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BOGOTÁ 8, COLOMBIA

Trámite : 011
Evento : 379
Actuación : 444

Referencia : Expediente No. 04.105.802
Asunto : Solicitud de Patente para **PLANTA DE COGENERACION
INDIVIDUAL Y RED LOCAL**
Solicitante : MDI MOTOR DEVELOPMENT INTERNATIONAL S.A.
Clase : F02G 005/000
Fecha de Solicitud : 21 de Octubre de 2004

1. Yo, Emilio FERRERO, obrando como apoderado del solicitante en el asunto antes identificado, me refiero al Oficio No. **12609** notificado por fijación en lista del 5 de Octubre de 2007.

2. Mediante el memorial radicado el 28 de diciembre de 2007, solicité oportunamente un plazo de 30 días para responder el Oficio No. **12609**.

3. Mediante el Oficio No. **12609** se puso en conocimiento del solicitante el informe que contiene las observaciones hechas por su Despacho sobre la presente solicitud de patente.

Atiendo a las observaciones de la manera siguiente:

3.1 CLARIDAD DE LA SOLICITUD

Respetuosamente ponemos de presente que tanto la descripción como el pliego reivindicatorio de la presente solicitud si son claros.

Lo anterior, por cuanto en respuesta a la solicitud del Señor Examinador presentamos junto con este escrito la corrección a las unidades de potencia de acuerdo con el SI de unidades (ver anexo 5.1.), y en el segundo, las reivindicaciones independientes de la planta de cogeneración, de la red local, y la planta de cogeneración instalada contienen todas las características esenciales de la invención, es decir cada uno de los elementos o etapas que conforman dicha invención. Adicionalmente, las reivindicaciones dependientes especifican y delimitan características particulares de la planta, la red local y la planta instalada reivindicados en las reivindicaciones independientes.

Con respecto a que las reivindicaciones dependientes incluyen materia nueva frente a lo revelado en la reivindicación independiente respetuosamente ponemos que lo mismo no se encuentra prohibido por la ley y por el contrario, el mismo Manual Andino de Patentes lo prevé como una posibilidad siempre y cuando efectivamente se refieran a un elemento o a una etapa de una reivindicación principal (ver Manual Andino de Patentes página 37 numeral 4.5.2).

Por otra parte, respetuosamente ponemos de presente que toda vez y la presente invención corresponde a objetos concebidos unos en función de otros, tal como la planta de cogeneración, la red local que emplea plantas de cogeneración y la planta de cogeneración instalada en una red local, la misma puede contener mas de una reivindicación independiente por categoría, cada una seguida por varias reivindicaciones dependientes.

Por lo tanto, el capítulo reivindicatorio es claro, ya que dicho pliego reivindica unos productos por sus características estructurales o de función y permite determinar el alcance de la protección reivindicada y compararla frente al estado del arte, de acuerdo con las disposiciones del artículo 30 de la Decisión 486.

3.2 NO CUMPLIMIENTO DE LOS REQUISITOS DE PATENTABILIDAD

3.2.1 Con relación a las objeciones que ese Despacho hizo a la redacción de las reivindicaciones porque las mismas caracterizaban los productos por la combinación de características estructurales y funcionales, nos permitimos señalar que dichas reivindicaciones son claras y están correctamente redactadas, pues no existe provisión legal alguna en la cual

se señale que la redacción bajo la cual se presentan se encuentra prohibida. En el evento que sea así, respetuosamente solicitamos al Señor Examinador señalar dicha norma.

Por lo tanto, le solicito se sirva continuar con el trámite de la presente solicitud pues ésta se presenta de una forma clara y una persona versada en la materia podría obtener el producto objeto de esta invención con la información presentada en la descripción y reivindicaciones.

4. Puesto que se han atendido a cabalidad las observaciones hechas por su Despacho sobre la presente solicitud de patente, atentamente solicito que se continúe su tramitación.

5. **Anexo:**

5.1 Páginas 30 y 38 de la descripción.

Señora Jefe,



EMILIO FERRERO

T.P.A. No. 31.929

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No. M-2008-119383\NNJ

manejo de energía maneja la operación de la red de la misma forma que se describió plenamente para las casas individuales.

De acuerdo a una variación de la invención una planta de cogeneración de alta potencia por ejemplo de más de 447,3 KW utiliza una construcción simple con una red de un grupo de edificios es remplazada ventajosamente mediante un grupo de plantas de cogeneración de baja energía por ejemplo unidades de 8,8 X 37,3 KW ligadas e interconectadas mediante cualquier medio manejada por una estación de manejo de potencia tal como se describió anteriormente donde cada una de las unidades en este grupo será entonces activadas sucesivamente una después de la otra de acuerdo con los requisitos de energía del edificio.

Otros objetos, ventajas y características de la invención serán evidentes de la lectura y de la descripción delimitantes de un número de modalidades que son dadas con referencia a los dibujos finales a los cuales:

- La Figura 1 es una descripción diagramática en sección transversal de los elementos con

estado de hogares urbanos donde cada casa está equipada con una planta de cogeneración de acuerdo con la invención 40, 40A, 40B, 40C, 40D y cada planta de cogeneración está conectada a las otras mediante un conductor eléctrico 41 que constituye una red local; una estación de manejo de potencia 42 es instalada para hacer posible manejar el suministro de energía eléctrica a cada una de las casas agrupadas de esta manera de una o más unidades capaces de ser sucesivamente activada o alternativamente dependiente de los requisitos totales de las casas de la red.

La Figura 8 describe una planta de cogeneración de alta potencia por ejemplo 335.6 KW constituida de acuerdo con la invención de 9 unidades de plantas de cogeneración pequeñas de 37,3 KW tal como las descritas anteriormente, 40, 40A, 40B, 40C, 40D, 40E, 40F, 40G, 40H, y que tiene cada una su alternador, no mostrado, su suministro y su sistema de calentador térmico montado en un bastidor 43, conectado por conductores eléctricos 41 a una estación de manejo de energía 42 la misma conecta al suministro de energía eléctrica para la casa por vía de medios adecuados 44 u otras instalaciones de tal forma que la estación arrancará y activará las unidades de esta

United States Patent [19]
Katz

[11] **Patent Number:** 4,715,192
[45] **Date of Patent:** Dec. 29, 1987

[34] **ELECTRICAL OR THERMAL TRACKING
COGENERATION SYSTEM UTILIZING
OPEN CYCLE-AIR-CONDITIONING**

[75] **Inventor:** Yoram Katz, Los Angeles, Calif.

[73] **Assignee:** Imperial Private Power, Santa
Monica, Calif.

[21] **Appl. No.:** 61,455

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[31] **Int. Cl.:** F25B 27/00

[52] **U.S. Cl.:** 62/323.1; 62/238.3;
237/12.1; 237/13; 290/2

[58] **Field of Search:** 62/323.1, 272, 92, 238.3,
62/238.6; 237/12.1, 13; 123/41.19; 290/1 A, 2

[56] **References Cited**

U.S. PATENT DOCUMENTS

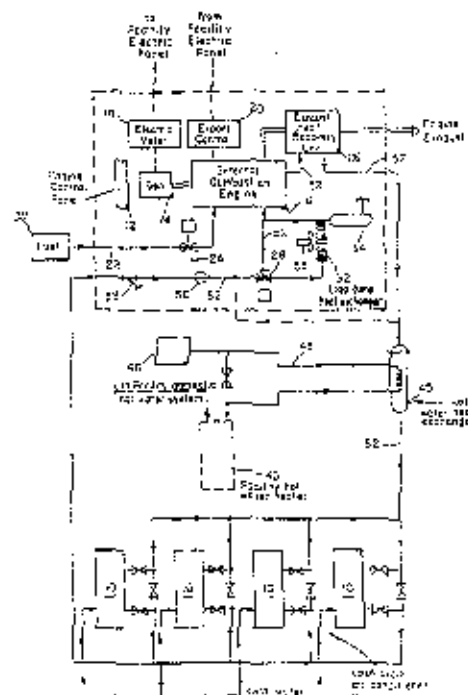
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Primary Examiner—Henry A. Bennet
Attorney, Agent, or Firm—Thomas I. Rozsa

[57] **ABSTRACT**

The invention is a cogeneration system which utilizes an open cycle air-conditioner in conjunction with an internal combustion engine, a generator, an exhaust heat recovery unit, a hot water heat exchanger, a circulating pump, a load dump heat exchanger and an electrical sensing circuit to enable a single fuel source to produce electricity, hot water, and air-conditioned (cooled or heated) air. In addition to running as a stand alone unit, the system can be used to operate in conjunction with existing electrical utilities. The system can float around the electrical or thermal demand of the facility and adjust itself to the needs of the facility. The system is thermally controlled and electrically controlled, based on need.

9 Claims, 4 Drawing Figures



ELECTRICAL OR THERMAL TRACKING COGENERATION SYSTEM UTILIZING OPEN CYCLE-AIR-CONDITIONING

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to the field of cogeneration systems. Cogeneration is the production of two energies from one fuel source. For example, the two energies can be electricity and heat or electricity and air-conditioning. Open cycle air-conditioning operates by dehumidification of incoming air and then cooling the air through a heat exchanger and thereafter cooling the dry air through an evaporative process so that cool air is exhausted into the room. The room air is recirculated back into the air-conditioner so that it pre-cools the incoming fresh air before it is exhausted out to the atmosphere. A major advantage of the open cycle air conditioning system is that a constant supply of fresh and filtered air is delivered to the space which is being cooled while conventional closed systems merely recirculate air from the room where the air is being cooled. The present invention utilizes cogeneration combined with open cycle air conditioning to provide a self contained system which generates electricity, hot water and heated and air-conditioned air.

2. Description of the Prior Art

In general, open cycle air conditioning systems which use desiccant material to absorb moisture from the air are well known in the prior art. U.S. Pat. No. 4,180,985 issued to Northrup, Jr. in 1980 for "Air Conditioning System With Regeneratable Desiccant Bed" as the title states discloses an air-conditioning system with a regeneratable desiccant bed. In this invention, the desiccant material is carried by a continuous belt with "waste heat" serving to remove moisture from the desiccant material. U.S. Pat. No. 4,594,860 issued to Coellner et al. in 1986 for "Open Cycle Desiccant Air-Conditioning System And Components Thereof" discloses an open cycle air-conditioning unit with improvements in the desiccant wheel and improvements in the heat exchanger wheel portion of the unit.

Overall cogeneration systems for heating dwellings are known in the prior art. U.S. Pat. No. 4,063,055 issued to De Cosimo in 1977 for "Complete System For A Home Air Heating And Cooling, Hot And Cold Water, And Electric Power" discloses such a complete unit. The system however is used with a conventional evaporate water cooling system wherein an electric engine is electrically powered from a generator, the electric engine drives a compressor in a cooling circuit with a cooler and a condenser. This cooling system is connected by a pump and a pipe to a spray head located inside an air duct for spraying the moving air duct with cold water to cool off the same. Furthermore, the system does not provide any means to control the electrical or thermal output to match the facility demand. In De Cosimo, there is also shown a gasoline engine which serves to power an electric generator to produce electric power for the building. Hot exhaust gases from the engine pass through a heat exchanger to heat water.

U.S. Pat. No. 4,010,378 issued to Tharpe et al. in 1977 for "Integrated Electric Generating And Space Conditioning System" shows a system wherein vapor from an expander or rotary prime mover is conveyed to a heat exchanger serving to heat fluid such as water or air. The rotary prime mover also powers an alternator serving to

produce electricity. The rotary prime mover or expander may also serve to power a compressor to provide air-conditioning. Once again, the air conditioning is supplied in a conventional closed cycle apparatus. The system serves to supply electricity, heat and power to drive the compressor.

The following prior art reference also disclose various types of cooling systems:

1. U.S. Pat. No. 4,380,910 issued to Hood et al. in 1983 for "Multi-Stage Indirect-Direct Evaporative Cooling Process And Apparatus".

2. U.S. Pat. No. 2,239,886 issued to Feidbush et al. in 1941 for "Power Plant Refrigerating System".

3. U.S. Pat. No. 2,339,903 issued to Alexander in 1944 for "Refrigerating Apparatus".

4. U.S. Pat. No. 2,491,314 issued to Hopkirk in 1949 for "Turbogenerator Cooling System".

None of the prior art disclose any type of apparatus which can be used in conjunction with an open cycle air-conditioning/heating system for efficiently providing electricity, heat and air-conditioning from a single fuel source. In addition, none of the prior art references disclose a system which can be used in conjunction with the existing heating and cooling system of a facility to provide an overall more efficient use of the system. In addition, none of the prior art references disclose a system where the amount of electrical or air-conditioning output is controlled to match the facility demand.

Present day heating and cooling systems for facilities such as restaurants are extremely inefficient. Power is used during the peak times of the day when it is more expensive and the system does not provide for a method of utilizing power during non-peak hours when it is less expensive. In addition, present day systems require use of power throughout the day and in the evening for even when the facility is closed, burglar alarms, refrigerators and other operations which require power must be kept operational. None of the cited references disclose a system wherein a cogeneration system can be used in conjunction with an existing electrical and air-conditioning facility to provide an overall more efficient system that can accommodate facility load fluctuation, including electrical, cooling and heating.

Therefore, a significant need exists for an efficient cogeneration system which can generate electricity, heat and air-conditioning from an open cycle air-conditioning system. A further significant need exists for such a system which can be used in conjunction or to supplement the existing heating and air-conditioning system of a given facility.

SUMMARY OF THE PRESENT INVENTION

The present invention relates to an improved cogeneration system which produces heated water, electricity, and air-conditioning/heated air through an open cycle air-conditioning/heating system, all from a single fuel source.

The present invention also relates to a cogeneration system which in addition to providing an efficient stand alone system, also provides a cogeneration system which can be used in conjunction with an existing facility and with the existing power and air-conditioning/heating systems of a given facility to provide an overall extremely efficient use of energy. The present invention permits the system to stand alone and adjust itself automatically to the facility energy needs or to draw excess power from commercially available sources, but

only when needed to fill peak load requirements. The system also permits use of only commercial utility sources of electricity if the power requirements fall below efficient use of the cogeneration system.

It is therefore an object of the present invention to provide a cogeneration system through which electricity, hot water and heating and/or cooling can be generated under controlled conditions from a single fuel source, which system includes an open cycle air-conditioner.

It is another object of the present invention to provide a cogeneration system which can be operated as an independent unit and can also be used in conjunction with commercially available sources of power.

It is a further object of the present invention to provide a cogeneration system which can thermally track the requirements of the facility in order to bring into the system a load dump heat exchanger to cool the engine in the event the air-conditioning source of cooling is only partially used or not used at all.

It is yet another object of the present invention to provide a cogeneration system which can be electrically track the facility electrical requirements in order to determine if supplemental sources of power are required to fulfill the system needs at a given time or if the cogeneration electrical output must be curtailed to match the facility needs.

Further novel features and other objects of the present invention will become apparent from the following detailed description, discussion and the appended claims, taken in conjunction with the drawings.

DRAWING SUMMARY

Referring particularly to the drawings for the purpose of illustration only and not limitation, there is illustrated:

FIG. 1 is a schematic representation of the present invention cogeneration system, shown in stand-alone configuration and with connecting apparatus to commercial sources of power.

FIG. 2 is a schematic representation of a portion of the present invention cogeneration system used in conjunction with the existing air-conditioner/heater of a facility, with the systems interconnected by a given embodiment.

FIG. 3 is a schematic representation of a portion of the present invention cogeneration system used in conjunction with the existing air-conditioner/heater of a facility, with the systems interconnected by an alternative embodiment.

FIG. 4 is a circuit diagram of the control system which enables the present invention cogeneration system to either act in stand-alone mode and function in accordance with the facility needs or to switch to supplemental use of power from commercial sources.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Although specific embodiments of the invention will now be described with reference to the drawings, it should be understood that such embodiments are by way of example only and merely illustrative of but a small number of the many possible specific embodiments which can represent applications of the principles of the invention. Various changes and modifications obvious to one skilled in the art to which the invention pertains are deemed to be within the spirit, scope and

contemplation of the invention as further defined in the appended claims.

Referring to FIG. 1, there is shown at 1 a schematic diagram of the overall cogeneration system of the present invention in a "stand alone" embodiment. The cogeneration system 1 is design to work with at least one open cycle air-conditioning system 10. In the preferred embodiment, a multiplicity of open cycle air-conditioning systems 10 are connected to each other as illustrated in FIG. 1. While four such units 10 are shown in FIG. 1, it will be appreciated that any number of such open cycle air-conditioning units 10 can be used with the present invention.

By way of example only, in one typical open cycle air-conditioning unit 10 which can be used with the present invention, in the air cooling mode, air enters the system and is forced through a desiccant wheel to remove moisture therefrom. Thereafter, the air enters a rotary regenerative heat exchanger wheel wherein the heat is transferred from the air to the wheel structure. Evaporator means is then utilized to humidify and cool the air and then the air is exhausted into the room area to be cooled. Exhaust air from the room which is cooled returns into the unit and is first evaporatively cooled, and then passes through the regenerative heat exchanger cooling the structure and heating the air. Heat removed from the air which was sent to into the cooled room is added to such exhaust air. The air is further heated as it passes through a liquid-to-heat exchanger with the fluid heat source being a gas fired boiler. The hot exhaust air passes through the desiccant structure heating and drying (regenerating) the desiccant for reuse. Thereafter, the hot air is exhausted to the atmosphere and new fresh cooler air is taken from the atmosphere and fed into the system from which it goes through the desiccant wheel, etc. Alternatively, in the air heating mode, the air-conditioner 10 can also comprise a heating coil so that after air leaves the heat exchanger, it is heated rather than cooled before it is exhausted into the room whose air is to be treated. An open cycle air-conditioner comparable to this is also disclosed in U.S. Pat. No. 4,594,860 issued to Coeffner et al. for "Open Cycle Desiccant Air-Conditioning System And Components Thereof". It is emphasized that this is only one type of open cycle air-conditioning system which can be used with the present invention cogeneration system 1, and other types of open cycle air-conditioning systems, whether using a desiccant wheel or otherwise, are within the spirit and scope of present invention. In the embodiment shown in FIG. 1, a conventional open cycle air-conditioner 10 will require approximately 30,000 Btu for 3-3.5 Tons of cooling. In the system as shown in FIG. 1 which uses four such devices 10, the power requirements to drive all four devices 10 will require a 25 Kilowatt engine.

The cogeneration system 1 contains an internal combustion engine 16 connected to generator 14. The engine 16 is supplied with liquid or gas fuel 30 which runs through pipe line 22 and is turned on and off by means of fuel valve 24. The engine control panel 12 regulates the engine 16 to control the amount of power produced by the generator 14 and monitor other engine vital functions. The fuel 30 runs internal combustion gas engine 16 which powers the generator 14 which generates the electricity which is supplied to the facility. The engine generator 14 generates the electricity which is used in the facility. Also attached to the engine 16 is a load dump heat exchanger 32 which in turn is con-

Optimization of Multipiant Cogeneration System Operation Including Electric and Steam Networks

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Abstract - The problem of optimizing the short-term operation of a multipiant cogeneration system in a large industrial complex is solved. A cogeneration system is defined as a system that simultaneously produces electric power (electricity) and thermal power (steam). The cogeneration system model includes both the electric and thermal systems. The electric system model includes generation and transmission. The thermal system model includes the individual plants which are comprised of boilers, turbines, condensers, deaerators, pumps, and storage tanks and the interconnecting steam network. The optimization problem has as its objective the minimization of the overall cost of all fuels and makeup water used during the scheduling horizon (1 to 24 hours), subject to satisfying a number of constraints on electric and steam systems. A novel solution approach is introduced which is based on coordinated optimization of the electric and thermal systems. A production-grade computer program has been developed and tested for a real industrial complex. The program is being integrated as part of the Energy Management System of the industrial complex where it is to be used as an operational scheduling tool. The technical approach is described and numerical results are reported.

INTRODUCTION

A growing number of industrial and commercial establishments are installing on-site cogeneration facilities due to their multifacet benefits including good return on investment, increase in availability of reliable power in a utility blackout and the use of alternative fuels [1]. In order to take full advantage of such benefits, the operating companies need scheduling tools that can assist them in economic and secure operation of their cogeneration facilities [4]. Previously published work in this area has mainly focused on simulation and operation of single plant facilities and their interaction with the neighboring utilities

[2,3]. Little work has been done on modeling and optimal scheduling of multipiant cogeneration facilities with detailed representation of their electric and thermal systems.

In this paper the problem of optimizing the short-term (1 to 24 hours) operation of a cogeneration system in a large refinery and petrochemical complex is considered. The optimization objective is to minimize the overall cost of all fuels and makeup water used during the scheduling horizon subject to satisfying constraints representing in detail the electric and steam systems. The cogeneration system includes oil- and gas-fired boilers that produce steam at 400 and 600 PSIG pressures for process and electric power generation applications. The steam output from the turbines is delivered at varying pressures and temperatures for process, feedwater, and heating applications. The electric generation capacity of the cogeneration system is about 100 MW and its electric network is interconnected with the neighboring utility.

The Cogeneration System Operation Optimization (CSOO) problem as described above is a special case of the class of power system operation optimization problems where the generating plants are of cogeneration type. The solution to these type of scheduling problems requires combined (simultaneous or coordinated) optimization of the electric and thermal systems. Traditionally the optimization of the electric and thermal systems have been treated separately. The models used for electric systems are usually simple and represent the thermal system by heat rate curve of individual generating units. These curves are predefined and are not directly linked to the thermodynamic conditions of their associated thermal units. They are difficult to define for common header units. And similarly, the thermal system models are simple and mainly limited to single plants with no explicit representation of the electric system.

We have developed a methodology for coordinated operation optimization of electric and thermal systems applicable to cogeneration systems. The model includes the cogeneration system electric network and part of the neighboring utility grid. On the thermal side it includes the individual plants which are comprised of boilers, turbine-generators, condensers, deaerators, pumps, and storage tanks and the interconnecting steam network.

90 SM 459-8 PARS A paper recommended and approved by the IEEE Power System Engineering Committee of the IEEE Power Engineering Society for presentation at the IEEE/PES 1990 Summer Meeting, Minneapolis, Minnesota, July 15-19, 1990. Manuscript submitted January 31, 1990; made available for printing May 18, 1990.