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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 :		(11) International Publication Number:	WO 91/16962
B01D 36/04	A1	(43) International Publication Date:	14 November 1991 (14.11.91)

(21) International Application Number: PCT/US91/03283

(22) International Filing Date: 10 May 1991 (10.05.91)

(30) Priority data:
521,482 10 May 1990 (10.05.90) US

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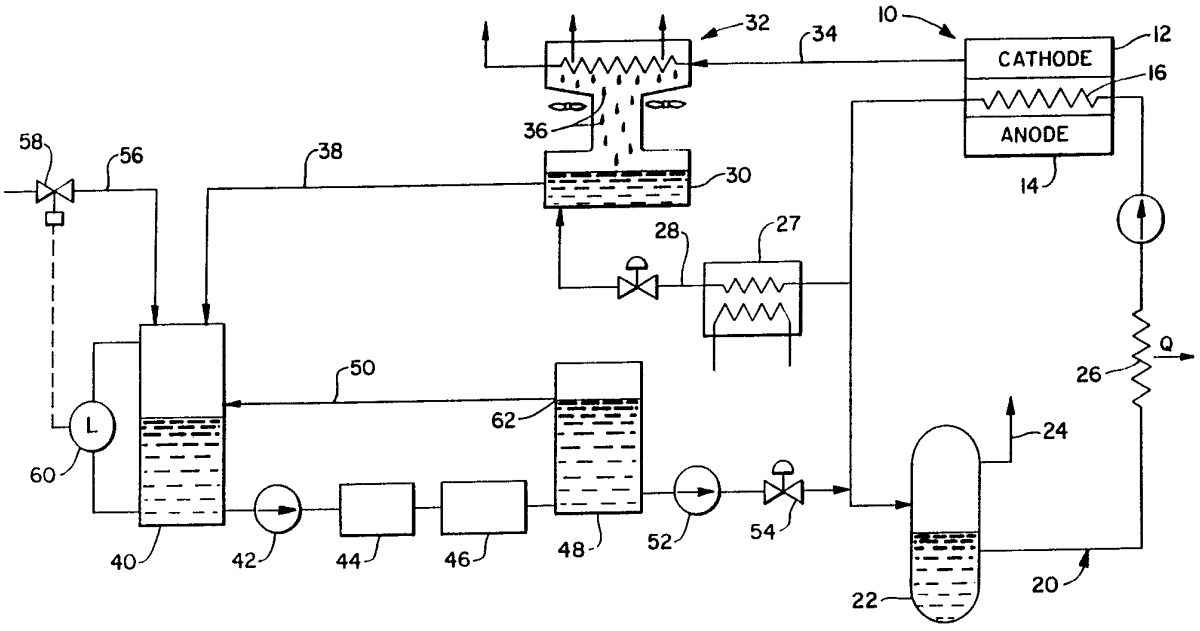
(81) Designated State: JP.

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: WATER TREATMENT SYSTEM FOR A FUEL CELL POWER PLANT



(57) Abstract

A fuel cell power plant coolant loop (20) has makeup water supplied via a dirty water tank (40), a water treatment system including a demineralizer (46) and a clean water tank (48). A recirculation line (38) from clean water tank (48) to dirty water tank (40) permits flow through the water treatment system (46) to remain at a consistent high level. Channeling through the demineralizer (46) and slime buildup are decreased.

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Description

Water Treatment System for a Fuel Cell Power Plant

Technical Field

The invention relates to water treatment systems for use in a fuel cell power plant and in particular, to a water treatment system for makeup water used for the fuel cell coolant loop.

Background of the Invention

In a fuel cell power plant, the fuel cells are cooled by cooling water passing through a portion of each fuel cell in heat exchange relationship. After the cooling water is heated by cooling the fuel cell, a portion of this water is flashed into steam which is used as a supply for the gas reformer. With this steam being removed, the solids will tend to build up in the recirculating coolant loop and accordingly a portion of the water is blown down, preferably continuously, to avoid solids build up in the system.

Treated water must be added to the system to make up for both of these losses. Conventionally, the blow down passes through a water treatment system and is returned to the circuit. The water which is electrochemically produced in the fuel cell reaction and contained as vapor in the gases exiting the cathode is condensed and also collected for

addition to the loop after treatment. Further, raw water may be added as required. Water may also be collected from anode exiting gases if desired.

This dirty water from the various sources is conventionally collected in a tank and pumped through a water treatment system comprised of filters and demineralizers from which it is supplied to the recirculating coolant loop for makeup water as required.

The loss of water from the coolant loop is a function of the load on the system and it follows that the quantity of makeup water required will also vary in accordance with the load on the system. The water treatment system is therefor designed for the full rating so that it supplies sufficient water at that time.

At reduced fuel cell power plant ratings, the treatment system must either operate a reduced flow or operate intermittently.

At the design flow, the water being treated flows rather uniformly through the resin bed. At reduced flows, however, there is a tendency for the water to channel through only portions of the bed. It follows that predominantly the resin only in that portion of the bed is used and the effectiveness of the bed is greatly diminished.

On the other hand, if the system is operated intermittently, there are clearly times which no flow exists through the water treatment system. It has been found that at these no-flow conditions the rate of bacteria reproduction and slime generation increases in the system. This bacteria reproduction and slime generation does not amount to any

significant degree with the continuous flow through the system.

Summary of the Invention

A pump is located to pass water through a water treatment system including a filter and a demineralizer. It takes suction from a dirty water tank and delivers the discharge to a clean water tank. The supply means for passing water to the fuel cell coolant loop takes water from the clean water tank. A recirculating line is provided from the clean water tank to the dirty water tank with the pump operating to pass a substantially constant flow of water through the demineralizer at all times.

The constant supply of water through the demineralizer avoids both the low flow problem of channeling and the intermittent flow problem of bacteria reproduction and slime generation. The clean water tank may be sized to provide a flow of clean water to the coolant loop during times when the water treatment system is inoperative or being regenerated. A sufficiently large clean water tank will also provide clean water for use in the regeneration process.

Brief Description of the Drawing

The drawing is a schematic illustration of a fuel cell power plant having a coolant loop and the water treatment system arrangement.

Description of the Preferred Embodiment

A fuel cell power plant has a plurality of fuel cells of which one fuel cell 10 is shown. This includes a cathode 12, an anode 14 and a coolant flow path 16. A pump 18 circulates coolant through the fuel cell power plant coolant loop 20 with heat being removed from the fuel cell by heat exchanger 16 and the coolant passing to steam separator 22. Through outlet 24, the steam separated here, passes to a fuel reformer not shown. A heat exchanger 26 removes excess heat from the loop.

The blow down line 28 operates to remove water from the coolant loop for the purpose of avoiding solids build-up therein. This delivers the water through heat exchanger 27 to a well 30 in condenser 32.

Air passing through cathode 12 discharges through line 34 and contains substantial water vapor formed in the fuel cell. This passes through the condenser 32 where the condensate 36 drops into well 30.

The blow down and condensate pass through line 38 to dirty water tank 40.

Pump 42 takes suction from dirty water tank 40 passing water at a substantially constant flow rate through filter 44 and demineralizer 46. The water is discharged into clean water tank 48. A recirculating line 50 is provided to return water from the clean water tank to the dirty water tank 40.

A supply means in the form of a high pressure pump 52 and a valve 54 are operable to transfer water from the clean water tank 48 to the coolant

loop 20 as required for makeup. With the pump 42 passing water through the demineralizer at a constant rate, the portion of water passing through the demineralizer which is not transferred to the coolant loop is recycled through line 50. Accordingly, a constant uniform flow is achieved through the water treatment system at all times, independent of the instantaneous requirements of coolant loop 20.

Additional makeup water may be supplied through raw water line 56 modulated by valve 58 to maintain water level 60 in the dirty water tank.

With the recirculating line 50, located at a high elevation 62 in the clean water tank, significant water storage is achieved in the tank. Anytime the tank is below the overflow level, the uniform flow through the water treatment system will operate to fill the tank. Once the tank has reached the overflow level, it will continually be recirculated.

The recirculation of the clean water into the dirty water tank dilutes the dirty water providing an increased purity at the inlet of the water treatment system. This further improves the quality of water achieved at the outlet of the water treatment system.

Accordingly, it can be seen that low velocities through the demineralizer leading to channeling are avoided, reproduction of bacteria and generation of slime is minimized and an improved clean water quality is achieved.

Claims

1. A water treatment system arrangement for a fuel cell power plant operable at varying rates and having a fuel cell coolant loop requiring treated makeup water comprising:

a dirty water tank;

a water treatment system including a filter and a demineralizer;

a pump for passing water from said dirty water tank through said water treatment system at a substantially constant flow rate;

supply means for passing water from the discharge of said water treatment system to said coolant loop as required for clean water makeup to said coolant loop; and

a recirculating conduit for returning water from the discharge of said water treatment system to said dirty water tank beyond that passing through said supply means.

2. A water treatment system arrangement as in claim 1:

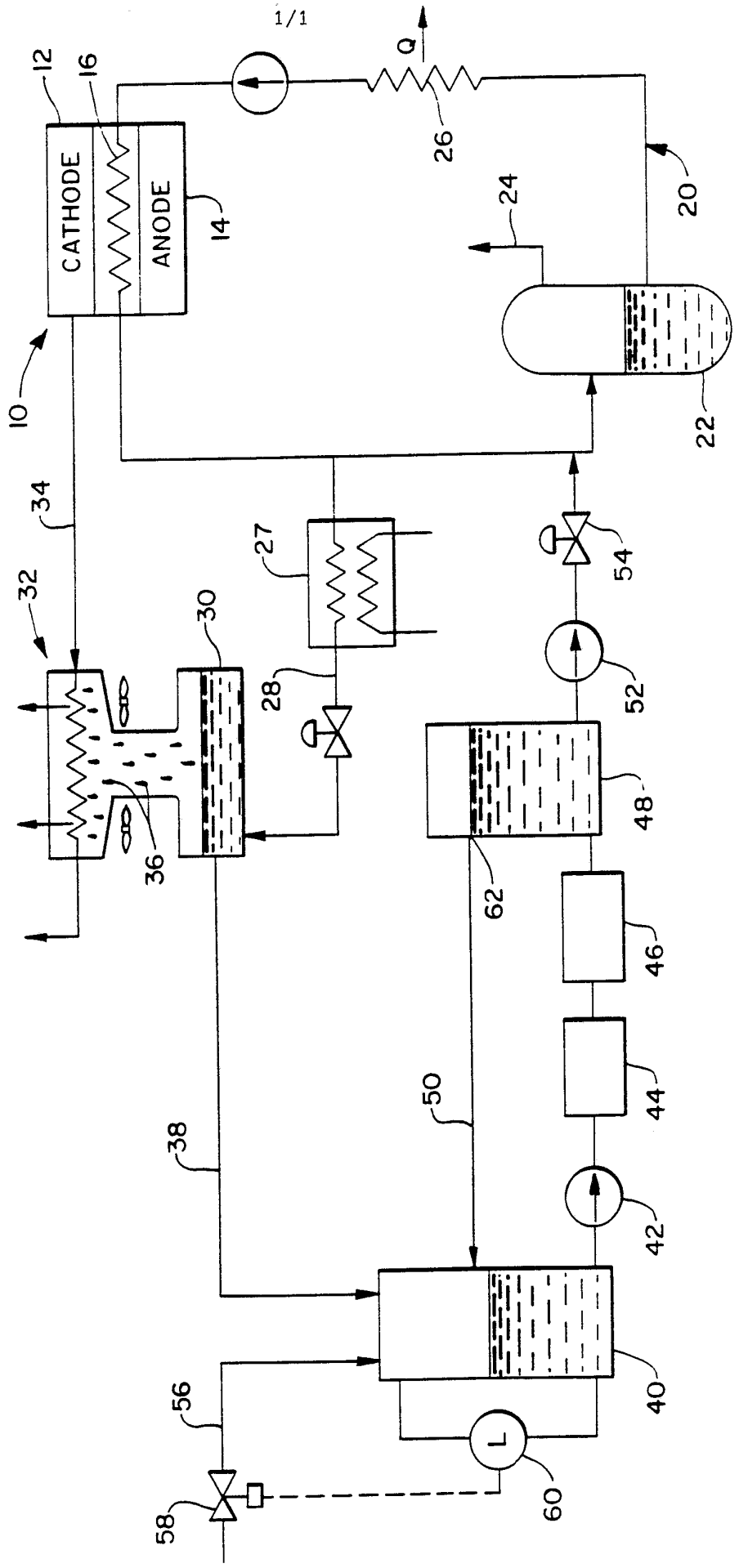
a clean water tank located at the discharge of said water treatment system;

said supply means being connected to take makeup water from said clean water tank;

said recirculating conduit being connected to return water from said clean water tank to said dirty water tank.

3. A water treatment system arrangement as in claim 2:

said recirculating conduit connected to said clean water tank at a high elevation, whereby said clean water tank will accumulate a volume of stored clean water before recirculation starts.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INTERNATIONAL SEARCH REPORT

International Application No. PCT/US91/03283

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC(5):B01D 36/04
U.S. CL.: 210/167

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
U.S.	210/167,195.1, 257.1,258,260; 429/12,26

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
X	US,A, 4,804,591 (GRASSO ET AL) 14 FEBRUARY 1989 SEE ENTIRE DOCUMENT	1-3
A	US,A, 4,510,211 (STRUTHERS) 09 APRIL 1985	1
A	US,A, 4,344,850 (GRASSO) 17 AUGUST 1982	1-3
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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
20 AUGUST 1991	05 SEP 1991
International Searching Authority	**Signature of Authorized Officer**
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Form PCT/ISA/210 (second sheet) (Rev.11-87)