined plant indicated in FIG. 3 through a pipe line 66. After passage upwardly through the tunnel 9' the cabinet 2 is deposited on a moving conveyor belt 15a which runs over reversible rollers 16 and 17.

In accordance with a feature of the construction an impregnation tank 14 is located at a lower end of the conveyor 15a and a dryer inlet 18 includes an inlet orifice or opening which is located below the impregnation liquid level 13c. Cabinets 2 which are deposited on the conveyor 15a are lifted upwardly through the liquid layer 13c and into the dryer inlet without destroying the seal of the inlet and its associated drying chamber 19. Inert gas is fed into the drying chamber 19 from a conduit 20 and is directed out at the opposite end through a conduit 21. Fans 22a at the roof of the dryer 19 circulate the inert gas and they have protected by hoods 27a.

In accordance with the further feature of the invention the cabinets 2 are passed through the exit end of the dryer 19 into an air lock 23 having a duct 24. In this air lock 24, resilient sealing elements engage around the cabinet and bend to conform to its shape as it is passed through on the conveyor 15 so that they prevent the drying air from entering into a cooling chamber 28 which is located directly along side the air lock 24. During the passage through the air lock the hangers 3 are turned around.

The cabinets pass from the lock 24 into the cooling chamber 28 which has an inlet 25 and an outlet 26 for inert

gas and which also includes circulating fans or ventilators 22b having drives protected by hoods 27b.

In accordance with a further feature of the invention the exit of the cooling chamber 28 is provided with an air lock 30 having an inclined roller trackway 31 therein which is arranged at a height to receive the cabinets 2 from the exit end of the conveyor 15a and to deliver them at a lower end onto a horizontal trackway 31 located at the exterior of the air lock 30. The air lock 30 is provided with a conduit 36 for the inlet of the inert gas and, as shown at FIG. 2, it is provided with an inner door 34 which is pivotally mounted so that its lower edge lies above the top edge of an outlet door 35 located at the outlet end of the lock 30. The doors are opened each time by the impact of the cabinets 2 and the outer door 35 is not opened until after the inner door 34 has closed.

In FIG. 3, there is indicated a combined flat for the treatment of negative plates and positive plates. Conveyor means 5a are effective to move the positive plates through washing tubs 37 and 38 and thence into a dryer 39 having circulating fans 22c. Air locks are associated with the entrance and exit of the dryer 39 but are now shown in order to facilitate illustration of all of the parts. The negative plates are moved by conveyor means 5a through the tanks 10, 12 and dryer and cooler 19 and 28 as described previously.

The plant operation of the combined plant of FIG. 3 is as follows:

Propane or other combustible gas is supplied through a conduit 45 to a burner 46 of an oven 47 and combustion air is supplied through a combustion line 40, filter 41, pipe 42, fan 43 and pipe 44 to the burner 46. The combustion produces an inert gas consisting of nitrogen and carbon dioxide and it contains less than 0.2 percent by volume of oxygen. Return pipes 65 connects to the oven 47 and returns the inert gas from the system after its temperature is materially reduced for example, below 60° C. This gas is added to the inert gas which is generated in the oven 47 and the combined product is delivered through the conduit 48 at a temperature of 148° C. This high temperature gas first moves through a heat exchanger 49 where it releases a portion of its heat to the pre-heating of dry air for the dryer 39 and the high temperature gas is cooled to 139° C. It is then delivered through a pipe 50 into the drying chamber for the negative plates 19 and it leaves the chamber 19 through conduit 51 at approximately 90° C. The fan 52 conveys this inert gas through pipes 53 and 54 into a heat exchanger 55 in which the dry air for the dryer 39 is preheated. Water condenses from the inert gas which is cooled 58° C. but it is separated out in a separator 57 and conducted off through a pipe 58. The cooled inert gas goes through pipes 56 and 59 into a cooling chamber 28 and leaves it through pipes 60 at a temperature of approximately 60° C. The washed and impregnated damp lead plates enter the dryer 19 at 20° C. and are heated up to 120° C. They enter at this temperature into the cooling chamber and cooled off to 80° C. At this temperature no considerable danger of oxidation will any longer exist. The inert gases are then directed back through pipe 61, fan 62, pipe 63, 64 and 65 to the oven 47 for remixing with the freshly made inert gases and recycle backward with these gases through the conduit 48.

The dry air for the positive plates is drawn in by the pipe 68 and the fan 58 and is forced through the pipe 69 into the heat exchanger 55 and is preheated thereby inert gas from the drying chamber to a temperature of approximately 70° C. The gas then moves through pipes 70 and 71 to the heat exchanger 49 where it is heated to 85° C. by the inert gas from the oven 47 and then passes through pipe 72 and 11 to the dryer 39. At this location it dries the damp positive plates which emerges from the dryer at approximately 65° C. The dry air is released from the dryer into the atmosphere

What is claimed is:

1. A device for the continuous production of lead plates for storage batteries comprising at least one washtub, at least one impregnation tub, at least one drying chamber, conveyor means for conducting one or more lead plates through said

5

washing tub, said impregnation tub and said drying chamber, said drying chamber having an inlet extending downwardly below the level of liquid in one of said tubs to provide a seal at the location of said conveyor means and extending from said tub to said dryer for the passage of the plates from the tub into the dryer without losing any gases therethrough, means for circulating an inert gas through said dryer for the drying of the plates therein, a cooling chamber located alongside said drying chamber, and air lock means defined between said drying chamber and said cooling chamber, said air lock means including members through which the plates are moved past and which provide a seal with the plates as they are so moved.

2. A device for the continuous production of lead plates for storage batteries comprising at least one washtub, at least one impregnation tub, at least one drying chamber, conveyor means for conducting one or more lead plates through said washing tub said impregnation tub and said drying chamber, said drying chamber having an inlet extending downwardly below the level of liquid in one of said tubs to provide a seal at the location of said conveyor means and extending from said tub into the dryer without losing any gases therethrough, means for circulating an inert gas through said dryer for the drying of the plates therein, an air lock chamber after said drying chamber, said lock chamber having an inlet door overlying said conveyor means for said plates and an outlet door spaced from said inlet and outlet doors being staggered in height such that the bottom edge of the inlet door lies above the top edge of said outlet door, said plates being movable by said conveyor means to successively open said inlet and outlet doors.

3. A device for the continuous production of lead plates for storage batteries comprising at least one washtub, at least one impregnation tub, at least one drying chamber, conveyor means for conducting one or more lead plates through said washing tub said impregnation tub and said drying chamber, said drying chamber having an inlet extending downwardly below the level of liquid in one of said tubs to provide a seal at the location of said conveyor means and extending from said tub into the dryer without losing any gases therethrough, means for circulating an inert gas through said dryer for the drying of the plates therein, a cooling chamber located alongside said drying chamber having a plate inlet adjacent said drying chamber and an opposite end with a plate outlet, and means for circulating inert gas in through said drying chamber adjacent one end and out through said drying chamber adjacent the other end and for circulating inert gas into said cooling chamber adjacent one end and out through said chamber adjacent said opposite end, the outlet of said inert gas from said drying chamber being connected to said cooling chamber by a conduit connection adjacent said plate outlet and a heat exchanger in said conduit connection.

4. A device for the continuous production of lead plates for storage batteries comprising at least one washtub, at least one impregnation tub, at least one drying chamber, conveyor means for conducting one or more lead plates through said washing tub said impregnation tub and said drying chamber,

6

said drying chamber having an inlet extending downwardly below the level of liquid in one of said tubs to provide a seal at the location of said conveyor means and extending from said tub to said dryer for the passage of the cabinets from the tub into the dryer without losing any gases therethrough, means for circulating an inert gas through said dryer for the drying of the plates therein, said dryer being defined by an elongated path through which said conveyor means extends, a cooling chamber located along said side of said dryer and continuing the elongated path through which said conveyor extends, an inlet pipe for conducting inert gas into said dryer adjacent one end thereof, an outlet pipe for conducting inert gas out of said dryer adjacent the other end, inlet and outlet pipe means located at respective ends of said cooling chamber, and an oven for producing inert gases connected to the outlet means of said cooling chamber and to the inlet means of said drying chamber.

5. A device for the continuous production of lead plates for storage batteries comprising at least one washtub, at least one impregnation tub, at least one drying chamber, conveyor means for conducting one or more lead plates through said washing tub said impregnation tub and said drying chamber, said drying chamber having an inlet extending downwardly below the level of liquid in one of said tubs to provide a seal at the location of said conveyor means and extending from said tub to said dryer for the passage of the cabinets from the tub into the dryer without losing any gases therethrough, and means for circulating an inert gas through said dryer for the drying of the plates therein, a cooling chamber located along said conveyor means adjacent said drying chamber, said washing basin, said impregnation basin, said drying chamber and said cooling chamber being provided for the negative plates of the storage battery, and including a positive-plate-washing basin, a positive-plate-impregnation basin and a positive-plate dryer, second conveyor means for conveying positive plates through said positive-plate-washing basin, said positive-plate-impregnation basin and said positive plate dryer, said means for circulating inert gas including a generator for producing inert gases at high temperature and for directing them into said dryer, a heat exchanger, a conduit for removing inert gases from said dryer and for delivering them through said heat exchanger and into said cooling chamber, and means for directing air for said positive plate dryer through said heat exchanger and into said positive-plate dryer.

6. A device, according to claim 5, including a second heat exchanger, said second heat exchanger being connected to said generator of inert gases at high temperatures and located before said dryer, said air for said positive-plate dryer being directed through said first heat exchanger and said second heat exchanger then into said positive-plate dryer.

7. A device, according to claim 6, including means for withdrawing inert gases from said cooling chamber and delivering them back to said generator, for producing inert gases at high temperature.

8. A device, according to claim 7, including means for drawing gases from said dryer and delivering them back to said first heat exchanger for delivery into said cooling chamber.

* * * * *

60

65

70

75