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Cohen et al.

[11] **3,885,822**

[45] **May 27, 1975**

[54] **AUTOMATIC LOAD AND VACUUM SENSITIVE EXHAUST HOOD SPRAY SYSTEM**

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[73] Assignee: **Westinghouse Electric Corporation,** Pittsburgh, Pa.

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[52] **U.S. Cl.** ..... **290/1 R;** 290/40 R; 290/52; 415/116; 239/1; 239/289; 415/1

[51] **Int. Cl.** **F01d 5/00**

[58] **Field of Search** ..... 415/175, 176, 1, 116, 117; 290/40 R, 40 C, 40 B, 1 R, 1 A, 52; 239/1, 239/13, 289

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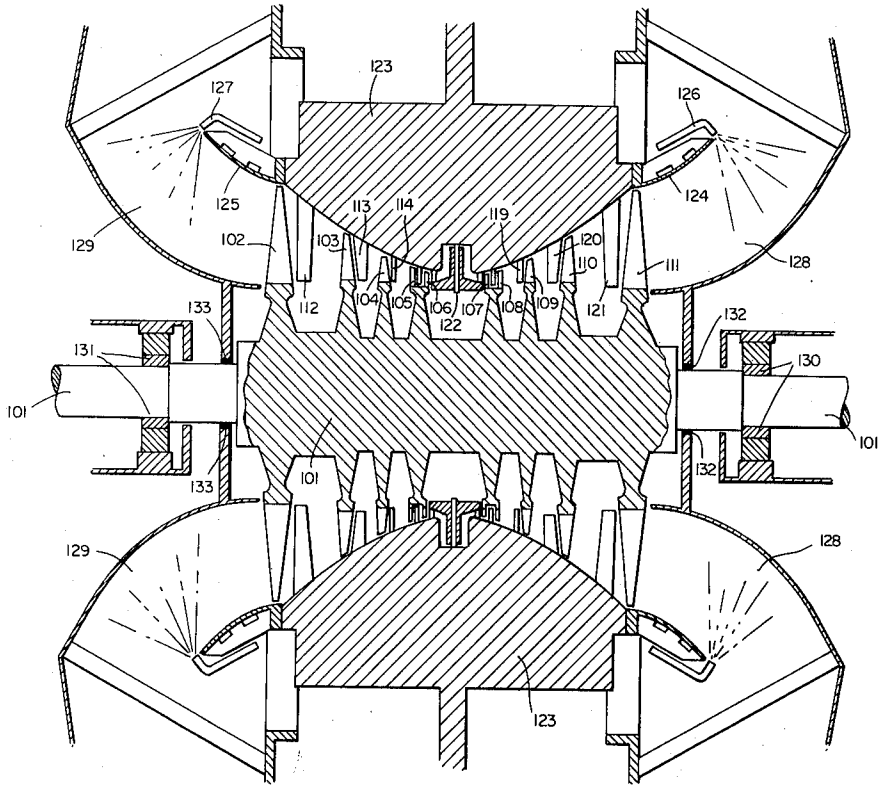
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[57] **ABSTRACT**

In order to provide temperature control for the exhaust hood region of low pressure turbines, the exhaust hood sprays are activated in response to measured load and steam exhaust pressure. During start-up of the generator, the sprays always are turned on. During normal operation, the status of the sprays depends on the relative amounts of load and vacuum pressure. If the load is less than 10 percent, the sprays are always on, and if the load is greater than 25 percent, they are always off. In the range between 10 and 25 percent load, the status of the sprays depends both upon load and vacuum. In that range, if the vacuum is less than 26 inches Hg., the sprays will be on, and if the vacuum is greater than 28½ inches Hg., they are off. Between 28½ and 26 inches vacuum pressure for the 10 percent to 25 percent load, the status of the sprays depends upon a combination of the two factors.

41 Claims, 4 Drawing Figures



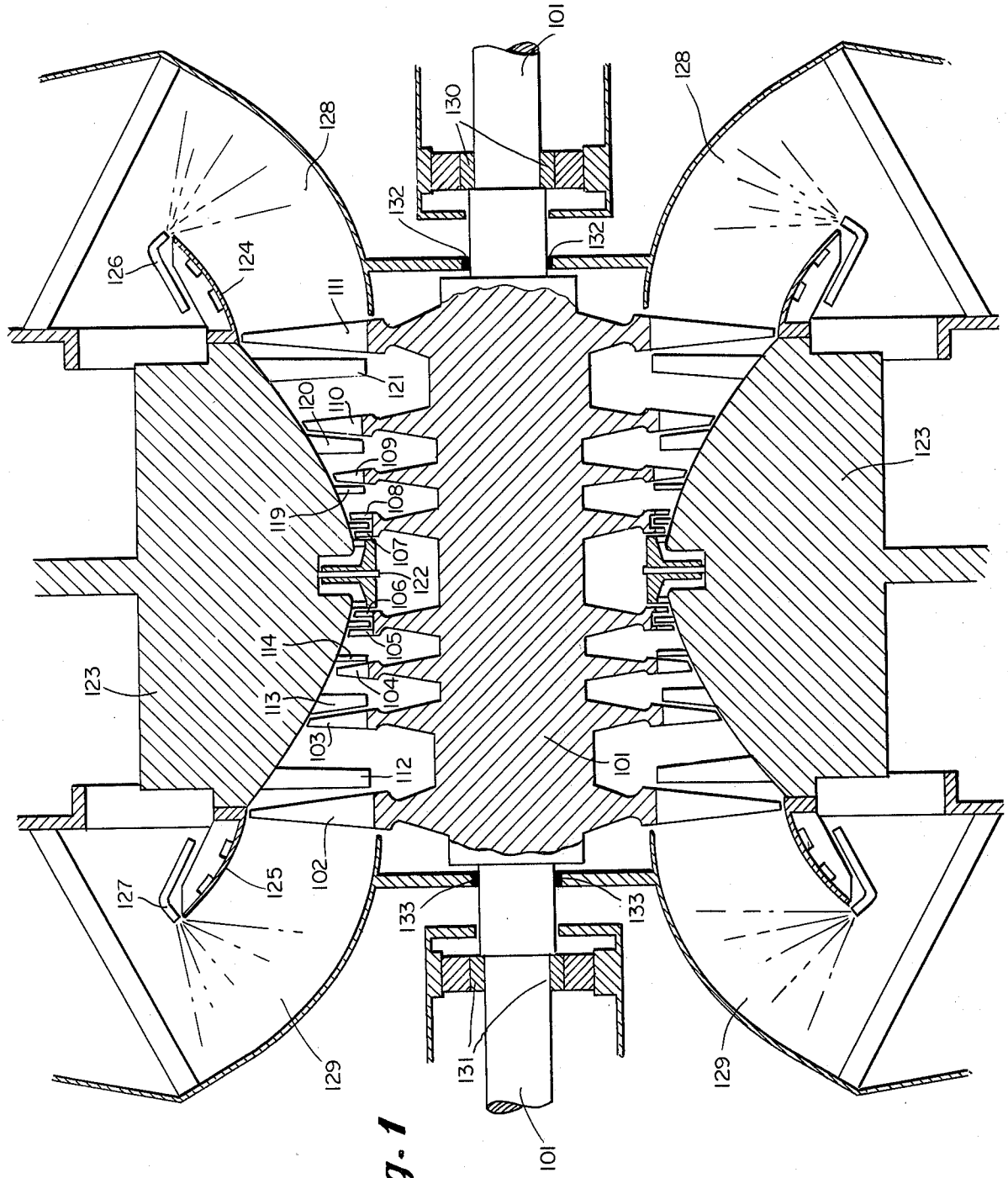

101
128
130
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111
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120
110
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108
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Fig. 1

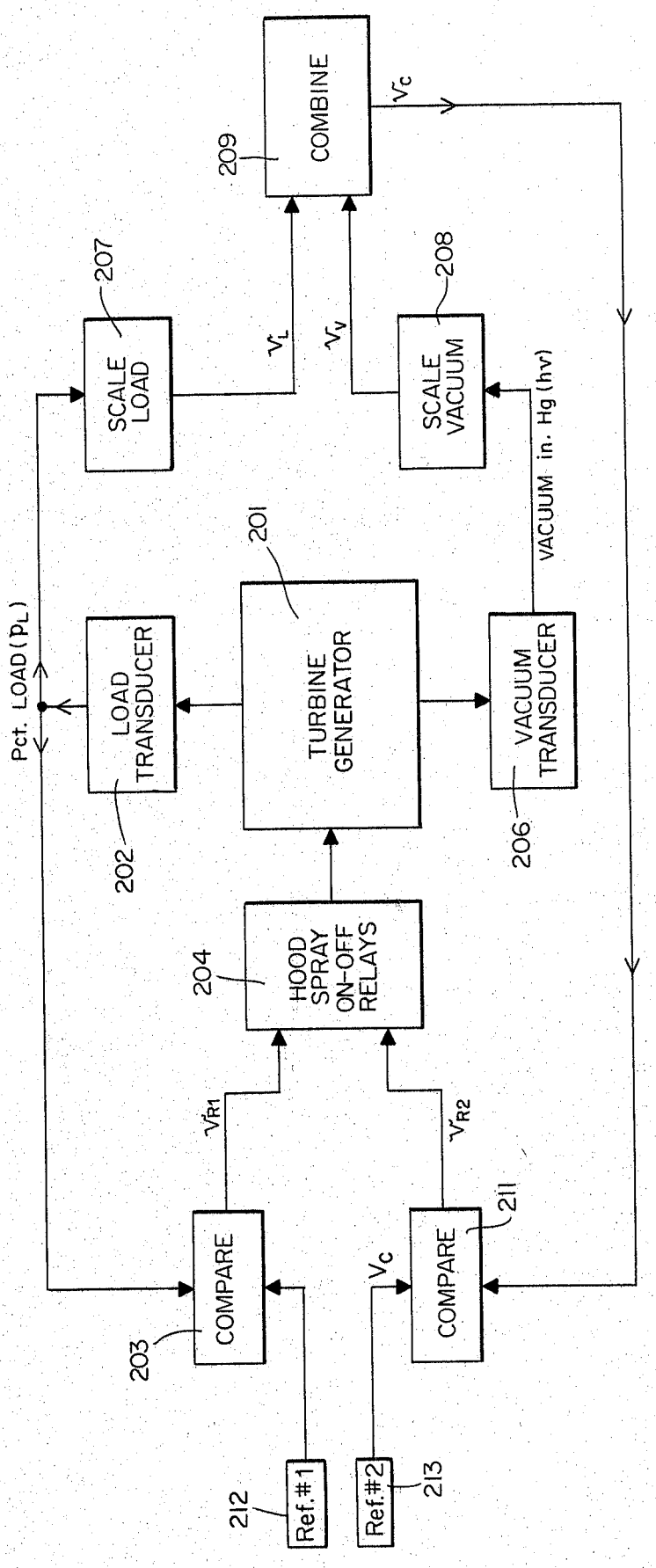
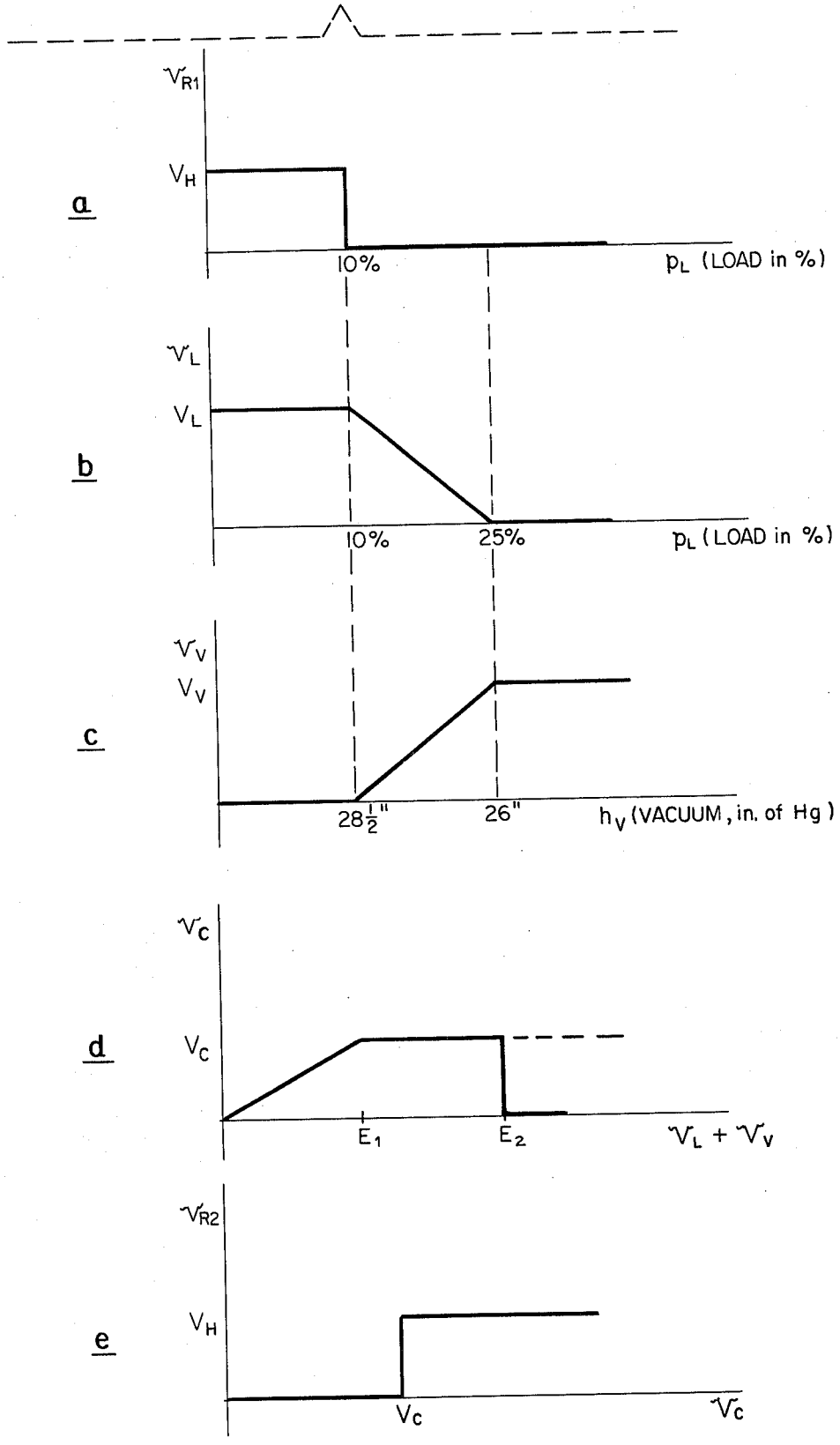

COMBINE
209
V_C
SCALE LOAD
207
V_L
V_V
SCALE VACUUM
208
VACUUM in. Hg (hv)
201
TURBINE GENERATOR
LOAD TRANSDUCER
202
Pct. LOAD (P_L)
VACUUM TRANSDUCER
206
HOOD SPRAY ON-OFF RELAYS
204
V_{R1}
V_{R2}
COMPARE
203
COMPARE
211
V_C
Ref. #1
212
Ref. #2
213

Fig. 2

Fig. 3


a
V_{R1}
V_H
10%
p_L (LOAD in %)
b
V_L
V_L
10%
25%
p_L (LOAD in %)
c
V_V
V_V
$28\frac{1}{2}$"
26"
h_V (VACUUM, in. of Hg)
d
V_C
V_C
E_1
E_2
$V_L + V_V$
e
V_{R2}
V_H
V_C
V_C

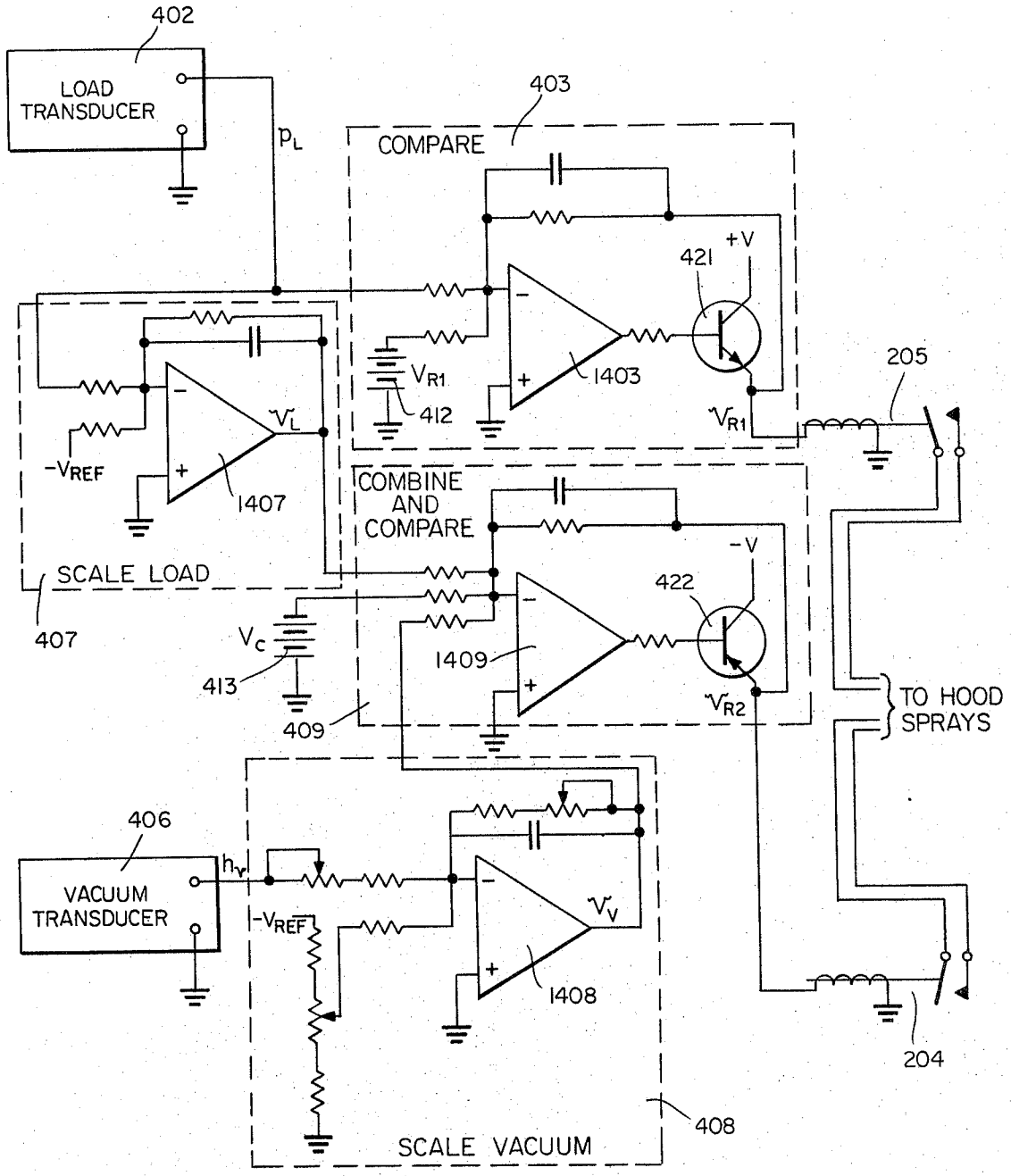

402
LOAD TRANSDUCER
p_L
403
COMPARE
421
+V
V_{R1}
412
1403
205
V_{R1}
V_L
$-V_{REF}$
1407
SCALE LOAD
407
COMBINE AND COMPARE
-V
422
V_c
413
1409
V_{R2}
TO HOOD SPRAYS
409
406
VACUUM TRANSDUCER
h_v
$-V_{REF}$
V_v
1408
204
408
SCALE VACUUM

Fig. 4

AUTOMATIC LOAD AND VACUUM SENSITIVE EXHAUST HOOD SPRAY SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to the generation of electrical power, and more particularly, to the enhancement of generation reliability by control of temperatures at the last turbine output stage.

2. State of the Prior Art

In conventional power generating system, it is common to utilize a succession of three turbines, with steam being circulated in order, from a high, intermediate, and low pressure set of turbines. Typically, the high pressure turbines are the smallest in size and the low pressure turbines are the largest. Also typically, steam is introduced into the center part of the bore of oppositely facing dual low pressure turbines, and exits at the outer portion of either side thereof. In that region, exhaust hoods contain and direct the flow of steam, to a condenser where water is formed and pumped back to the boiler.

Dur to the large size of the low pressure turbines, there is often produced large amounts of heat due to friction of the turning blades with surrounding steam. This friction is commonly known as windage. In particular, the amount of heat produced from windage is dependent on the vacuum in the region of the exhaust hoods. In accordance with modern design trends, which feature cooling towers and a general trend toward operation with a poorer vacuum, windage heat may be sufficiently high to bring about inefficient operation an physical damage to the equipment.

A common approach to limiting the accumulation of heat in the exhaust hood region of low pressure turbines has been to provide hood sprays which supply a cooling fog to mix with hot steam in the exhaust hood area and thereby regulate the temperature. The most common approaches to control of the hood sprays have been to use either a set of fixed speed-related and load related set points for turn-on in the range of 600 rpm. and turn-off, at approximately 10 percent load or a direct thermostatic control, typically seeking to maintain the temperature below 175° F.

The fixed set point scheme involves obvious disadvantages relative to flexibility and adaptation to changing operational conditions.

In most cases, direct thermostatic control of heat in the area of the exhaust hoods has also been inadequate, principally during times of low load upon the turbine generator, or when the turbine generator is being brought up to speed during start-up. During these times particularly, the temperture stabilizing effect of steam through the turbine is absent, and windage heat builds up to excessive levels. This effect is further accentuated if the exhaust vacuum is relatively poor.

It is accordingly a principal object of the present invention to provide apparatus and methods for the control of hood sprays in turbine generators. It is a more particular object to provide such method and apparatus which prevents build up of unwanted heat during times of start-up and low load and/or poor vacuum.

SUMMARY OF THE INVENTION

The present invention fulfills the foregoing objects by providing a hood spray control system which is responsive both to load and to vacuum in the exhaust hood area of turbine generators. In accordance with the principles of the present invention, the hood sprays are always turned on for very low loads, which include the no load start-up conditions. Above a predetermined level, both the load and the vacuum are considered, the spray energizing signal being inversely proportional to the load and directly proportional to vacuum for a specified range of each. Above the respective load and vacuum ranges, the sprays may either be disabled, or alternatively, may be energized in accordance with conventional techniques.

In an illustrative embodiment, transducers sense the present generator load and the exhaust pressure. The load percentage is compared with a first reference, and if the reference is larger, the hood sprays are energized. Both the measured load and the measured vacuum are respectively scaled to facilitate interaction with one another. The scaled load and vacuum signals are combined and compared with a second reference. Again, whenever the combined signal is smaller than the reference, the hood sprays are energized. In preferred embodiments, the hood sprays are automatically turned on for all loads less than 10 percent, and the ranges 10 to 25 percent load and 28½ to 26 inches Hg. vacuum form the inactive range with the second reference.

It is a feature of the present invention that excessive temperature at the exhaust stage of low pressure turbines is avoided. In particular, both load and vacuum pressure factors are utilized to achieve interactive control. Moreover, accurate control is achieved for low load and imperfect vacuum conditions where the heating effects of windage overcome the temperature stabilizing influence of steam. These and other features may be seen from consideration of the figures in conjunction with the following detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows symbolically the exhaust hood region of a dual low presure turbine, with hood sprays;

FIG. 2 shows in block diagrammatic form an illustrative embodiment of the present invention;

FIG. 3*a* through 3*e* show waveforms for the embodiment of FIG. 2; and

FIG. 4 shows a schematic diagram of an analog circuit embodying the principles of the present invention.

DETAILED DESCRIPTION

FIG. 1 shows a stylized version of a low pressure double flow turbine typical of those used in the art. A centrally located rotor **101** connects the low pressure turbine shown with intermediate and high pressure turbines, and a generator, as desired. The view shown in FIG. 1 is from the top, with a cutaway in the region of the rotor. It is to be understood that the apparatus shown in FIG. 1 is simplified considerably, and that actual turbines involve machinery of considerably greater detail and complexity. However, the detail shown in the top view of FIG. 1 has been simplified to illustrate the principles of the present invention. Since the turbine is cylindrical in shape, the structure shown at the bottom of FIG. 1 is identical to that shown at the top.

The rotor **101** is mounted on bearings **130** and **131**, and the actual double flow turbine is isolated from ambient conditions in the region of the rotor by seals **132** and **133**, thereby forming a steam tight chamber within the turbine. The turbine housing is partially formed by the steam exhaust hoods, shown generally as **128** and

129. The hoods 128 and 129 are fixed relative to the rotor 101, and are connected to central structural portions shown generally as 123. In reality, the large solid apparatus shown as 123 involves considerable structural complexity, but none of which is relevant to the principles of the present invention.

As is common in the art, the turbine of FIG. 1 includes oppositely facing separate turbine units, radiating outwardly from the steam inlet 122. Then, from the steam inlet at 122 to the hoods 128 and 129 are respective pluralities of blades, some of which, 102 through 111, are affixed to the rotor 101, and others of which, such as 112 through 114 and 119 through 121, are affixed to the stationary portion 123 of the turbine. The steam enters the turbine at steam inlet 122 and from there passes outwardly in both directions through the stationary and moving blades toward exhaust hoods 128 and 129. The force of the steam passing through the blades causes the rotor 101 to turn, thereby facilitating production of electricity by generator means, not shown. As the steam reaches the exhaust hood regions 128 and 129, it is channeled around flow guides 124 and 125 and down through a bottom exhaust, not shown, where it is directed into condensor apparatus, not shown. In the normal course, a partial vacuum is set up in the exhaust hood regions 128 and 129.

Also shown stylistically in FIG. 1 are the hood sprays 126 and 127, which expel a cooling water spray into the exhaust hood regions 128 and 129, thereby providing temperature stability, in those regions.

As is explained in considerable detail hereinafter, the principles of the present invention involve carefully controlled operation of the sprays 126 and 127 into the hood regions 128 and 129 in response both to the measured load on the generator and the partial vacuum in the region of the exhaust hoods 128 and 129.

FIG. 2 shows in block diagrammatic form an illustrative embodiment of the present invention. The waveforms of FIGS. 3*a* through 3*e* depict operation of various blocks of the FIG. 2 embodiment, and together illustrate the operational effect of the principles of the present invention.

In FIG. 2, a turbine generator 210 is shown symbolically. The turbine generator block 201 represents a plurality of turbines, at least the low pressure segment of which includes exhaust hoods and hood sprays. The hood sprays are energized by one or more on-off relays 204. Located appropriately in the turbine generator are transducer probes 202 and 206 which respectively sense the present values of operating load and partial vacuum in the exhaust hood region of the generator 201. The load and vacuum transducers 202 and 206 produce voltage signals p_L and h_v. The time variant load signal p_L is given in terms of percentage of peak load, and the partial vacuum h_v is represented in terms of inches of mercury, commonly designated "in. Hg." Of course, the signal p_L and h_v are rather arbitrary in terms of absolute signal magnitudes, it being important only that they interact properly with one another and with the various reference voltages throughout the system.

The percentage load p_L is coupled to a comparator 203 where it is compared with a first reference voltage, V_{RI}, from a reference voltage source 212. The amplitude of the first reference voltage represents the load cut-off below which the hood sprays are always turned on. In preferred embodiments, the first reference V_{RI} from source 212 corresponds to 10 percent load, such that below that value, the sprays always will be turned on.

The transfer characteristic of the comparator 203 is shown in FIG. 3*a*, where the percentage load p_L is represented on the abscissa, and the output voltage of the comparator 203, designated v_{RI}, is shown on the ordinate. As is represented in FIG. 3*a*, the output of the comparator v_{RI} is energized to produce an output voltage, designated V_H, whenever the percentage load, p_L, is less than the first reference, V_{RI}, from source 212. The voltage V_H is one which is sufficient to energize the on-off relays 204 of the hood spray. For percentage loads above V_{RI} (which for the embodiment of FIG. 2 and FIG. 3*a* is assumed to be 10 percent), the output voltage v_{RI} of comparator 203 is zero. Thus, for the embodiment shown, the comparator 203 operates responsively to the percentage load p_L to turn on the hood sprays by means of on-off relays 204 whenever the percentage load is less than 10 percent.

The percent load p_L is also coupled to a scaling amplifier 207 which produces a scaled, shaped voltage output waveform v_L which facilitates operation of the principles of the present invention. FIG. 3*b* shows a preferred transfer characteristic for the scaling amplifier 207. In preferred embodiments of the present invention, as exemplified in FIG. 3*b*, the crucial range for interaction of load with vacuum to control the hood sprays is between 10 and 25 percent load. Thus, in FIG. 3*b*, the crucial cut-offs may be seen to occur at 10 and 25 percent load. For loads below 10 percent, it will be recalled that comparator 203 provides that the hood sprays will be in an "on" condition; thus, a "don't care" condition exists for scaling amplifier 207 below 10 percent load. In order to insure smooth operation, however, it is preferable that for loads below 10 percent, the scaling amplifier 207 produce an output voltage which has continuity with the desired waveform above 10 percent. In FIG. 3*b*, this voltage is designated V_L. In the range between 10 and 25 percent load, the output voltage v_L of scaling amplifier 207 linearly decreases from V_L to zero, and for loads above 25 percent is maintained at zero. The linear decrease in v_L from 10 to 25 percent load facilitates operation of the present invention because, as the load increases, the stabilizing effect of steam in the hood spray region tends to require less cooling from the hood sprays. Thus, the voltage v_L, which in conjunction with the exhaust vacuum will determine whether or not hood sprays are required above 10 percent load, tends to decrease with increases in loads. A linear decrease is shown for this region in FIG. 3*b*, but is to be understood that other transfer waveforms may be desired, such as, for example, parabolic, hyperbolic, or exponetial changes in v_L over a prescribed range in percentage load, p_L.

The vacuum h_v is also coupled to a scaling amplifier 208 where it is operated upon for interaction with the scaled voltage signal v_L. The transfer characteristic of scaling amplifier 208 is shown in FIG. 3*c*, wherein the exhaust vacuum h_v is shown on the abscissa and the output voltage v_V is shown on the ordinate. In preferred embodiments of the present invention, vacuum as complete as 28½ in. Hg. tend not to cause sufficient windage heat to require hood spray cooling. Between 28½ and 26 inches of mercury, however, the windage heat tends to increase, and so does the need for the hood sprays. Below 26 inches of mercury, hood spray cooling generally is required below 25 percent load. This vac-

uum responsive requirement for hood spray cooling is reflected in the transfer characteristic of FIG. 3*c*, for which the output voltage v_V is zero up to 28½ inches of mercury, and then linearly increases between 28½ and 26 inches, reflecting the increased need for cooling, and levels off at a voltage V_V beyond 26 inches of mercury. In this fashion, the output voltage v_V of the scaling amplifier **208** represents a progressively greater need for hood spray cooling as the vacuum in the exhaust hood region becomes less and less perfect. As in the transfer characteristic of FIG. 3*b*, the linear change shown in FIG. 3*c* may be supplanted, as desired, with waveforms of varying shapes.

Since the principles of the present invention featue dual interactive control of hood spray cooling in response both to vacuum and to load, the output voltages from scaling circuits **207** and **208** are merged in a combine circuit **209** in accordance with an aggregate transfer characteristic for control of the sprays. In accordance with the principles of the present invention, the combined characteristic, which is shown in FIG. 3*d*, takes into account the need for cooling both due to the absence of the stabilizing effect of steam (i.e., low load) and the heat produced from windage (i.e., imperfect vacuums). The abscissa in FIG. 3*d* represents the addition at circuit **209** of the load and vacuum control voltages v_L and v_V. On the ordinate is plotted a voltage v_C, the control voltage which, relative to a desired reference, determines whether the hood sprays are on or off in the desired range of load and vacuum. In FIG. 3*d*, for values of v_L plus v_V up to a first level, designated E_1, the control voltage v_C progresses from zero to some level V_C. In this range, neither the load nor the vacuum is sufficiently low to require hood spray cooling. Next, in a range of v_L plus v_V from E_1 to E_2, the output control voltage v_C is stationary at the level V_C because of the increasing effect of v_V and the decreasing effect of v_L. Above E_2, it is desirable to have the sprays off at all times. Accordingly, the transfer waveform of FIG. 3*d* may merely involve a cut off of v_C for comparable increases of v_L plus v_V, or alternatively may, be any level below the phantom line at V_C for increases of v_L plus v_V above E_2.

The combined vacuum and load control voltage v_C is coupled to a comparator **211** where it is compared with a second reference voltage, equal to V_C, in order to determine whether or not the hood sprays should be energized. The transfer characteristic of the comparator **211** is shown in FIG. 3*e*, wherein the control voltage v_C is plotted on the abscissa and the second relay control voltage v_{R2} is shown on the ordinate. As may be seen from FIG. 3*e*, the relay control voltage v_{R2} is binary, being zero for input control voltages below the reference V_C, and being the relay energizing voltage V_H for joint load and vacuum control voltages v_C above the second reference V_C. Accordingly, the second comparator **211** in conjunction with the reference V_C from source **213** establishes the joint load and vacuum control over the hood spray on-off relays **204**, as desired.

In summary, the embodiment of FIG. **2**, as represented by the waveforms of FIGS. 3*a* through 3*e*, causes the hood sprays to be turned on for start up and for low loads, preferably those below 10 percent load. For loads between 10 and 25 percent, the question becomes whether the load and vacuum together require hood spray cooling, even though they might not be sufficient individually to require such cooling. Finally, if the load is sufficiently high and the vacuum sufficiently effective, hood spray cooling is not required and the relays are maintained in the off condition.

While the embodiment described is operated on the basis of crucial cut-off points being 10 and 25 percent load and 28½ and 26 in. Hg. of exhaust vacuum, it is to be understood that those cut-off points are subject to variation, as desired, by those skilled in the art in order to accommodate other generating systems of varying characteristics. Clearly, a given system might feature a predominate effect of either load or vacuum over the other, which of course would require comparable variation in the various transfer characteristics of circuits **207, 208,** and **209.** Such alteration, however, is believed well within the capability of those skilled in the art.

FIG. **4** shows a schematic circuit diagram of the embodiment of FIG. **2.** In FIG. **4,** a load transducer **402** and a vacuum transducer **406** respectively sense the present generator load and the present partial vacuum in the exhaust hood region, depicting them in the form of voltage signals p_L and h_v. The load signal p_L is coupled to a comparator **403** and to a load scaling amplifier **407.** The comparator **403** corresponds to the first comparator **203** of the FIG. **2** embodiment, and serves to compare the percentage load signal p_L with a voltage reference V_{Rl} from a supply **412.** Accordingly, the output voltage from the operational amplifier **1403,** v_{Rl}, may be utilized to turn on the hood sprays by means of a hood spray control relay **205.** Accordingly, the voltage v_{Rl} is coupled through the emitter stage of a transistor **421** to operate the relay **205.** In turn, so long as v_{Rl} is sufficiently large to energize the relay, the closure of the switch of relay **205** energizes the hood sprays. The operational amplifier **1403** of comparator **403** involves various resistors and capacitors selected to produce a transfer characteristic such as shown in FIG. 3*a*.

The percentage load signal p_L is also coupled to an input stage of a load scaling amplifier **407,** which includes an operational amplifier **1407** and appropriate input and feedback circuitry to produce a transfer characteristic such as shown in FIG. 3*b*. The output of the operational amplifier **1407,** v_L, is coupled to a first input of a combine and compare circuit **409.**

The output voltage h_v from the vacuum transducer **406** is coupled to an input of a vacuum scaling amplifier **408,** which in turn includes an operational amplifier **1408** with appropriate input and feedback circuitry. In addition, to scale the vacuum voltage signal for appropriate interaction with the load signal p_L, and thereby to achieve harmonious interaction throughout the circuitry, the scaling amplifier **408** includes variable resistors. By adjusting these resistors appropriately, coordinated operation is insured. The output voltage from the operational amplifier **1408,** v_V, is coupled to another input of the combine and compare circuit **409.** Connected to yet a third input for the combine and compare circuit **409** is a reference voltage V_c from a source **413.** The combine and compare circuit **409** includes an operational amplifier **1409** properly biased at its input and feedback circuitry to merge the functions of combine circuit **209** and comparator **211** of FIG. **2.** Thus, the emitter voltage of transistor **422,** designated v_{R2}, is the control voltage for a relay **204** which operates the hood sprays. Thus, since the various circuits **407, 408,** and **409** together embody the transfer characteristics shown in FIGS. 3*b* through 3*e*, the

result is operation as previously described in conjunction with the embodiment of FIG. 2.

In summary, the circuit of FIG. 4 duplicates the bifurcated path of the FIG. 2 embodiment to achieve control of hood sprays utilizing both load and vacuum as control parameters. Moreover, proper selection and adjustment of the various resistors and capacitors utilized to bias the corresponding operational amplifiers will produce transfer characteristics similar to those shown in FIGS. 3*a* through 3*e*, or, if desired, predetermined variations thereof, In any event, selection of the components is well within the capability of those skilled in the art. Moreover, the various transducers and operational amplifiers set forth in FIG. 4 are embodied as multi-purpose, generally available circuit packages commonly used in the art.

While the detailed embodiment set forth in FIG. 4 is an analog circuit, it is clear that the principles of the present invention may be embodied just as effectively by digital circuitry. For example, any of the voltage quantities referred to herein may be represented by appropriately quantized and coded digital signals for utilization by well known digital circuitry in the same fashion as are the analog signals set forth hereinbefore.

It is to be further understood that all of the embodiments set forth herein are intended to be illustrative of the principles of the present invention, as set foth in the appended claims. Many variations thereof will readily occur to those skilled in the art without departure from the spirit or scope of the principles of the present invention.

What is claimed is:

1. In a turbine generator system having an exhaust hood on at least one turbine and cooling sprays for said hood, hood spray control apparatus comprising:
- a. means for measuring the present load of said generator;
- b. means for measuring the present exhaust vacuum of steam from said turbine; and
- c. means responsive to the measured present load and to the present measured exhaust vacuum for selectively activating said cooling sprays.

2. Control apparatus as described in claim **1** wherein said means for selectively activating comprises:
- a. first means for activating said sprays when said present load is below a first predetermined level;
- b. means for developing a control signal from said present load and said present exhaust vacuum; and
- c. second means, responsive to said control signal, for selectively activating said sprays whenever said present load and said present exhaust vacuum are respectively within first and second predetermined ranges.

3. Control apparatus as described in claim **2** wherein said means for developing a control signal comprises:
- a. means for developing a first signal directly proportional to exhaust vacuum in said second predetermined range;
- b. means for developing a second signal inversely proportional to measured load in said first predetermined range; and
- c. means for combining said first and second signals to yield said control signal.

4. Control apparatus as described in claim **2** wherein said first means for activating comprises:
- a. a source of a first reference level; and
- b. means for comparing said present load with said first reference level.

5. Control apparatus as described in claim **2** wherein said second means for activating comprises:
- a. a source of a second reference level; and
- b. comparator means for comparing said first reference level with said control signal.

6. Control apparatus as described in claim **2** wherein said first predetermined level is substantially equivalent to a ten percent load.

7. Control apparatus as described in claim **2** wherein said first predetermined range is substantially between 10 and 25 percent load, and said second predetermined range is substantially between 28½ and 26 inches of mercury.

8. In an electric generator, apparatus for maintaining the exhaust load region of a low pressure turbine within specified temperature ranges comprising:
- a. at least one spray for each exhaust hood for producing a cooling mist in said hood region;
- b. means for exhausting steam from said turbine to a condenser means, thereby producing a partial vacuum in said hood region;
- c. means for measuring the vacuum in said hood region;
- d. means for measuring the present load of said generator; and
- e. means responsive to the present load and to the measured vacuum for selectively activating said spray.

9. Apparatus as described in claim **8** wherein said means for selectively activating comprises:
- a. first means for activating said spray when said present load is below a first predetermined level;
- b. means for developing a control signal from said present load and from measured vacuum; and
- c. second means for selectively activating said spray whenever said present load and said measured vacuum are respectively within first and second predetermined ranges.

10. Apparatus as described in claim **9** wherein said means for developing a control signal comprises:
- a. means for developing a first signal inversely proportional to load in said first predetermined range;
- b. means for developing a second signal directly proportional to vacuum in said second predetermined range; and
- c. means for combining said first and second signals to produce said control signal.

11. Apparatus as described in claim **9** wherein said first means for activating comprises:
- a. a source of a first reference level; and
- b. means for comparing said measured present load with said first reference level.

12. Control apparatus as described in claim **9** wherein said second means for activating comprises:
- a. a source of a second reference level; and
- b. comparator means for comparing said first reference level with said control signal.

13. A method of controlling the activation of hood sprays in an electric generator system comprising the steps:
- a. evaluating the present load on said system;
- b. evaluating the present exhaust vacuum from the exhaust hood region of said system;

c. selectively activating the hood sprays in response to evaluations of the present load and the present vacuum.

14. A method as described in claim **13** wherein said activating step includes:

a. energizing the hood sprays when the present load is below a first predetermined level; and

b. selectively energizing the hood sprays when the present load and present vacuum are respectively within first and second predetermined ranges.

15. A method as described in claim **14** wherein said step of selectively energizing comprises:

a. developing a control signal from said present load and said present exhaust vacuum;

b. comparing said control signal with a second predetermined level; and

c. energizing the hood sprays when said control signal is at least said second predetermined level.

16. A method as described in claim **15** wherein said step of developing a control signal comprises:

a. developing a first signal directly proportional to exhaust vacuum in said second predetermined range;

b. developing a second signal inversely proportional to load in said first predetermined range; and

c. combining said first and second signals to yield said control signal.

17. A method as described in claim **14** wherein said first energizing step includes:

a. developing a first reference level; and

b. comparing said present load with said first reference level.

18. A method as described in claim **14** wherein said first predetermined level is substantially equivalent to ten percent load.

19. A method as described in claim **14** wherein said first predetermined range is substantially between 10 and 25 percent load, and said second predetermined range is substantially between 28½ and 26 inches of mercury.

20. A temperature stablized power generation system comprising:

a. a turbine generator having high, intermediate, and low pressure segments, at least one segment having an exhaust hood portion and sprays for cooling the region of said exhaust hood portion;

b. means for measuring the present load of said generator;

c. means for measuring the present exhaust vacuum of steam from said turbine; and

d. means responsive to the measured present load and to the present measured exhaust vacuum for selectively activating said cooling sprays.

21. A system as described in claim **20** wherein said means for selectively activating comprises:

a. first means for activating said sprays when said present load is below a first predetermined level;

b. means for developing a control signal from said present load and said present exhaust vacuum; and

c. second means, responsive to said control signal for selectively activating said sprays whenever said present load and said present exhaust vacuum are respectively within first and second predetermined ranges.

22. A system as described in claim **21** wherein said means for developing a control signal comprises:

a. means for developing a first signal directly proportional to exhaust vacuum in said second predetermined range;

b. means for developing a second signal inversely proportional to measured load in said first predetermined range; and

c. means for combining said first and second signals to yield said control signal.

23. A system as described in claim **21** wherein said first means for activating comprises:

a. a source of a first reference level; and

b. means for comparing said present load with said first reference level.

24. A system as described in claim **21** wherein said second means for activating comprises:

a. a source of a second reference level; and

b. comparator means for comparing said first reference level with said control signal.

25. A system as described in claim **21** wherein said first predetermined level is substantially equivalent to ten percent load.

26. A system as described in claim **21** wherein said first predetermined range is substantially between 10 and 25 percent load, and said second predetermined range is substantially between 28½ and 26 inches of mercury vacuum.

27. A temperature stabilized power generation system comprising:

a. a turbine generator having high, intermediate, and low pressure segments, at least one of said segments having an exhaust hood portion;

b. at least one spray for each exhaust hood for producing a cooling mist in said hood region;

c. means for exhausting steam from said turbine to a condenser means, thereby producing a partial vacuum in said hood region;

d. means for measuring the vacuum in said hood region;

e. means for measuring the present load of said generator; and

f. means responsive to the present load and to the measured vacuum for selectively activating said spray.

28. A system as described in claim **27** wherein said means for selectively activating comprises:

a. first means for activating said spray when said present load is below a first predetermined level;

b. means for developing a control signal from said present load and from measured vacuum; and

c. second means for selectively activating said spray whenever said present load and said measured vacuum are respectively within first and second predetermined ranges.

29. A system as described in claim **28** wherein said means for developing a control signal comprises:

a. means for developing a first signal inversely proportional to load in said first predetermined range;

b. means for developing a second signal directly proportional to vacuum in said second predetermined range; and

c. means for combining said first and second signals to produce said control signal.

30. A system as described in claim **28** wherein said first means for activating comprises:

a. a source of a first reference level; and

b. means for comparing said measured present load with said first reference level.

31. A system as described in claim 28 wherein said second means for activating comprises:

a. a source of a second reference level; and

b. comparator means for comparing said first reference level with said control signal.

32. A system as described in claim 28 wherein said first predetermined level is substantially equivalent to a ten percent load.

33. A system as described in claim 28 wherein said first predetermined range is substantially between 10 and 25 percent load, and said second predetermined range is substantially between 28½ and 26 inches of mercury vacuum.

34. A method of operating a generator system having a plurality of turbine generator segments, at least one of which has associated exhaust hood and hood spray apparatus, comprising the steps of:

a. successively starting up and loading said generator;

b. energizing the sprays during startup;

c. evaluating the present load on said system;

d. evaluating the present exhaust vacuum from the exhaust hood region of said system;

e. selectively activating the hood sprays in response to evaluations of the present load and the present vacuum.

35. A method as described in claim 34 wherein said activating step includes:

a. energizing the hood sprays when the present load is below a first predetermined level; and

b. selectively energizing the hood sprays when the present load and present vacuum are respectively within first and second predetermined ranges.

36. A method as described in claim 35 wherein said step of selectively energizing comprises:

a. developing a control signal from said present load and said present exhaust vacuum;

b. comparing said control signal with a second predetermined level; and

c. energizing the hood sprays when said control signal is at least said second predetermined level.

37. A method as described in claim 36 wherein said step of developing a control signal comprises:

a. developing a first signal directly proportional to exhaust vacuum in said second predetermined range;

b. developing a second signal inversely proportional to load in said first predetermined range; and

c. combining said first and second signals to yield said control signal.

38. A method as described in claim 35 wherein said first energizing step includes:

a. developing a first reference level; and

b. comparing said present load with said first reference level.

39. A method as described in claim 35 wherein said first predetermined level is substantially equivalent to ten percent load.

40. A method as described in claim 35 wherein said first predetermined range is substantially between 10 and 25 percent load, and said second predetermined range is substantially between 28½ and 26 inches of mercury vacuum.

41. A method as described in claim 35 wherein said first predetermined range is substantially between 10 and 25 percent load, and said second predetermined range is substantially between 28½ and 26 inches of mercury vacuum.

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