OPIC
Office de la propriété intellectuelle du Canada

CIPO
Canadian Intellectual Property Office

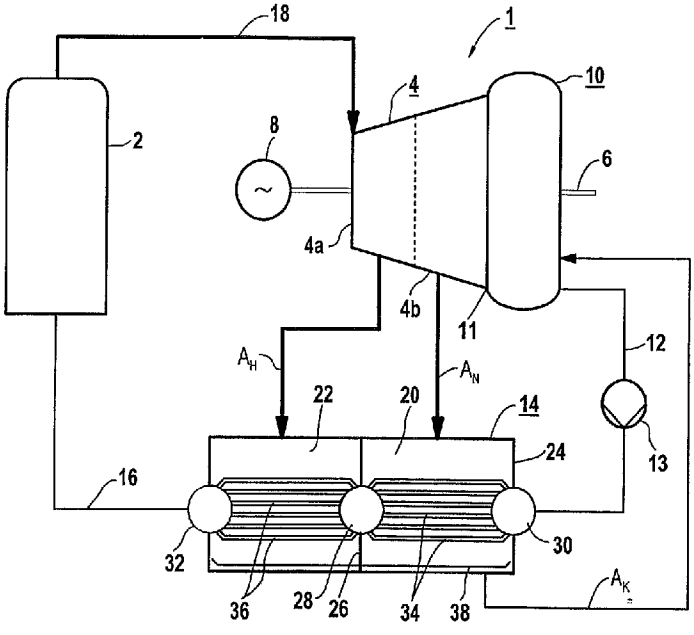
(12) (19) (CA) **Demande-Application**

(21) (A1) **2,234,227**
(86) 1996/10/08
(87) 1997/04/17

(72) KEFER, Volker, DE
(72) DROSDZIOK, Armin, DE
(71) SIEMENS AKTIENGESELLSCHAFT, DE

(51) Int.Cl.[6] F01K 7/40, F22D 1/32
(30) 1995/10/09 (195 37 478.9) DE

(54) **CENTRALE THERMIQUE A VAPEUR**
(54) **STEAM POWER PLANT**



(57) Dans cette centrale thermique à vapeur (1) comportant une pluralité de paliers de pression (4a, 4b) montés sur un arbre (6) commun à toutes les turbines, un condensateur (10) est monté du côté d'écoulement dans le sens axial de l'arbre (6) des turbines et un préchauffeur (14) d'eau d'alimentation est conçu de façon modulaire, ce qui permet d'obtenir une centrale thermique à vapeur particulièrement compacte. Le préchauffeur (14) d'eau d'alimentation comprend une pluralité de modules échangeurs de chaleur (20, 22) montés dans un seul bâti (24) et susceptibles d'être chauffés par la vapeur (A_N, A_H) prélevée sur un ou tous les paliers de pression (4a, 4b). Les modules échangeurs de chaleur sont montés en série côté eau d'alimentation et en parallèle côté vapeur prélevée.

(57) In order to obtain a particularly compact steam power plant (1) with a plurality of pressure stages (4a, 4b) mounted on a common turbine shaft (6), a condenser (10) is mounted at the outflow side in the axial direction of the turbine shaft (6) and a feed-water preheater (14) has a modular design. The feed-water preheater (14) has a plurality of heat exchanger modules (20, 22) which are arranged in a common housing (24) and may be heated by steam (A_N, A_H) tapped from one or all pressure stages (4a, 4b). The heat exchanger modules (20, 22) are mounted in series at the feed-water side and in parallel at the tapped steam side.

(57) Abstract

In order to obtain a particularly compact steam power plant (1) with a plurality of pressure stages (4a, 4b) mounted on a common turbine shaft (6), a condenser (10) is mounted at the outflow side in the axial direction of the turbine shaft (6) and a feed-water preheater (14) has a modular design. The feed-water preheater (14) has a plurality of heat exchanger modules (20, 22) which are arranged in a common housing (24) and may be heated by steam (A_N, A_H) tapped from one or all pressure stages (4a, 4b). The heat exchanger modules (20, 22) are mounted in series at the feed-water side and in parallel at the tapped steam side.

Description

Steam-turbine plant

The invention relates to a steam-turbine plant having a number of pressure stages arranged on a common turbine shaft.

In a steam-turbine plant, a condenser connected downstream of the steam turbine is normally arranged below the steam turbine. In addition, the steam-turbine plant comprises a multiplicity of preheaters of a preheating section for preheating condensate or feedwater conducted in the steam cycle of the steam turbine. To connect the preheaters to one another and to the steam turbine, a correspondingly complex piping system is provided. US Patent 5,404,724, for example, discloses a steam-turbine plant having a multiplicity of such preheaters. On account of the type of construction of the steam turbine and on account of the large number of structural components, such a steam-turbine plant is considerably expensive in terms of construction and requires considerable space. In addition, the assembly cost when erecting such a steam-turbine plant is especially high, particulary as the steam turbine arranged above the condenser necessitates a complicated supporting structure.

A steam-turbine plant having a number of pressure stages and having a condenser arranged on the downstream side in the axial direction of the turbine shaft has been disclosed in EP-A-206 135.

The object of the invention is therefore to specify an especially compact steam-turbine plant which in addition can be assembled in an especially simple manner.

This object is achieved according to the invention by a steam-turbine plant having a number of pressure stages arranged on a common turbine shaft, a condenser arranged on the outflow side in the axial direction of the turbine shaft, and also a feedwater preheater having a number of heat-exchanger modules which can be heated with bled steam from one or each pressure stage, are arranged in a common casing and are connected in series on the feedwater side and in parallel on the bled-steam side, in each case two adjacent heat-exchanger modules being separated from one another on the bled-steam side by a dividing wall and being connected to one another on the feedwater side by means of a collector.

The invention starts out from the idea that, on the one hand, the assembly cost during the erection of a steam-turbine plant is especially low due to all relevant structural parts, in particular of the steam turbine and the condenser as well as of the feedwater preheater of the preheating section, being arranged at ground level. On the other hand, by a compact type of construction of the preheating section, this preheating section can be arranged in an especially space-saving manner and in addition close beside the steam turbine. A compact type of construction of the preheating section can in turn be achieved by a modular design of an individual feedwater preheater. Corresponding heat-exchanger modules may then be directly connected one behind the other on the feedwater side like a multiplex preheater so that connecting lines are saved. In addition, a further reduction in the assembly cost is achieved by the heat-exchanger modules being arranged in a common casing. A heat-exchanger module per se has been disclosed, for example, by publication DE-A-39 05 066. The various pressure stages of the bled steam can be decoupled from one another particularly reliably by the separation of the heat exchanger modules in each case via the respective

dividing wall.

In an advantageous development, the pressure stages of the steam turbine and the condenser are arranged in a common casing. In order to utilize in an especially effective manner the heat content of the bled steam fed in each case to the individual heat-exchanger modules and to thus achieve an especially high efficiency of the steam-turbine plant, each heat-exchanger module, with regard to its design pressure, is in addition expediently adapted to a pressure stage.

To feed back bled steam condensed during the heat exchange inside the heat-exchanger modules, a collecting rail, common to the heat-exchanger modules, for condensed bled steam is expediently provided.

For use in the output range up to about 350 MW, the steam turbine is advantageously designed for half speed. This means that the rotational frequency of the turbine shaft is equal to half the mains frequency (50 or 60 Hz) of the mains fed by the generator.

The advantages achieved with the invention consist in particular in the fact that, by an axial arrangement of the condenser on the outflow side of the turbine shaft, an especially high efficiency of the steam turbine is achieved on account of the axial outflow of the expanded steam. Furthermore, due to the arrangement of the condenser directly behind the outflow flood, the steam turbine can be set up virtually at ground level and thus without complicated supporting structures. In combination with the feedwater or multiplex

preheater of compact design, which can likewise be set up at ground level and directly next to the steam turbine, an especially compact and space-saving type of construction is obtained overall. The requirements imposed as regards the statics and the size of the machinery house are therefore not great. Furthermore, if it is assumed that plant components are lifted in and out with mobile cranes or truck-mounted cranes during assembly or even during a subsequent inspection, the machinery house can be constructed as pure weather protection. In addition, the concept described enables the components, in particular the heat-exchanger modules, to be largely prefabricated. Furthermore, only especially

short pipe lines for bled steam, condensate return and feedwater feed are required. Therefore the steam turbine and the condenser as well as the feedwater delivery and feedwater preheating can be planned and produced as an integrated unit.

An exemplary embodiment of the invention is described in more detail with reference to a drawing, in which the figure schematically shows a steam-turbine plant having a condenser, arranged axially to the steam turbine, and a multiplex preheater.

The steam-turbine plant according to the figure is part of a steam-turbine plant 1 having a steam generator 2. The steam-turbine plant comprises a steam turbine 4 having a high-pressure stage 4a and a low-pressure stage 4b which drive a generator 8 via a common turbine shaft 6. The steam turbine 4 is designed for half speed, i.e. the turbine shaft 6 rotates at half the mains frequency of the electric mains to be fed. A condenser 10 connected downstream of the steam turbine 4 and arranged with the latter in a common casing is arranged on the outflow side in the axial direction of the turbine shaft 6 and thus next to the steam turbine 4.

The condenser 10 is connected on the outlet side to a feedwater preheater 14 or multiplex preheater via a feedwater line 12 in which a feedwater pump 13 is connected. Via a feedwater line 16, the feedwater preheater 14 leads on the outlet side into the steam generator 2, which in turn is connected on the outlet side to the high-pressure part 4a of the steam turbine 4 via a live-steam line 18.

In the exemplary embodiment, the multiplex preheater 14 comprises two heat-exchanger modules 20, 22 which are arranged in a common casing 24. Bled steam A_N or A_H is admitted to each heat-exchanger module 20, 22 of the multiplex

preheater 14. In this case, the pressure and temperature of the bled steam A_N, A_H are functions of the location of the respective bleed point of the steam turbine 4. In the exemplary embodiment, the bled steam A_N is extracted from the low-pressure stage 4b of the steam turbine 4, whereas the bled steam A_H is extracted from the high-pressure stage 4a of the steam turbine 4. Therefore the bled steam A_H has a high temperature and a high pressure, whereas the bled steam A_N has a comparatively low temperature and a comparatively low pressure. The heat-exchanger modules 20, 22 arranged one behind the other are accordingly designed for the different pressure ranges of the bled steam A_H or A_N. Alternatively, however, bled steam A_H from the high-pressure stage 4a of the steam turbine 4 or also bled steam A_N from the low-pressure stage 4b of the steam turbine 4 may equally be fed to both heat-exchanger modules 20, 22. In addition, further heat-exchanger modules and/or further steam bleed points A may be provided.

In order to uncouple the pressure ranges of the heat-exchanger modules 20, 22 from one another, a dividing wall 26 is provided between the heat-exchanger module 20 and the heat-exchanger module 22. The heat-exchanger modules 20, 22 are therefore connected in parallel on the bled-steam side.

On the feedwater side, the heat-exchanger modules 20, 22 are connected to one another via a collector 28. In the exemplary embodiment, the collector 28 forms part of the dividing wall 26. Further collectors 30, 32 are provided at the feedwater-side inlet and outlet respectively of the multiplex preheater 14.

In each case a number of feedwater tubes 34 and 36 respectively are provided in the heat-exchanger modules 20, 22. In this case, the feedwater tubes 34 of the heat-exchanger module 20 are connected on the inlet side to the inlet collector 30 and on the outlet side to

the collector 28. Furthermore, the feedwater tubes 36 of the heat-exchanger module 22 are connected on the inlet side to the collector 28 and on the outlet side to the outlet collector 32. The heat-exchanger modules 20, 22 of the multiplex preheater 14 are therefore connected in series on the feedwater side.

To feed back condensed bled steam A_N, A_H into the condenser 10, a collecting rail 38, common to the heat-exchanger modules 20, 22, for condensed bled steam A_K is provided.

Both the steam turbine 4 with condenser 10 connected downstream and the multiplex preheater 14 are arranged at ground level and especially close together. Therefore the space required for the steam-turbine plant is especially small.

Patent Claims

1. Steam-turbine plant having a number of pressure stages (4a, 4b) arranged on a common turbine shaft (6), a condenser (10) arranged on the outflow side in the axial direction of the turbine shaft (6), characterized by a feedwater preheater (14) having a number of heat-exchanger modules (20, 22) which can be heated with bled steam (A_N, A_H) from one or each pressure stage (4a, 4b), are arranged in a common casing (24) and are connected in series on the feedwater side and in parallel on the bled-steam side, in each case two adjacent heat-exchanger modules (20, 22) being separated on the bled-steam side by means of a dividing wall (26) and being connected to one another on the feedwater side by means of a collector (28).

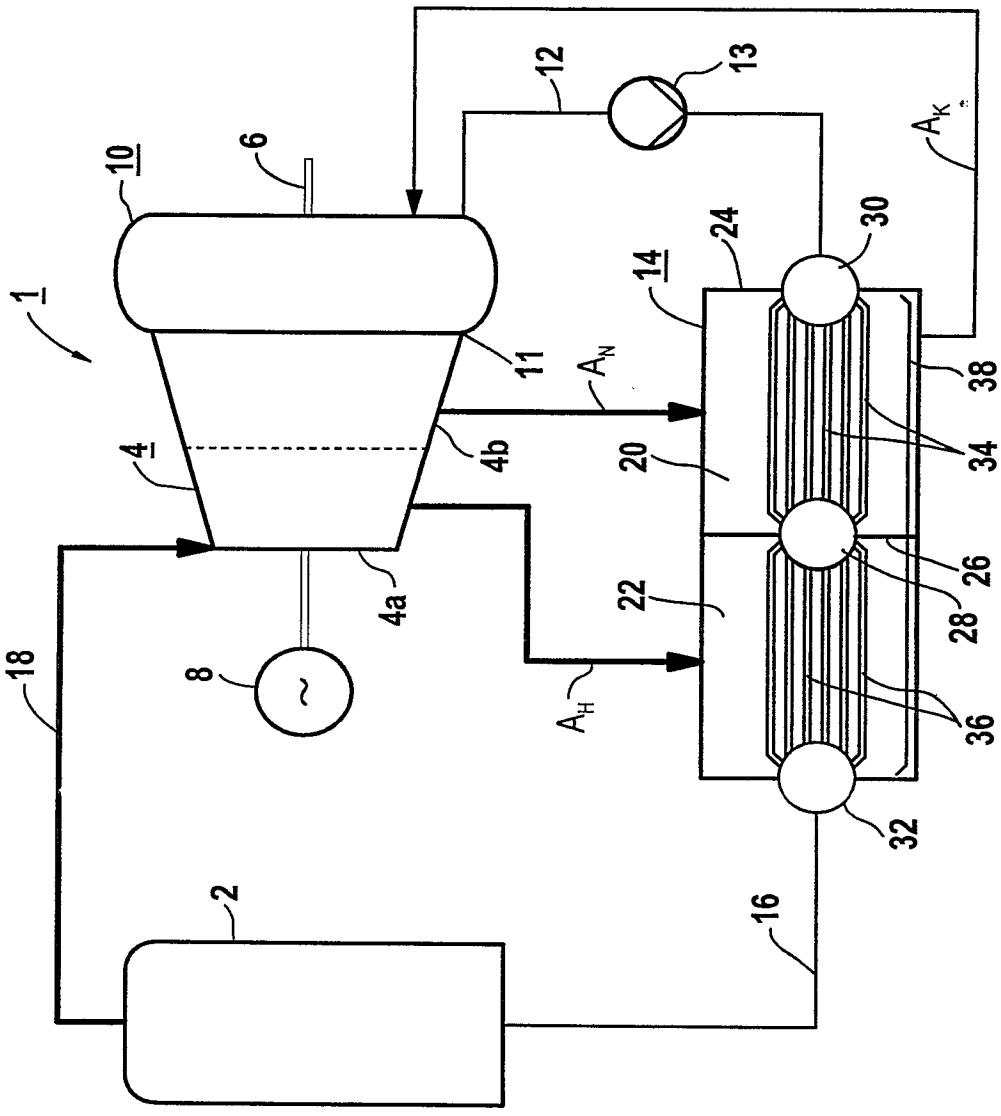
2. Steam-turbine plant according to Claim 1, characterized in that the pressure stages (4a, 4b) and the condenser (10) are arranged in a common casing (13).

3. Steam-turbine plant according to Claim 1 or 2, characterized in that each heat-exchanger module (20, 22) is adapted to a pressure stage (4a, 4b).

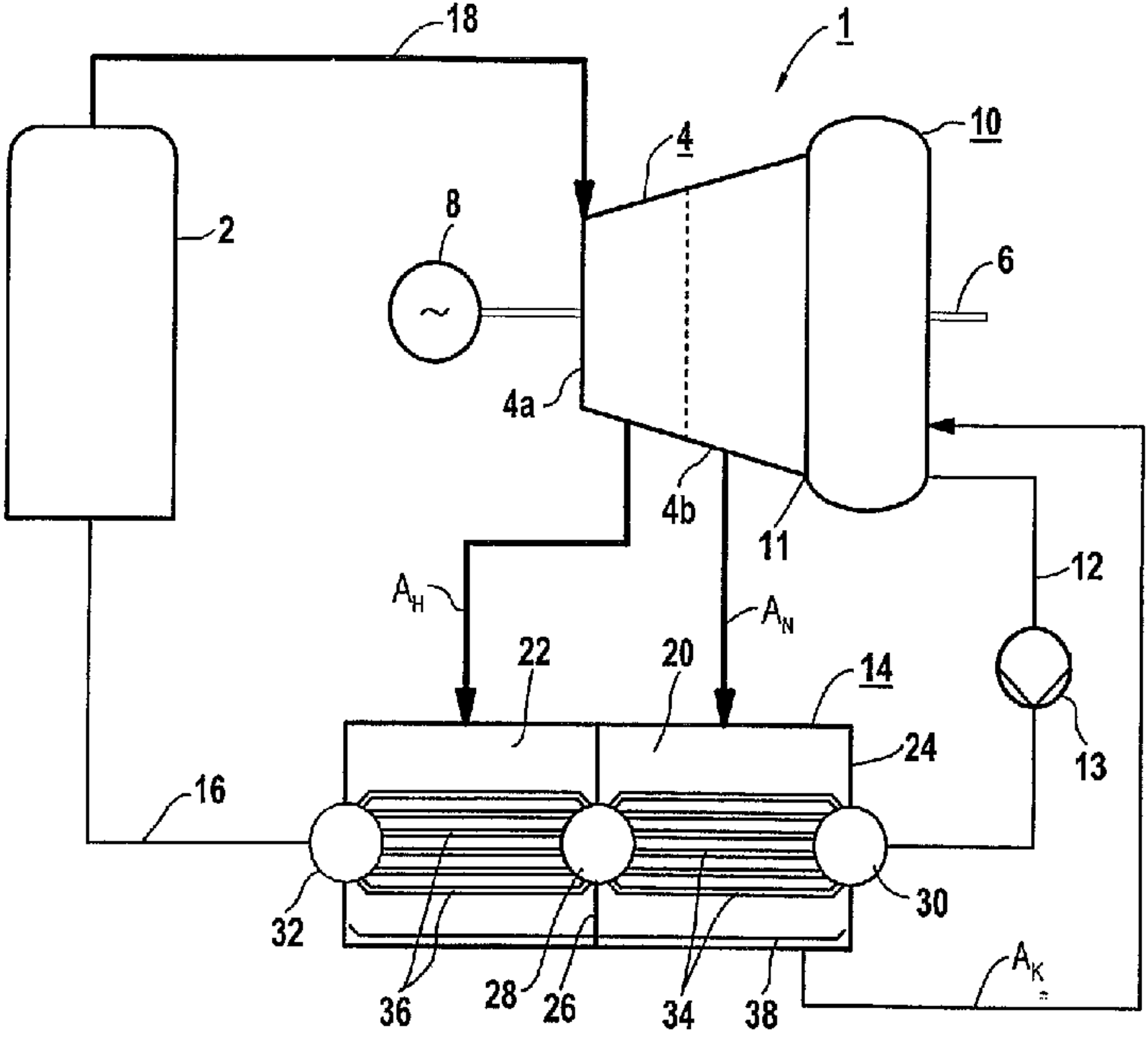
4. Steam-turbine plant according to one of Claims 1 to 3, characterized by a collecting rail (38), common to the heat-exchanger modules (20, 22), for condensed bled steam (A_K).

5. Steam-turbine plant according to one of Claims 1 to 4, characterized in that the steam turbine (4) is designed for half speed.

CA 02234227 1998-04-07



Patent Agents
Fetherstonhaugh & Co.


18
1
10
4
2
8
6
4a
4b
11
12
A_H
A_N
22
20
14
24
13
16
32
30
36
28
26
34
38
A_K