

Nov. 27, 1951

P. CROCCHI

2,576,284

VAPOR ELECTRICITY GENERATOR SET

Filed Jan. 21, 1949

2 SHEETS—SHEET 2

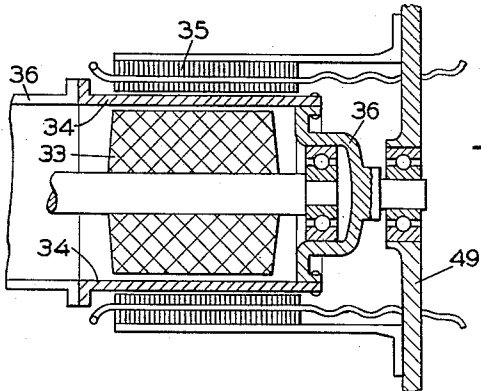


Fig. 3

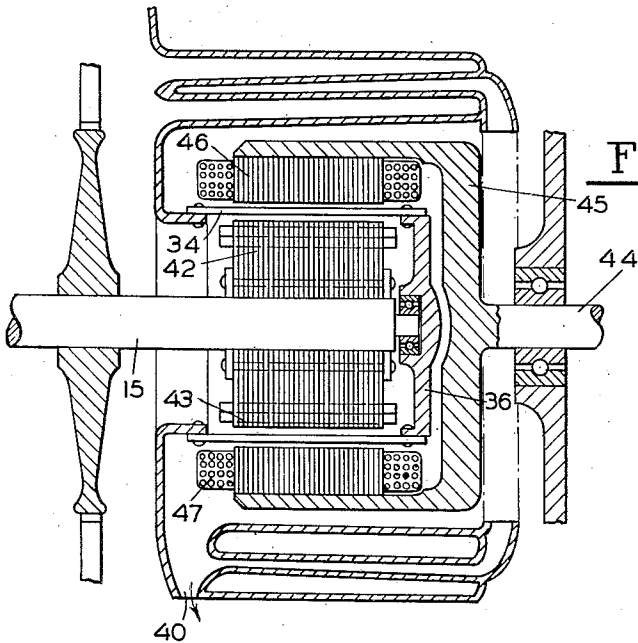


Fig. 4

INVENTOR.
PIERO CROCCHI

BY

Deane Shuckers
attorney

UNITED STATES PATENT OFFICE

2,576,284

VAPOR ELECTRICITY GENERATOR SET

Piero Crocchi, Milan, Italy

Application January 21, 1949, Serial No. 71,859

In Italy February 19, 1948

8 Claims. (Cl. 290—2)

1

2

The present invention relates to an electrical generating system, and particularly to a vapor electrogenerator set, which constitutes a sole rotating unit hermetically closed.

It is well known that in steam turbines which are used at present and are suitable to be coupled with electrogenerators, the driving shaft comes out of the body of the turbine or condenser through a packing which is never strictly air-tight.

As a consequence of this, vapor escapes through the said packing and a continuous replenishing of the working fluid is necessary in order to maintain the fluid level in the boiler, as well as the application of a pump for removing the air which enters into the condenser through said packing.

It has been previously suggested to provide electricity generating systems consisting of a vapor turbine and an alternator, in which the alternator operates immersed in vapor and the whole is enclosed in a gas-tight casing.

However, such systems present considerable practical difficulties as the device would be very bulky and heavy; there would be many connections, which are difficult to keep in gas-tight condition, and it would be also difficult to lubricate the auxiliary organs (feeding-pump, etc.), which also had to be placed within the gas-tight casing.

These difficulties are overcome by the present invention by the use of a rotating boiler and other special arrangements described hereinafter.

The main object of the present invention is to provide an electricity generating set in which boiler, turbine, condenser and alternator form a self-contained, completely gas-tight unit; in this unit the alternator operates immersed in vapor, thereby eliminating the exit of the turbine-shaft.

Another object of the present invention is to provide an electricity generator system which is enclosed in a gas-tight casing; in this system the vacuum is provided only once, and the working fluid is used for an indefinite period of time, without dispersion and without coming in contact with the air.

A further object of this invention is to provide a combined rotatable unit, comprising a turbine, a boiler, a condenser and an alternator in compact and simple constructional form.

It is also an object of this invention to provide an electricity generator set in which boiler and surface condenser rotate together on a common axis, in such a way as to ensure the return of the condensate from condenser to boiler by the sole effect of centrifugal force, thus rendering the use of a feeding pump unnecessary.

A further object of this invention is to provide a simple electricity generator set operating without the need of control and supervision.

A still further object of this invention is to provide an electricity generator set in which the circulation of the cooling medium (air or water) in the condenser, as well as the draft in the furnace are obtained by means of the centrifugal force caused by the rotation of the entire unit.

Further objects and features of the invention will become more apparent from the following detailed description of some typical embodiments of the invention, wherein reference will be made to the accompanying drawings in which:

Fig. 1 shows, one half in full view and the other half in section, an electricity generator set according to the invention.

Fig. 2 is an axial section of a portion of the device, showing the cooling of the condenser with water, and a different type of construction of the alternator.

Fig. 3 is an axial section of a portion of the device, showing another modification of the construction of the alternator.

Fig. 4 shows a system in which the driving shaft couple is transmitted externally by means of an electromagnetic coupling.

Referring now to the drawings in detail, Fig. 1 shows the rotating unit which includes the boiler 8, the turbine 10—11, the condenser 20 and the alternator 16—19. This unit rotates together, resting on the two bearings 1 and 2. These bearings rest on a stand which supports the entire unit, the combustion chamber (furnace) 4, the burners 5 and the exhaust pipe 6. On this stand rests a small electric motor 7, which serves to impart a rotary motion to the above mentioned unit. This motor may receive the electric current either directly from the alternator or from any other electrical source.

The boiler has a ring shape and contains the turbine body. As a result of the rotary motion, the working fluid is spread along the walls of the boiler while the vapor flows through channels 9 into the first distributor 10 of the turbine 11. The channels 9 are formed by the grooved wall of the boiler and by wall 12. This wall is perforated at 13 and 14, so as to ensure the passage of the vapor, which becomes superheated in channels 9.

The turbine may consist of one or more wheels, in accordance with known systems. As an example, Fig. 1 shows a pressure staged impulse turbine, with three rows of nozzles (distributors) and three wheels. The distributors rotate jointly with the boiler, and the turbine wheels are

keyed on a central shaft 15 on which the inductor 16 of the alternator is likewise keyed.

The shaft 15 rotates in two bearings 17-18 which are fixed within the gas-tight casing, and operate immersed in vapor, without any communication to outside. The armature 19 of the alternator rotates jointly with the boiler and condenser. The condenser 20 is formed by a cylindrical ring which encircles the alternator. Its external wall 21 is slightly conical, i. e. its diameter increases as it approaches the boiler, so that the condensate is forced towards the boiler by centrifugal force.

Under the action of centrifugal force, the air enters through opening 23 flowing through the ring channel 24 situated between the condenser and alternator, thereby cooling the wall 22 and finally rushing out through openings 25 which cross hermetically the body of the condenser. By this device a continuous flow of air is generated through centrifugal force, which cools the condenser and alternator.

The operation of the generator set is as follows:

The air required for combustion enters through opening 26 thereby cooling the external walls of the internal bearings 17 and burning the fuel spread by the burners 5.

The gas thus heated passes through furnace 4 transmitting its heat to the walls of the boiler and escaping through exhaust pipe 6.

The walls of the rotating boiler are suitably ribbed, in order to create a strong draft caused by their rotation. The furnace terminates with a curve, which approaches, without coming in contact with it, the protruding fin 28 of the rotating boiler. In this way, the undesirable escape of hot gas is entirely, or almost completely, eliminated.

The entire unit (boiler, turbine body, condenser, inductor) is put in rotation by the electric motor 7. The vapor, generated in the boiler 8 and superheated in channels 9 acts in the turbine 11 and subsequently enters the condenser 20.

The condensate flows along the conical wall 21, hence along the wall 29, which separates the turbine from the boiler, subsequently passing through the small openings 30 in the separating wall of the turbine body. Said condensate returns to the boiler as a result of centrifugal force passing through tube 31.

Evidently the return of the condensate into the boiler is opposed by the pressure within the boiler. In order to render said return possible, even at a moderate speed of rotation, it is necessary that such pressure should be relatively low.

Should mercury be used as a working fluid, it is possible to operate with a very low boiler pressure for instance 1 absolute atmosphere, corresponding to a temperature of about 355° C. This pressure may be overcome by a very low speed of rotation. Moreover, the pressure in the boiler being so low, it is practically not necessary to use a safety valve for the boiler.

The internal shaft 15 driven by the turbine wheels 11 rotates swiftly in an opposite direction to the boiler.

The inductor, being keyed to the said shaft, is made to rotate with it. As already pointed out, the armature rotates jointly with the boiler.

As a result of reciprocal rotation between the inductor and the armature, an alternating electrical current is generated, which is conveyed out to sliding contact 32, by means of conducting element 132 air-tightly crossing the wall of the casing. 132' denotes a contact brush.

A small portion of this electric current is utilized for the motor 7 while the remainder can serve for any desired purpose.

Fig. 1 shows an alternator of the inductor type, in which the rotor consists of two iron cogwheels, without windings or insulation.

The bearings 17-18 must work immersed in vapor, hence at rather high temperatures, without any possibility of supervising their lubrication, since they are enclosed within the gas-tight casing. In order to ensure a continued lubrication of these bearings, it may be advisable to use as working fluid a heavy hydrocarbon, or any other fluid having lubricating properties.

This invention may be carried out in various other ways, many of which may be designed by those skilled in the art on the basis of the above disclosure, without departing from the spirit and scope of the invention.

As a special feature, Fig. 2 shows a modified embodiment in which the condenser is cooled by water, instead of air, as illustrated in Fig. 1.

As shown in Fig. 2 the cooling water is supplied through the adjustable cock 37. This water drops into the rotating circular basin 38, and by centrifugal force it is subsequently carried along the hollow passage 39 and ejected through openings 40 and then gathered on the bottom 41. If advisable, the water is conveyed from there by means of a pump 50 into a radiator 51, where it is cooled, and then conveyed again to the adjustable cock 37, whereby a closed water circuit is provided.

Furthermore, Figure 2 illustrates an alternator, the inductor 33 of which is polarized by means of permanent magnets and which, therefore, has no windings.

The armature 35 rotates jointly with the casing, but is placed outside the casing so that it operates immersed in the air. In order to reduce the eddy currents which would occur in the iron wall placed between inductor and armature, this wall is interrupted and replaced by a thin wall of insulating material, or a material which is a poor conductor of electricity. Wall 34 is connected with wall 36 in such a manner as to ensure a gas-tight seal.

Fig. 3 shows a similar device in which, as in Fig. 2, a thin wall of insulating material 34 is placed between the inductor and the armature. In this case, however, the armature approaches the insulating wall without coming in contact with it and it is connected with the fixed stand, and cannot, therefore, rotate.

In this way a reaction couple is obtained which makes the casing rotate in an opposite direction to the turbine shaft. Consequently motor 7 and sliding contact 32 may be omitted.

According to another modification shown in Fig. 4, the driving couple of the turbine shaft 15 may be transmitted externally by means of a magnetic or electro-magnetic coupling. In this case, the rotor 42 which has a squirrel-cage winding 43 is keyed on the turbine shaft 15. The driven shaft 44 is situated on the outside of the rotating casing and has a bell-shaped expansion 45, which holds the inductor 46. This inductor has one or more couples of poles which are excited by means of windings 47 through which direct electric current runs. As in Figs. 2 and 3, between the rotor and the inductor an insulating wall 34 is placed, which is connected with wall 36 of the rotary casing in such a manner as to provide a gas-tight seal. Should there be a reciprocal rotation between the rotor and

the inductor, an alternating electric current is generated in the squirrel-cage windings 34 which contrasts said reciprocal rotation. In this manner, the inductor 46 together with the driven shaft 44 is made to rotate with the driving shaft 15.

Furthermore, in this case the rotating unit will revolve as a result of reaction couple, and consequently motor 7 may be omitted.

The above described electro-magnetic coupling is described merely by way of example, and it is to be understood that any other magnetic or electro-magnetic coupling may also be used.

It will be understood that my invention is not limited to the specific constructions and details described above and illustrated in the appended drawings and may be carried out with various modifications without departing from the scope of the invention as defined in the appended claims.

I claim:

1. An electrical generating system, comprising a vapor producing boiler, a turbine-body, a turbine shaft, a surface condenser, an alternator, and a gas-tight casing within which the vapor circulates; boiler, turbine-body and condenser being rotatable jointly with the gas-tight casing on a common axis in one direction; turbine wheels and an inductor mounted on a coaxially arranged shaft rotatable in opposite direction, and placed internally within said rotatable casing, without communication with the outside; circulation of cooling medium in the condenser, as well as the return of condensate into the boiler being brought about by means of centrifugal force caused by rotation of said casing.

2. An electrical generating system, as claimed in claim 1, in which the entire alternator is placed within the rotatable casing, the inductor is fixed to the turbine shaft, the electric current is conveyed outside by means of insulated wiring passing in a gas-tight manner through the casing, and the casing is rotated by means of an electric motor.

3. An electrical generating system, as claimed in claim 1, in which the inductor is fixed to the turbine shaft and is placed within the rotatable casing which consists, at least partially, of a poor conductor of electricity, an armature being placed outside the casing and rotatable with it, the casing being rotated by an electric motor.

4. An electrical generating system, as claimed in claim 1, in which the inductor is fixed to the turbine shaft and is placed within the rotatable casing which consists, at least partially, of a poor conductor of electricity; an armature being placed outside the casing and connected to a fixed stand to prevent its rotation; the casing being rotated by the effect of a reactional force.

5. An electrical generating system, as claimed in claim 1, in which a working fluid having lubricating properties is used.

6. An electrical generating system, comprising a vapor producing boiler, a turbine-body, a turbine shaft, a surface condenser, a magnetic coupling, an alternator having a shaft, and a gas-tight casing within which the vapor circulates; boiler, turbine-body and condenser being rotatable jointly with the gas-tight casing on a common axis in one direction, turbine wheels mounted on a coaxially arranged shaft, rotatable in the opposite direction and placed internally within the rotatable casing; circulation of cooling medium in the condenser, as well as the return of condensate into the boiler being brought about by centrifugal force caused by rotation of said casing; the turbine shaft transmitting its driving couple by means of a magnetic coupling, to the shaft of said alternator.

7. An electrical generating system, as claimed in claim 6, in which a working fluid having lubricating properties is used.

8. A vapor prime mover, comprising a vapor producing boiler, a turbine-body, a turbine shaft, a surface condenser and a gas-tight casing within which the vapor circulates; boiler, turbine-body and condenser being rotatable jointly with the gas-tight casing on a common axis, while the turbine shaft transmits its driving couple by means of a magnetic coupling to another shaft placed outside the casing.

PIERO CROCCHI.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
525,390	McElroy	Sept. 4, 1894
741,271	Porter et al.	Oct. 13, 1903
777,865	Stumpf	Dec. 20, 1904
791,055	Stumpf	May 30, 1905
890,591	Andreas	June 16, 1908
958,681	Schulz	May 17, 1910
1,025,021	Schulz et al.	Apr. 30, 1912
1,584,383	LeBlanc	May 11, 1926
1,638,944	Ljungstrom	Aug. 16, 1927
1,804,694	Jones	May 12, 1931
2,031,968	Mathias	Feb. 25, 1936
2,452,581	Lehmann	Nov. 2, 1948
2,495,745	Litton	Jan. 31, 1950

FOREIGN PATENTS

Number	Country	Date
173,918	Great Britain	Jan. 19, 1922
640,558	Germany	July 19, 1937

OTHER REFERENCES

Power and Works Engineer, December 1939, page 475.

Zeitschrift des Vereines Deutscher Ingenieure, April 8, 1939, Bd. 83, Nr. 14, pages 397 to 404.

Wege Zur Raum Schifffahrt, by Oberth, pages 413 to 415.