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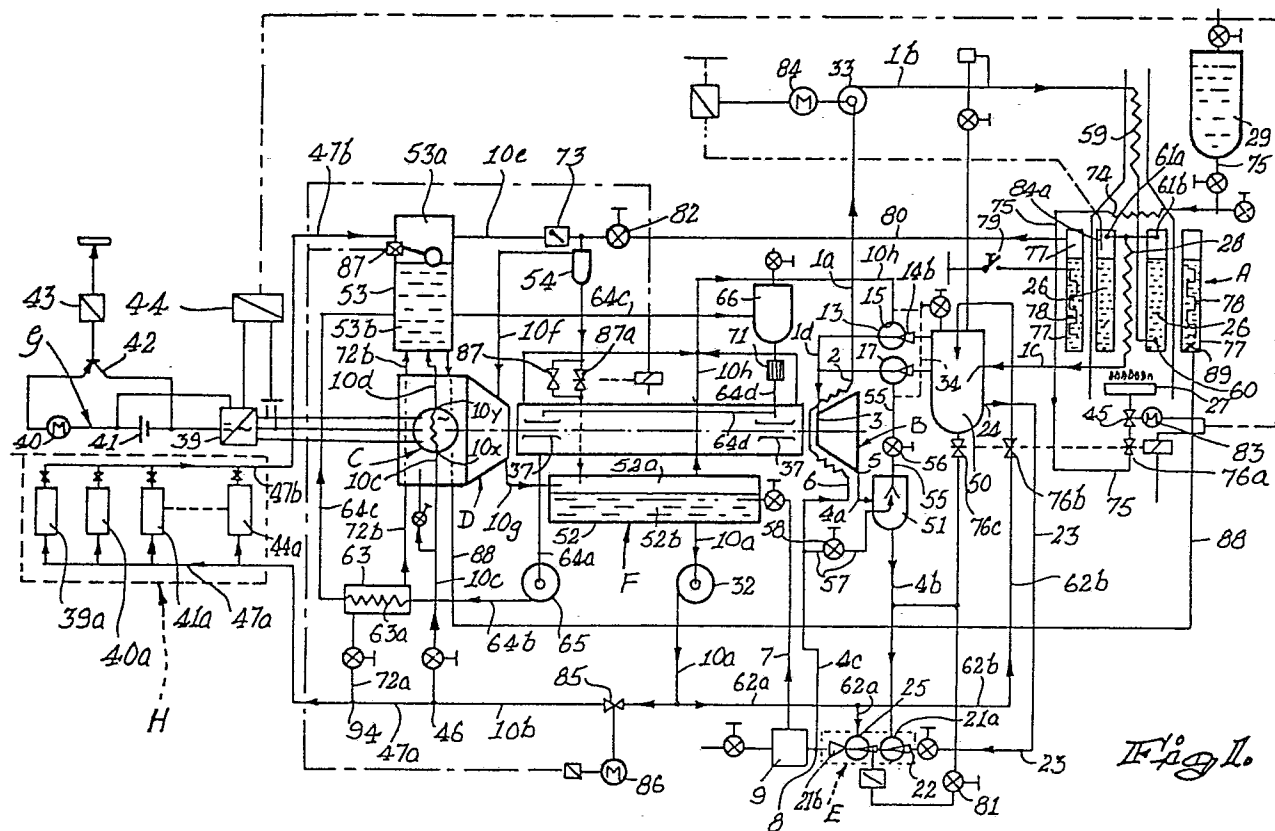
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54 **Thermodynamic power plant and method of operating the same.**

57 A method of operating a closed cycle power plant and also a closed cycle power plant including a closed cycle power plant including heating means (A); a thermodynamic prime mover (B); a cooling chamber in and/or round the prime mover (B); electric generating means (C) drivingly coupled to the prime mover (B); a cooling chamber (11,12) in and/or round the generating means (C); condenser means (E); cooling means (F); a first fluid line or circuit (1) extending from an outlet (2) from the cooling chamber of the prime mover (B) through the heating means (A) and communicating with a high pressure inlet (3) into the prime mover (B); a second fluid line or circuit (4) extending from a low pressure outlet (5) from the prime mover (B) through the condenser means (E) and communicating with an inlet (b) into the cooling chamber of the prime mover (B); a third fluid line or circuit (7) branching off from the second fluid line or circuit (4) downstream of the condenser means (E) and communicating with the cooling means (F); and a fourth fluid line or circuit (10) extending from the cooling means (F) to the cooling chamber (11,12) of the generating means (C) and from there to the first fluid line or circuit (1) in a position between the heating means (A) and the prime mover (B); and means (13) operative to introduce fluid from the fourth fluid line or circuit (10) into the first fluid line or circuit (1).

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THERMODYNAMIC POWER GENERATION

This invention relates to thermodynamic power generation.

Conventional thermodynamic power plants for converting thermal energy into mechanical energy and/or electrical energy do not normally fully
5 utilise the intrinsic heat energy contained in the fuel or other medium or source, such as for example a solar energy converter, from which the thermal energy is derived. It is accordingly an
10 object of the present invention to avoid or at least to minimize the above disadvantage.

According to one aspect of the invention a method of operating a closed cycle power plant includes the steps of heating a working fluid to an
15 operating temperature; utilizing a flow of heated working fluid to drive a thermodynamic prime mover and thereby to drive associated plant; utilizing low grade waste heat and/or low grade reject heat and/or low grade random heat losses from the prime
20 mover and/or associated plant and/or other associated apparatus to heat a recovery fluid; and introducing heated recovery fluid into heated

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working fluid flowing to the prime mover in a position upstream of the prime mover.

The arrangement according to the invention facilitates the recuperation of low grade heat losses and/or low grade waste heat and/or reject heat from the system and the transfer of such heat back into the working cycle to improve the utilization of the heat energy available in fuel or any other source or medium used for heating the working fluid.

The recovery fluid may be utilized to cool the prime mover and/or associated plant and/or other associated apparatus, whereby the recovery fluid absorbs low grade heat from the system. Such absorbed low grade heat may be introduced into the heated working fluid when the heated recovery fluid is introduced into the heated working fluid.

The recovery fluid may comprise a fluid which is physically and/or chemically different from, but compatible with the working fluid. Thus, a mixture of two or more fluids of different

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chemical composition may be used.

The recovery fluid may be derived or extracted wholly or partially from the working fluid.

The recovery fluid may comprise a permanent gas or
5 a condensable gas or vapour and may be utilized in any suitable state or condition.

The recovery fluid may comprise the same fluid chemically as the working fluid. Thus, a first portion of the working fluid may be heated to the
10 operating temperature to drive the prime mover; and a second portion of the working fluid may be heated by the low grade waste heat and/or low grade reject heat and/or random heat losses.

The working fluid may comprise any suitable
15 medium, such as freon or sulphur hexafluoride or methanol and/or water, and may be utilized in any suitable chemical and/or physical form or composition.

The heated working fluid may be at a higher

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temperature and pressure than the heated recovery fluid and a flow of the heated working fluid may be utilized to aspirate the heated recovery fluid into the heated working fluid.

- 5 At least part of the condensable gaseous and/or vaporous fluid passing from the prime mover (and which will hereinafter simply be referred to as "condensable fluid") may be condensed by compression produced by kinetic motion imparted to
10 such condensable fluid. The compressive condensation may or may not be effected in conjunction with cooling of the condensable fluid.

Kinetic motion may be imparted to the condensable fluid passing from the prime mover by drawing off
15 at elevated pressure upstream of the prime mover part of the heated working fluid and causing a flow of such drawn-off portion of the working fluid to impart kinetic motion to such condensable fluid passing from the prime mover.

- 20 Additionally or alternatively, cooled recovery

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fluid may be introduced into the condensable fluid passing from the prime mover, thereby to simultaneously cool and increase the kinetic motion of condensable fluid passing from the prime
5 mover.

At least part of the condensed fluid may be utilized to cool the prime mover.

In the process of cooling the prime mover, the condensed fluid will become heated in a
10 recuperative preheating stage and such pre-heated condensed fluid may comprise working fluid which may be heated to the higher operating temperature for driving the prime mover.

Alternatively or additionally, at least part of
15 the condensed fluid may be cooled by expansive evaporation.

Vacuum conditions for expansive evaporation may be created by a flow of heated working fluid or a part thereof.

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At least part of the condensable fluid and/or the cooled condensed fluid may constitute or comprise the recovery fluid for recuperating low grade heat losses and/or reject and/or waste heat and
5 returning such recuperated heat to the system by introducing the heated recovery fluid into the working fluid upstream of the prime mover.

It is also possible for part of the condensable fluid and/or the cooled condensed fluid to
10 constitute or comprise recovery fluid for recuperating very low grade heat losses and/or reject and/or waste heat and returning such recuperated heat to the system by introducing the resultant heated recovery fluid into the fluid
15 system in the cooling stage or at any other suitable point.

The prime mover and associated plant may comprise a turbo-electric unit.

A thermodynamic turbine may drive electric
20 generating means, such as an alternator adapted to

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feed into a load.

The load may comprise an electric motor and/or an electric and/or other energy accumulator and/or any suitable power conversion means.

- 5 The recovery fluid may be utilized to cool the electric generator and/or the electric motor and/or the load and/or other apparatus or parts in which thermal losses occur, and/or in which waste or reject heat is available, whereby the recovery
10 fluid absorbs at least part of the heat losses and/or the reject and/or waste heat before the recovery fluid is introduced into the heated working fluid upstream of the prime mover and/or into the fluid system at any other suitable point,
15 such as in the cooling stage.

The heated recovery fluid may advantageously be compressed prior to the introduction into the heated working fluid. The heat generated by mechanical work performed during compression may
20 also be recuperated by the recovery fluid.

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The working fluid may be heated to the operating temperature by any suitable heating means, such as fuel burning means and/or electrical and/or nuclear heating means and/or solar energy absorber
5 means. Solar and/or nuclear heating may advantageously be utilized in the system.

Heating of the working fluid to the operating temperature may be effected by controlled external combustion means whereby atmospheric pollution may
10 be minimized.

The operating speed and/or the power output of the prime mover may be controlled by regulating the magnitude of the load applied to the prime mover and/or by regulating the heat input to the working
15 fluid and/or by introducing condensed fluid into heated gaseous or vaporous working fluid upstream of the prime mover.

Part of the condensable fluid passing from the prime mover and/or at least part of the condensed
20 fluid may be introduced into the heated working fluid in a position upstream of the prime mover,

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thereby to control the operating temperature and/or flow conditions and/or power output of the prime mover.

In a preferred embodiment, a load applied to
5 electric generating means driven by the prime mover is regulated to control the operating speed of the prime mover. Excess power may be absorbed in an energy storage system.

The operating speed and the power output of the
10 prime mover may be controlled to substantially constant values. The combustion rate of fuel burning heating means may thus be maintained substantially constant over extended periods whereby optimal operation of the power plant may
15 be achieved.

The load applied to electrical generating means driven by the prime mover and/or the heat input to the working fluid may be regulated in accordance with the speed and/or electrical output of the
20 generating means.

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According to another aspect of the invention a closed cycle power plant includes heating means; a thermodynamic prime mover; a cooling chamber in and/or round the prime mover; electric generating
5 means drivingly coupled to the prime mover; a cooling chamber in and/or round the generating means; condenser means; cooling means; a first fluid line or circuit extending from an outlet from the cooling chamber of the prime mover
10 through the heating means and communicating with a high pressure inlet into the prime mover; a second fluid line or circuit extending from a low pressure outlet from the prime mover through the condenser means and communicating with an inlet
15 into the cooling chamber of the prime mover; a third fluid line or circuit branching off from the second fluid line or circuit downstream of the condenser means and communicating with the cooling means; and a fourth fluid line or circuit
20 extending from the cooling means to the cooling chamber of the generating means and from there to the first fluid line or circuit in a position

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between the heating means and the prime mover; and means operative to introduce fluid from the fourth fluid line or circuit into the first fluid line or circuit.

5 Aspirator means may be provided to aspirate fluid from the fourth fluid line or circuit into the first fluid line or circuit.

A return line or circuit branching off from the second fluid line or circuit upstream of the
10 condenser means may communicate with the first fluid line or circuit between the heating means and the prime mover, to permit condensable fluid passing from the prime mover to be introduced directly into the first fluid line or circuit
15 upstream of the prime mover.

A branch fluid line or circuit may communicate with the second fluid line or circuit in a position between the condenser means and the cooling chamber of the prime mover and may be
20 adapted to communicate with the return line to permit condensed fluid to be introduced directly

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into the first fluid line ahead of the prime mover.

A further aspirator may be provided in the first fluid line or circuit between the heating means
5 and the prime mover, the further aspirator being operative under the influence of fluid flow along the first fluid line or circuit to aspirate condensable fluid and/or condensed fluid into the first fluid line or circuit from the return line
10 or circuit.

The thermodynamic prime mover may comprise a thermodynamic turbine.

The electric generating means may comprise an A.C. alternator.

15 The alternator may have a variable excitation system or a constant excitation system, such as derived from a permanent magnetic field.

The electric generating means may include tubular

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conductors in its magnetic windings, the tubular
conductors comprising or forming part of the
cooling chamber of the generating means and being
connected in fluid circuit with the fourth fluid
5 line or circuit. The tubular conductors may
constitute one or more internal cooling
compartments.

A compressor may be connected in the fourth fluid
line or circuit between the generating means and
10 the aspirator.

At least part of the cooling chamber of the
generating means which is connected in the fourth
fluid line or circuit, may comprise a cooling
compartment which is located about the generating
15 means and which communicates with the low pressure
side of the compressor, whereby the compressor is
adapted to create a low pressure atmosphere about
the generating means.

The cooling compartment located about the
20 generating means may constitute an external
cooling compartment which may be in communication

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with the internal cooling compartment/s constituted by the tubular conductors.

The aspirator may comprise a tubular body connected in the first fluid line or circuit; and
5 an inlet into the tubular body communicating with the fourth fluid line or circuit, fluid flow along the first fluid line or circuit through the tubular body being operative to aspirate fluid from the fourth fluid line or circuit into the
10 first fluid line or circuit through the inlet.

The cooling means may comprise expansive evaporation cooling means.

An aspirator in the first fluid line or circuit may be operative under the influence of fluid flow
15 along the first fluid line or circuit to withdraw fluid from the expansive evaporation cooling means, thereby to create low pressure conditions in the cooling means.

Alternatively or additionally, the expansive
20 evaporation cooling means may be connected to the

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low pressure side of the compressor, whereby the compressor is adapted to create low pressure conditions to a greater or lesser degree in the cooling means.

5 A single or multi-stage cooling means may be provided.

The condenser means may comprise dynamic compressive condenser means.

10 The compressive condenser means may be operative to condense condensable gaseous and/or vaporous fluid passing from the prime mover (i.e. "condensable exhaust fluid") by compression produced by kinetic motion imparted to the condensable fluid.

15 The compressive condenser means may comprise a tubular body; a first inlet communicating with the low pressure outlet from the prime mover via

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portion of the second fluid line; and a second inlet communicating via a fifth fluid line with the first fluid line in a position between the heating means and the prime mover, fluid flow
5 through the second inlet being operative to aspirate condensable fluid passing from the prime mover through the first inlet into the tubular body and to compress such condensable fluid by converting its directional kinetic motion into a
10 pressurised condition.

The tubular body may include a third inlet communicating with the cooling means, cooled fluid introduced under pressure through the third inlet being operative to cool and further to compress by
15 kinetic motion the condensable fluid passing from the prime mover.

Condensed fluid passing via the second fluid line from the condenser to the cooling chamber of the prime mover, is heated in the cooling chamber
20 which acts as a pre-heating stage for fluid passing from the cooling chamber of the prime mover to the heating means along the first fluid

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line.

The heating means may comprise fuel burning means. The heating means may include a main heating stage in which working fluid flowing along
5 the first fluid line is subjected to heating by the combustion of fuel.

The heating means may also include a pre-heating stage in which working fluid flowing along the first fluid line is subjected to heating by hot
10 waste gases of combustion.

The heating means may also include superheating means.

Alternatively or additionally to fuel burning means, the heating means may comprise electric
15 and/or solar and/or nuclear heating means.

The prime mover and the electric generating means may comprise a turbo-electric unit operating at constant or variable power output.

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The power plant may include a load which is electrically connected to the output of the electric generating means.

5 The load may comprise one or more components and may include and/or constitute an energy storage system.

The load may comprise an electric motor and/or energy accumulator means and/or power conversion means.

10 The energy accumulator means may comprise a chemical energy accumulator, such as an electric storage battery connected to the rectified output of the electric generating means, and/or a heat
15 energy accumulator, such as a mass of glauber salts or other suitable fusible material provided with an electric heater connected to the output of the electric generating means.

Control means may be provided for regulating the operating speed and/or the power output of the
20 loaded prime mover. The operating speed and/or

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power output of the loaded prime mover may be regulated to substantially constant values.

The control means may be adapted to vary the heat input to working fluid flowing along the first
5 fluid line. Where fuel burning heating means is used, the heat input to the working fluid may be varied by varying the fuel supply to the heating means. The heat input may be varied in accordance with the output of the electric generating means
10 and/or energy accumulator means. Variation of the heat input may involve a certain reaction time delay in the control of the operating speed of the prime mover.

Alternatively or additionally, the control means
15 may be adapted to regulate rapidly the operating speed of the prime mover by varying the load on the prime mover. The load on the prime mover may be varied by varying the load connected to the electric generating means. The load on the
20 generating means may be varied in accordance with the output of the generating means.

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The load applied to the prime mover may thus form part of the prime mover speed control system.

The total load applied directly or indirectly to the prime mover may comprise a plurality of load
5 components which may be combined and/or varied in any suitable manner to establish a required controlled operating condition in order to achieve optimal utilization of the prime mover and/or associated plant and/or apparatus.

10 Thus, a combination of load components, which individually may be of constant or variable magnitude, may be suitably controlled to present a substantially constant load to the prime mover. The prime mover may run at substantially constant
15 rotational speed and simultaneously at substantially constant power output despite variations in individual load components. Accordingly, the fuel consumption and therefore the combustion rate of fuel burning heating means
20 may be maintained at a substantially constant value corresponding to optimal utilization of heat

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energy available in fuel as well as of the power plant and the connected load components as a complete system.

The power plant may further include a sixth fluid
5 line or circuit extending from the cooling means to a cooling system for the electric load and/or for control means associated with the electrical generating means and/or the load, the sixth fluid circuit or line extending from such cooling system
10 to any suitable point in the fluid system for the reintroduction into the system of heat recuperated by recovery fluid flowing in the sixth fluid circuit or line in the cooling system.

Normally, the heat recuperated by the sixth fluid
15 line or circuit will be of a very low grade with the result that the heated recovery fluid is likely to include a liquid component. It is therefore preferable for the sixth fluid line or circuit to return to the cooling means.

20 It will be appreciated that with the arrangement

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according to the invention, a maximum recuperation of heat losses and/or of reject heat and/or waste

heat may be effected and the recuperated heat returned to the system to obtain maximum
5 utilisation of the intrinsic heat energy available in fuel or other medium or source from which thermal energy is derived.

The invention also includes within its scope an electrical machine including tubular electric
10 conductors adapted to be connected to a cooling fluid circuit.

The cooling fluid circuit may form part of a thermo-dynamic fluid circuit of a power plant.

For a clear understanding of the invention,
15 preferred embodiments will now be described purely by way of example with reference to the accompanying drawings in which:-

Figure 1 is a diagrammatic circuit diagram of a constant power output, closed cycle, thermodynamic

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turbo-electric power plant according to the invention.

Figure 2 is a sectional view of an aspirator in the fluid circuit of the power plant of figure 1.

5 Figure 3 is a diagrammatic sectional view of the dynamic compressive condenser means of the power plant of figure 1.

Figure 4 is a diagrammatic sectional representation of an A.C. alternator with tubular
10 stator windings, of the power plant of figure 1.

Figure 5 is a diagrammatic representation of the stator windings of the alternator of figure 4.

Figure 6 is a diagrammatic circuit diagram of a variable power output, closed cycle,
15 thermodynamic, turbo-electric power plant according to the invention.

Referring first to figures 1 to 5, the power plant comprises heating means A; thermodynamic turbine

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B which is located in a cooling chamber; electric alternator C which is located in an external cooling compartment, is provided with an internal cooling compartment and is drivingly coupled to
5 turbine B; compressor D which is also drivingly coupled to turbine B; compressive condenser means E; expansive evaporation cooling means F; and a load G for the alternator C.

The power plant also includes a plurality of fluid
10 lines or circuits for conveying working fluid and heat recovery fluid as will be described in greater detail below.

First fluid line 1 comprising portions 1a, 1b, 1c and 1d, extends from outlet 2 from the cooling
15 chamber of turbine B, through pump 33, through heating means A, through moisture trapping vessel 50, through aspirators 13 and 17, and communicates with a high pressure inlet 3 into turbine B. A second fluid line 4 comprising portions 4a, 4b and
20 4c, extends from low pressure outlet 5 from prime mover B through combining vessel 51, through condenser E and communicates with inlet 6 into the

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cooling chamber of turbine B. Third fluid line 7 branches off from second fluid line 4 downstream of condenser E at 8 and communicates with cooling means F through a reservoir 9 for working fluid, such as freon. Fourth fluid line 10 comprising portions 10a, 10b ...10h, extends from the bottom of the chamber 52 of cooling means F, through pump 32, through the tubular stator windings 12 and the external cooling compartment 11 of alternator C (figures 4 and 5), through evaporator vessel 53, liquid trap 54, compressor D, the upper region 52a of the chamber 52 of cooling means F, and through aspirator 13 (figure 2) to first fluid line 1. Aspirator 13 is located in a position between heating means A and turbine B and is operative to aspirate fluid from the fourth fluid line 10 into the first fluid line 1.

Heating means A comprises annular boiler chamber 26 in which liquid working fluid can be heated by fuel burner 27. Heating means A further includes in its flue a heat exchanger tube 59 which is connected in first fluid line 1 and acts as a

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preheating stage for liquid in boiler 26. Preheated liquid flowing from preheater tube 59 enters boiler chamber 26 tangentially towards its lower end at 60, the tangential entry into boiler chamber 26 serving to enhance circulation and heating of the working fluid in boiler chamber 26.

Heating means A further includes superheating heat exchanger tube 28 which communicates with the upper end of boiler chamber 26 at diametrically opposite zones 61a, 61b. Tube 28 acts as a superheater and conveys heated working fluid in gaseous form from the upper end of boiler chamber 26 and down the bore of annular boiler chamber 26, thereby to cause superheating of the working fluid by heat from fuel burner 27. It will be appreciated that preheater 59, boiler chamber 26 and superheater 28 forms part of the first fluid circuit 1.

As illustrated diagrammatically in figure 4, the stator windings 12 of alternator C comprise hollow electrical conductors of tubular configuration which constitute an internal cooling compartment

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or compartments within the alternator C, such cooling compartment being in communication with the external cooling compartment 11 surrounding alternator C. Both the internal and external
5 cooling compartments are connected in circuit with the fourth fluid line 10 between portions 10c and 10d.

Where the stator windings 12 of alternator C comprise star connected, 3-phase windings, the
10 fourth fluid line 10 may be connected at 10x to the interconnected star-point of the tubular windings as shown in figure 5, outer ends 12a of the windings opening directly into the interior of the external cooling compartment 11 which has an
15 outlet 11a communicating with the fourth fluid line at 10y.

The external cooling compartment 11 of alternator C communicates with the evaporator vessel 53 which communicates with an intermediate pressure side of
20 compressor D which, in turn, is located in the fourth fluid line 10 between alternator C and aspirator 13, so that during operation a low

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pressure atmosphere is created in the upper region 53a of evaporator vessel 53 to evaporate heated cooling fluid passing from alternator C and to draw the resultant vapour through compressor D and
5 through the upper region 52a of the chamber 52 of evaporator cooling means F which is in free communication with the suction inlet 15 of aspirator 13.

As shown in figure 2, aspirator 13 comprises
10 tubular body 14 which is connected in the first fluid line portion 1d. Tubular body 14 is provided with a constriction 14a intermediate its ends and a constricted high pressure inlet 14b. High pressure fluid flowing along the first fluid
15 line 1 passes through tubular body 14 at accelerated velocity. Aspirator 13 is also provided with a suction inlet 15 which is connected to the fourth fluid line portion 10h. A flow of high pressure working fluid through
20 tubular body 14 aspirates recovery fluid which is at lower pressure, from the fourth fluid line 10 into the first fluid line 1 and into the working fluid flowing along the first fluid line 1.

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Dynamic compressive condenser E is operative to condense condensable gaseous and/or vaporous fluid passing from the low pressure outlet 5 of turbine B and through combining vessel 51 along second 5 fluid line 4, by compression produced by kinetic motion imparted to the condensable fluid and by accompanying cooling.

The condenser E used in the plant of figure 1 is shown in full lines in figure 3. The additional 10 parts shown in chain dotted lines may be added for the plant of figure 6.

As shown in figure 3, condensor E comprises a tubular body 20 which is adapted to be connected in the second fluid line 4 and which includes a 15 constricted zone 20a intermediate its ends. Body 20 is provided with a first axially directed inlet nozzle 21a adapted to communicate with the combining vessel 51 in line with the low pressure outlet 5 from turbine B and has an outlet 21b 20 adapted to communicate with branch point 8.

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Condensor E also includes second axially directed inlet 22 located within first inlet nozzle 21a and adapted to communicate via a fifth fluid line 23 with the first fluid line 1 at 24 through liquid trap 50 in a position between the heating means A and aspirators 13, 17. Condenser E further includes a third inlet 25 into the zone around the first inlet 21a upstream of the constricted zone 20a of body 20. Third inlet 25 is adapted to communicate with the lower portion 52b of the chamber 52 of cooling stage F via portions 10a and 10a of the fourth fluid line 10 and connecting fluid line 62a.

High pressure fluid flow into body 20 through second inlet 22 aspirates condensable fluid passing from the low pressure outlet 5 of turbine B, through the combining vessel 50 and into tubular body 20 through its first inlet end 21a. Accelerated kinetic motion is imparted to the condensable fluid in constricted zone 20a of body 20 and the directional kinetic motion of the condensable fluid is converted into a pressurised

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condition in the enlarged zone 20b beyond
constricted zone 20a, thereby to compress and
condense the condensable fluid.

Cooled fluid from cooling means F is introduced
5 under pressure by pump 32 along the portions 10a,
10a of the fourth fluid line 10 and along
connecting line 62a into the body 20 in the zone
around first inlet 21a through the third inlet 25,
thereby to cool and further to compress by kinetic
10 motion the condensable fluid passing from the
outlet 5 of turbine B.

As shown in figure 3, tubular body 20 is provided
with an outlet 67 in the constricted zone 20a and
with an enclosure 68 around the constricted zone
15 20a and outlet 67. Liquid passing through
constricted zone 20a, particularly during starting
up of the plant, can drain through outlet 67 into
enclosure 68 and from there through outlet 69
which is provided with a flap-type non-return
20 valve 70 adapted to permit the outflow of liquid
from enclosure 68 but does not permit an inflow of

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fluid into enclosure 68.

In operation of the power plant, a first portion of condensed fluid which passes from condenser E, constitutes a working fluid which flows from
5 branch point 8 along the second fluid line portion 4c into the cooling chamber of turbine B which acts as a preheating stage which imparts heat to the working fluid during the process of the latter acting to cool the turbine B.

10 In order to maintain a predetermined liquid level in boiler 26, preheated working fluid is pumped by speed controlled pump 33 from the cooling chamber of turbine B along the first fluid line portions 1a and 1b to the pre-heating stage 59 of heating
15 means A which is connected in the first fluid line 1 and in which the working fluid is heated further in the flue of the heating means A by means of hot waste gases of combustion from fuel burner 27. Thereafter the working fluid is heated to a

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required operating temperature by fuel burner 27 in boiler 26 and superheater 28 which is also connected in the first fluid line 1. The working fluid is heated to its operating temperature by
5 the combustion in burner 27 of any suitable fuel supplied to it from fuel reservoir 29.

The heated working fluid flows from superheater 28 along the first fluid line portion 1c, through moisture trapping vessel 50 and through aspirators
10 13 and 17 into turbine B through its high pressure inlet 3 to rotatably drive the turbine in conventional manner.

Condensable fluid in gaseous and/or vaporous form flows from turbine B through its low pressure
15 outlet 5, through combining vessel 51 and along the second fluid line portion 4b to compressive condenser E where it is condensed to restart the operating cycle for driving turbine B.

Combining vessel 51 is connected by return line 55
20 through control valve 56 to the suction inlet of a further aspirator 17 which is similar to aspirator

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13 and which is connected in parallel with aspirator 13 in the first fluid line portion 1d in a position between moisture trapping vessel 50 and turbine B. Low pressure conditions are created in combining vessel 51 by further aspirator 17 which is operative under the influence of high pressure fluid flowing along the first fluid line 1 to aspirate part of the condensable exhaust fluid passing from turbine B through low pressure outlet 5, from combining vessel 51, along fluid return line 55, through control valve 56 and directly back into the first fluid line 1 for return to turbine B.

Branch line 57 connects the portion 4c of second fluid line 4 through control valve 58 to the interior of combining vessel 51. The low pressure conditions created in combining vessel 51 causes small quantities of condensed liquid to be drawn from second fluid line portion 4c into combining vessel 51 from where it is aspirated together with part of the condensable turbine exhaust fluid along return line 55 by aspirator 17 and into high

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temperature, superheated working fluid flowing to turbine B along fluid line 1. The condensed liquid evaporates in first fluid line 1 and increases the fluid volume flow into turbine B
5 even if the temperature of the working fluid is reduced slightly. The rate of flow of condensed fluid into combining vessel 51 may be controlled by means of valve 58 and the rate of aspiration of condensable turbine exhaust fluid and/or
10 condensed fluid from condenser E into fluid line 1 through aspirator 17 may be controlled by means of valve 56.

Turbine B is mechanically coupled to compressor D and alternator C so that upon rotation of turbine
15 B, it rotatably drives compressor D and alternator C.

A second portion of condensed fluid which passes from condenser E, constitutes a cooling or recovery fluid and flows from branch point 8, to
20 fluid reservoir 9 and from there along third fluid

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line 7 into the lower region 52b of the chamber 52 of cooling means F.

A flow of high pressure working fluid along the first fluid line 1 through aspirator 13, causes
5 aspiration of fluid along fourth fluid line portion 10h from the upper region 52a of the chamber 52 of cooling means F, thereby to create low pressure conditions in chamber 52 and cause evaporative cooling of the fluid.

10 Part of the cooled fluid flows under pressure of pump 32 from the lower region of cooling means F, along fourth fluid line portions 10a, 10b and along connecting line 62a, to the inlet 25 of condenser E for the cooling and compressive
15 condensation of condensable exhaust fluid passing from turbine B , as described above.

Another part of the cooled fluid flows along the fourth fluid line portions 10a, 10b and 10c, through the hollow stator windings 12 and the
20 external cooling compartment 11 of alternator C,

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through evaporator vessel 53, along fourth fluid line portion 10e, through liquid separator 54, along fourth fluid line portion 10f to compressor D and from there passes freely through the upper
5 region 52a of cooling means F, along fourth fluid line portion 10h to aspirator 13.

During the process of cooling alternator C, the recovery fluid absorbs low grade heat losses developed in the alternator and the recovered heat
10 content causes evaporation of recovery fluid in evaporator vessel 53.

Low pressure conditions are created in the upper region 53a of evaporator vessel 53 by suction along fourth fluid line portions 10e, 10f, 10g and
15 10h from the aspirator 13 which is connected in circuit with cooling means E and compressor D. This suction causes aspiration into the first working fluid line 1, of vapour which is produced in the upper region 53a of evaporator vessel 53 by
20 the heat content of recovery fluid contained in the lower region 53a of evaporator vessel 53.

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The recovery fluid also absorbs low grade heat generated by mechanical work performed during compression in compressor D. The low grade heat absorbed by the recovery fluid is introduced into
5 the heated working fluid flowing along the first fluid line 1 by the introduction of the recovery fluid into the first fluid line 1 through aspirator 13.

Other low grade waste heat and/or low grade reject
10 heat and/or random heat losses in the power plant or associated apparatus may be recuperated by recovery fluid and introduced with the recovery fluid from fourth fluid line 10 through aspirator 13 into heated working fluid flowing along the
15 first fluid line 1 as described above.

Thus, low grade heat loss in the bearings of turbine B and/or compressor D and/or alternator C may be recovered by providing heat exchanger 63 having a coil 63a which is connected in a closed
20 oil circulating circuit 64. Heated oil from bearing housings 37 is pumped by pump 65 along

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fluid line portions 64a, 64b of the oil circuit 64, through heat exchanger coil 63a, where the oil is cooled by cool recovery fluid. The cooled oil then flows along fluid line portion 64c to header 5 tank 66 and from there through oil filter 71, along fluid line portions 64d and back to bearing housings 37. Cool recovery fluid for cooling the oil in heat exchanger 63 flows from point 46 in the fourth fluid line 10, along portion 47a of a 10 sixth fluid line 47 which will be described below, along branch line portion 72a and through heat exchanger 63 where the recovery fluid absorbs low grade heat. Heated recovery fluid flows along branch line portion 72b into the lower region 53a 15 of evaporator vessel 53 which is connected in fourth fluid line 10.

Heated recovery fluid from heat exchanger 63 entering evaporator vessel 53 adds recovered heat to recovery fluid in evaporator vessel 53. Heated 20 recovery fluid which is now in vaporous form, is passed from evaporator vessel 53 along fourth fluid line portion 10e, through non-return valve

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73, through liquid separator 54, through compressor D and freely through the upper region 52a of chamber 52 of cooling means F and along fourth fluid line portion 10h for introduction
5 into the first fluid line through aspirator 13.

As shown in figure 1, alternator C is electrically connected through rectifier 39 to load G which comprises D.C. motor 40 and storage battery 41 which are connected in series with each other.
10 The series arrangement of motor 40 and battery 41 are connected through gate means 42 to motor torque control means 43.

Speed control means 44 is provided for regulating the electrical output of alternator C by
15 controlled variation of the magnitude of the electrical load imposed on alternator C, thereby to regulate rapidly to a constant value the running speed of the turbo-electric unit. The electrical load imposed on the alternator C may be
20 varied by varying the input power to battery 41 which is also connected to motor 40. It will be appreciated that the load G forms part of the

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turbine speed control system.

Additionally or alternatively, the speed of the turbo-electric unit may be regulated with a certain reaction time delay by arranging for
5 control means 44 also to regulate the operation of fuel control valve 45 of heating means A in accordance with the state of charge of storage battery 41, thereby to regulate the supply of fuel
10 input to the working fluid in heating means A by burner 27.

Turbine B may thus be controlled to run at substantially constant rotational speed and simultaneously at substantially constant power
15 output despite variations in the load on the storage battery 41. The fuel consumption and therefore the combustion rate of fuel can thus be maintained at a substantially constant value corresponding to an optimal utilization of the

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power plant and the connected storage load as a complete system.

Low grade waste heat and/or low grade reject heat and/or random heat losses from rectifier 39, motor 5 40, battery 41, gate means 42, motor torque control means 43 and speed control means 44 may be recuperated and reintroduced into the system by passing recovery fluid from the fourth fluid line 10 at point 46 in fluid line portion 10c, along a sixth fluid circuit 47 and through the cooling units 39a, 40a, 41a, 42a, 43a and 44a respectively for these components which constitute a cooling system H. Normally, the heat recuperated in the cooling system H is of a very low grade with the 15 result that the heated recovery fluid is likely to include a liquid component. In order to avoid or minimize erosion by liquid in the cooling system of alternator C and in compressor D, the heated recovery fluid from cooling system H is returned 20 along sixth fluid line portion 47b into the upper region 53a of the evaporator 53 where separation of vaporous and liquid components of the recovery

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fluid takes place. The vaporous component is then extracted along fourth fluid line portion 10e for introduction through liquid separator 54, compressor D, the upper region of the chamber 52
5 of cooling means F, along fourth fluid line portion 10h and through aspirator 13 into the first fluid line 1. The liquid component discharged into evaporator vessel 53 is subjected to an overall heat extraction effect under reduced
10 pressure conditions.

Many variations in detail of the power plant of figure 1 is possible without departing from the scope of the appended claims. Thus, under certain circumstances compressor D may be omitted, or may
15 be replaced by an expander or by additional aspirator units similar to items 13 and 17.

A fuel pre-heater 74 may be provided in heating means A in the fuel supply line 75 from fuel reservoir 29 to fuel burner 27. As a safety
20 feature, a normally open, electrically operable, emergency fuel shut-off valve 76a may be provided

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in fuel supply line 75.

For rapid starting of the power plant, an outer annular boiler chamber 77 with an electric immersion heating element 78, may be provided
5 round boiler chamber 26 of heating means A. A normally open starting switch 79 in an electric supply circuit to immersion heating element 78 is closed to energise heating element 78 and cause evaporation in chamber 77 of liquid introduced
10 from evaporator vessel 53 along fluid line 88. Closure of starting switch 79 also starts pump 32 in fourth fluid line 10 to fill at least partially the evaporator vessel 53, start-up boiler chamber 77 and also main boiler chamber 26 along fluid
15 line portion 62a, through condenser E, along fluid line portion 4c, through the cooling chamber of turbine B and along fluid line portions 1a and 1b. Closure of starting switch 79 also causes ignition of fuel burner 27 to heat working fluid
20 in main boiler chamber 26.

A build up of vapour pressure in start-up boiler chamber 77 when the liquid therein is heated by

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heating element 78, causes closure of non-return
valve 89 in the bottom of boiler chamber 77 and of
non-return valve 73 in fourth fluid line portion
10e, thereby to supply vapour under pressure along
5 fluid line 80, through liquid separator 54 and
along fourth fluid line portion 10f to compressor
D which acts as an expander, thereby to rotate
compressor D. Rotation of compressor D causes
rotation of turbine B to draw heated working fluid
10 for driving turbine B, from heating means A along
first fluid line portions 1c and 1d and into the
high pressure input 3 of turbine B.

Moisture trapping vessel 50 in first fluid line 1
also serves as an emergency pressure equalising
15 chamber, as well as an emergency condensing
chamber in the event of a loss of full load.
During emergency run-away conditions, fuel
shut-off valve 76a closes the fuel supply;
normally closed valve 76b opens to cool the
20 superheated working fluid with cooling liquid from
cooling means F flowing along fourth fluid line
portions 10a, 10a and branch line portions 62a,

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62b; and normally closed valve 76c opens to discharge the emergency condensate and cooling liquid. The high and low pressure sides of turbine B are accordingly equalised and the
5 residual heat is dispensed in the cooling system. Under normal operating conditions the collected moisture level cannot rise above the opening in vessel 50 at point 24 which communicates with the fifth fluid line 23.

10 As described above, combining vessel 51 may be utilised in conjunction with valve 58 in branch line 57 to adjust the turbine operating temperature and flow conditions, by introducing small quantities of liquid through aspirator 17
15 into first fluid line 1 to adjust the degree of superheat or dryness of the working gas or vapour. This also provides means for improving the efficiency of energy conversion by introducing flash vapour droplets into the superheated fluid
20 in first fluid line 1 via the aspirator 17 to increase the volume flow through the turbine.

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Another way of looking at this procedure is that it represents a method of adding low grade heat at the highest possible temperature, namely at superheat temperature and not at boiling
5 temperature.

Heater exchanger 63 in the oil circulation circuit 64 may comprise a counter flow heat exchanger. This heat exchanger has the advantage that it completely isolates the oil from the recovery
10 fluid to avoid oil contamination of the latter.

The header tank 66 in the oil circulation circuit 64 accumulates a small reserve of oil so that short term failure of oil pump 65 can be tolerated without damage to the bearings.

15 Evaporator vessel 53 also acts as a liquid trap and provides low grade heat recovery via fourth fluid line portions 10e and 10f and compressor D, the vapour thereby doing positive work on the way to the main evaporator constituted by chamber 52
20 of cooling means F.

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During normal operation valve 82 is opened slightly to recover heat along fluid line 80 from outer boiler chamber 77 which then serves as a shielding jacket round heating means A.

- 5 Fuel control valve 45 of fuel burner 27 may be fitted with a small servo-motor 83 to allow automatic adjustment of control valve 45 under the influence of speed control means 44 of alternator C.
- 10 Pump 33 in first fluid line 10 may also be provided with a servo-motor control 84 which is operated under the influence of fluid level senser 84a in boiler 26.

- Control valve 85 in fourth fluid line portion 10b
- 15 may likewise be controlled by a servo-motor 86 to control the liquid level in outer start-up boiler chamber 77 and in evaporator vessel 53 as dictated by float valve 87. The liquid level in evaporator vessel 53 and in boiler chamber 77 may be
- 20 controlled by the opening and closing of control

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valve 85 which regulates the flow of cool condensed fluid along fourth fluid line portions 10b, 10c and 10d to evaporator vessel 53 and along equalising fluid line 88 to boiler chamber 77.

5 Liquid separator 54 may be arranged for accumulated liquid therein to be bled off continuously through small orifice 87 into evaporator cooling means F. Should the level of liquid in evaporator vessel 53 rise unduly and
10 liquid overflow into liquid separator 54, the normally closed magnetic valve 87a will open fully, thereby rapidly to drain the separator 54 through valve 87a into cooling means F.

Equalising fluid line 34 may be connected across
15 the suction inlets to aspirators 13 and 17.

Referring now to figure 6, the variable power output plant illustrated in this figure is in many respects similar to the constant power output plant of figure 1 and like parts are indicated by

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like reference numerals in figures 1 and 6.

The plant of figure 6 provides a system for utilising a dual component working fluid. This may have certain advantages. For example, the
5 problem of chemical dissociation of the freons at elevated temperatures may be overcome or at least minimized by utilising a fluid component of relatively high density which is suitable for use at high temperatures, which is combined or mixed
10 with a more volatile fluid component of less density and a lower evaporation temperature. It may also be advantageous to separate partially or wholly the liquid phase components after condensation. For this purpose, the separating
15 compressive condenser means El of figure 6 may be used.

The condenser means El of figure 6 is identical to the condenser means E of figure 1 as illustrated in full lines in figure 3 with the
20 addition of the parts shown in chain dotted lines which may replace working fluid reservoir of

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figure 1. The additional parts comprise a pair of axially extending spiral shaped deflection plates 114 in the enlarged zone 20b to impart a rotational movement to condensed fluid emerging
5 from constricted zone 20a of body 20. The rotational speed of the condensed fluid is increased by the introduction of high pressure vapour or gas through tube 115 into annular chamber 116 round body 20. A series of
10 circumferentially spaced apertures 117 are provided through the wall of body 20 within chamber 116 and are disposed as nearly as possible tangentially with respect to the wall of body 20 so that generally tangentially directed high
15 pressure jets of vapour or gas are injected into the enlarged zone 20b of body 20.

The rotation of the condensed fluid separates centrifugally the two constituent components (which differ in specific gravity) into a less
20 dense, more volatile component and a more dense, less volatile component. The more volatile component passes from body 20 through

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central outlet duct 21c which communicates via
third fluid line 7 with the lower region 112b of
the first stage compartment 112 of two stage
expansive evaporation cooling means F1. The more
5 dense, less volatile component passes from body 20
through the outer annular zone 21d of outlet 21b,
which is located round central outlet duct 21c.
Annular outlet zone 21d communicates via second
fluid line portion 4c with inlet 6 into the
10 cooling chamber of turbine B. The more dense,
less volatile component of the working fluid
passes through the cooling chamber of turbine B,
through the cooling chamber outlet 2 and is pumped
along first fluid line 1 to heating means A1 by
15 pump 33.

Part of the more dense, less volatile component of
the working fluid is also contained in the second
stage compartment 113 of cooling means F1 and is
circulated through fourth fluid line 10 and any
20 other heat recovery circuits such as 120 and 121,
as recovery fluid.

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Instead of being fuel burning means, the heating means A1 of figure 6 comprise electric boiler 90 which acts as a preheating stage and electric superheater 91 adapted to heat the more dense,
5 less volatile component of the working fluid flowing along the first fluid circuit 1 to a required operating temperature and pressure.

Vessel 107 serves as a liquid trap in first fluid circuit 1 and also as an emergency condensor
10 during overspeed conditions during which normally closed electromagnetic valve 108a opens to release pressurised cooling liquid from fourth fluid line 10 along release line 109 into vessel 107. Simultaneously, normally closed electromagnetic
15 valve 108b opens to allow condensate to drain along drainage line 110 through vessel 111 in the second fluid line 4, and along second fluid line portion 4b to condenser means E1.

The upper region 112a of the first stage
20 compartment 112 of cooling means F1 communicates with the suction inlet 17a into aspirator 17 which

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is connected in first fluid line 1 so that low pressure conditions are created in the upper region 112a of first stage cooling compartment 112 under the influence of a flow of high pressure
5 working fluid through aspirator 17 along first fluid line 1. The more volatile, low density component of the working fluid in the lower region 112b of first stage cooling compartment 112 is evaporated in the low pressure atmosphere in the
10 upper region 112a and the vapour is aspirated by aspirator 17 into the high pressure working fluid flowing along first fluid line 1 to turbine B.

The fourth fluid line 10 extends from the lower region 113b of the second stage compartment of
15 cooling means F1, through pump 32 to the external cooling compartment 11 and tubular stator windings 12 (figures 4 and 5) of alternator C, through the upper region 113a of second stage cooling compartment 113, through compressor D and through
20 aspirator 13 to the first fluid line 1. Low pressure conditions are created in the upper

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region 113a of second stage cooling compartment 113 under the influence of a flow of high pressure working fluid through aspirator 13 along first fluid line 1.

5 The less volatile, high density component of the working fluid and remnants of the more volatile, low density component which are contained in the lower region 113 of the second stage compartment 113 of cooling means F1 are evaporated in the low
10 pressure atmosphere in the upper region 113a and are aspirated by aspirator 13 into the high pressure working fluid flowing along fluid line 1 to turbine B.

The remaining evaporatively cooled fluid in the
15 lower region 113b of second stage cooling compartment 113 is circulated by pump 32 as heat recovery fluid to all the components of the system where cooling is required and is returned to the second stage compartment 113. The warm recovery
20 fluid returning to second stage compartment 113 contains low grade waste heat and/or low grade

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reject heat and/or low grade reject heat and/or random loss heat.

The first stage compartment 112 of the cooling means F1 includes a heat exchanger fluid circuit
5 92 for the introduction of very low grade heat into the system from an external source, by circulating low temperature heated fluid through fluid circuit 92.

Under the action of low grade heat flux introduced
10 through heat exchanger 92, the more volatile, low density component of the working fluid is caused to vaporise by virtue of the low pressure conditions prevailing in the first stage compartment, thereby releasing the more volatile
15 component of the condensate. The less volatile, more dense component of the working fluid returns to second stage compartment 113 since all the cooling return lines (i.e. the heat recovery return lines) communicate with second stage
20 compartment 113. The interiors of the first and second stage compartments 112 and 113 are in communication with each other via aperture 114 in

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the lower region of the partition between the two compartments. This allows a liquid interchange to a limited extent, whereby the liquid levels in the two compartments may equalise to some extent.

5 Oil chamber/s 37 is/are connected by oil line 64, through oil circulating pump 65, heat exchanger 63, header tank 54 to form a closed oil circuit. Fourth fluid line 10 supplying pressurised cooling fluid at point 94 is connected to the heat
10 exchanger vessel. Vaporised fluid is extracted at point 38 for return to second stage cooling compartment 113 along fluid line portion 72b. The electric loads G1 which are connected to alternator C by leads 95 comprise electric boiler
15 90 and electric superheater 91 of heating means A1 and also battery 41 and electric heater 96 of thermal accumulator 97. Battery 41 is connected to alternator C through rectifier 39.

Thermal accumulator 97 further comprises a fluid
20 tight casing 98 within which is contained a mass

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99 of glauber salts, fused eutectic materials or any other suitable material which has the characteristic of being able to store and release heat in a manner which may be controllable by
5 variation of pressure applied to the material. A conduit 100 with a control valve 101 is provided for introducing into and releasing from the interior of casing 98 a fluid under pressure in order to control the accumulation and release of
10 heat by the mass 99 of glauber salts or the like.

Thermal accumulator 97 further includes a heat exchanger fluid circuit 102 which is located in the mass 99 of glauber salts or the like and is connected in the first fluid line 1 between the
15 hot outlet 2 from the cooling chamber of turbine B and the heating means A1.

During operation of the power plant of figure 6, electric output from alternator C is utilized to controllably energize electric boiler 90 and/or
20 superheater 91 of heating means A1 through semi-conductor control elements 104 and 105

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respectively, and also to charge battery 41 through controlled rectifier 39. Electric output from alternator C is also controllably applied to energize electric heater 96 of thermal accumulator 5 97 through semi-conductor control elements 106, thereby to heat the mass 99 of glauber salts or the like.

By means of control valve 101, the fluid pressure on the mass 99 of glauber salts can be regulated 10 as required to control the accumulation by the mass 99 of heat supplied to it by electric heater 96 and the release of accumulated heat by the mass 99 to working fluid flowing in the first fluid circuit 1 as it passes through the heat exchanger 15 fluid circuit 102 of thermal accumulator 97. The working fluid which flows along the first fluid line 1 and which has been preheated in the cooling chamber of turbine B, can thus be preheated further in thermal accumulator 97 in a controlled 20 manner according to requirements, on the way to heating means A1 where it is heated further to a required operating temperature.

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The power plant of figure 6 is not controlled for constant power output from the turbine B or the plant as a whole. The rotational speed of the turbo-alternator is regulated to a constant value
5 by controlled power absorption in storage battery 41 and/or in thermal accumulator 97.

An electric power output from the plant can be obtained along lead 103 connected to battery 41.

The power plant of figure 6 is largely self
10 sufficient in regard to its energy requirements and whatever extraneous energy it requires to maintain the operational cycle may be supplied as low grade heat energy via the heat exchanger fluid circuit 92 in the first stage compartment 112 of
15 cooling means F1.

Many variations in detail are possible without departing from the spirit of the invention.

The invention includes within its scope dynamic compressive condenser means including a tubular

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body provided with a constricted zone intermediate
its ends; a first inlet for condensable fluid
located in the interior of the body in the
proximity of the constricted zone; and a second
5 inlet located within the first inlet, fluid flow
into the first inlet through the second inlet
being operative to aspirate condensable fluid into
the tubular body through the first inlet and
impart kinetic motion to the condensable fluid in
10 the constricted zone, the kinetic motion being
converted into a pressure condition in an enlarged
zone in the body beyond the constricted zone.

The first inlet into the tubular body may comprise
an axially directed inlet nozzle.

15 The second inlet into the tubular body may also
comprise an axially directed inlet nozzle located
within the first nozzle.

The tubular body may include a third inlet for
cool fluid into the zone about the first inlet, a
20 flow of cool fluid into the body through the third
inlet being operative to cause cooling and further
compression by kinetic motion of condensable fluid

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within the body.

The body may include an outlet for liquid. The outlet may be located in the constricted zone.

An enclosure may be provided around the outlet.

- 5 The enclosure may include an outlet and a non-return valve operative to permit an outflow of fluid from the enclosure but prevent an inflow of fluid into the enclosure.

- 10 The invention also includes within its scope fluid heating means including an upright cylindrical boiler chamber adapted to be heated; and a tangential fluid inlet into the boiler chamber in a lower region thereof.

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CLAIMS:

1. A method of operating a closed cycle power plant including the steps of heating a working fluid to an operating temperature; and utilizing a flow of heated working fluid
5 to drive a thermodynamic prime mover and thereby to drive associated plant; characterised in that low grade waste heat and/or low grade reject heat and/or low grade random heat losses from the prime mover
10 and/or associated plant and/or other associated apparatus is utilized to heat a recovery fluid; and heated recovery fluid is introduced into heated working fluid flowing to the prime mover in a position upstream of
15 the prime mover.
2. A method as claimed in claim 1, characterised in that the recovery fluid comprises a fluid which is physically and/or chemically different from but compatible with the
20 working fluid.

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3. A method as claimed in claim 1, characterised in that the recovery fluid is derived or extracted wholly or partially from the working fluid.
- 5 4. A method as claimed in any one of the preceding claims, characterised in that the heated working fluid is at a higher temperature and pressure than the heated recovery fluid and a flow of the heated
10 working fluid is utilized to aspirate the heated recovery fluid into the heated working fluid.
5. A method as claimed in any one of the preceding claims, characterised in that at
15 least part of the condensable fluid passing from the prime mover is condensed by compression produced by kinetic motion imparted to the condensable fluid.

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6. A method as claimed in claim 5, characterised
in that part of the condensable fluid passing
from the prime mover and/or at least part of
the condensed fluid is introduced into the
5 heated working fluid in a position upstream
of the prime mover.
7. A method as claimed in claims 5 or 6,
characterised in that at least part of the
condensed fluid is utilized to cool the prime
10 mover.
8. A method as claimed in claims 5 to 7,
characterised in that at least part of the
condensed fluid is cooled by expansive
evaporation.
- 15 9. A method as claimed in any one of the
preceding claims, characterised in that at
least part of condensable fluid passing from
the prime mover and/or at least part of
cooled condensed fluid constitutes or
20 comprises recovery fluid for recuperating low
grade waste heat and/or low grade reject heat
and/or low grade random heat losses.

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10. A method as claimed in any one of the preceding claims, characterised in that the operating speed and/or the power output of the prime mover is controlled by regulating the magnitude of a load applied to the prime mover and/or by regulating the heat input to the working fluid and/or by introducing condensed fluid into heated gaseous or vaporous working fluid upstream of the prime mover.
11. A method as claimed in claim 10, characterised in that the operating speed and the power output of the prime mover is controlled to substantially constant values, the prime mover and associated plant comprising a turbo-electric unit including electric generating means adapted to feed into a load, the load applied to the electric generating means and/or the heat input to the working fluid being adapted to be regulated in accordance with the speed and/or electrical output of the generating means.

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12. A closed cycle power plant characterised by heating means; a thermodynamic prime mover; a cooling chamber in and/or round the prime mover; electric generating means drivingly coupled to the prime mover; a cooling chamber in and/or round the generating means; condenser means; cooling means; a first fluid line or circuit extending from an outlet from the cooling chamber of the prime mover through the heating means and communicating with a high pressure inlet into the prime mover; a second fluid line or circuit extending from a low pressure outlet from the prime mover through the condenser means and communicating with an inlet into the cooling chamber of the prime mover; a third fluid line or circuit branching off from the second fluid line or circuit downstream of the condenser means and communicating with the cooling means; and a fourth fluid line or circuit extending from the cooling means to the cooling chamber of the generating means and from there to the first fluid line or circuit in a position between the heating means and the prime mover; and means operative to introduce fluid from the fourth fluid line or circuit into the first fluid line or circuit.

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13. A power plant as claimed in claim 12,
characterised in that aspirator means is
provided to aspirate fluid from the fourth
fluid line or circuit into the first fluid
5 line or circuit.

14. A power plant as claimed in claim 12 or 13
characterised by a branch line or circuit
which communicates with the second fluid line
or circuit in a position between the
10 condenser means and the cooling chamber of
the prime mover and is adapted to communicate
directly or indirectly with the return line
to permit condensed fluid to be introduced
into the first fluid line ahead of the prime
15 mover.

15. A power plant as claimed in any one of claims
12 to 14, characterised in that the cooling
means comprises expansive evaporation cooling
means.

20 16. A power plant as claimed in any one of claims
12 to 15, characterised in that the condenser
means comprises dynamic compressive condenser
means.

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17. A power plant as claimed in claim 16,
characterised in that the compressive
condenser means comprises a tubular body; a
first inlet into the body communicating with
5 the low pressure outlet from the prime mover
via portion of the second fluid line; a
second inlet into the body communicating via
a fifth fluid line with the first fluid line
in a position between the heating means and
10 the prime mover, fluid flow through the
second inlet being operative to aspirate
condensable fluid passing from the prime
mover through the first inlet into the
tubular body and to compress such condensable
15 fluid by converting its directional kinetic
motion into a pressurised condition; and
a third inlet into the body communicating
with the cooling means, cooled fluid
introduced under pressure through the third
20 inlet being operative to cool and further to
compress by kinetic motion the condensable
fluid passing from the prime mover.

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18. A power plant as claimed in claim 17, characterised in that the tubular body includes means operative centrifugally to separate condensed fluid comprising at least two components of different density and volatility into its components; and at least two outlets, the one outlet being connected to the second fluid line or circuit and operative to pass a more dense and less volatile component along the second fluid line to the inlet into the cooling chamber of the prime mover and the other outlet being connected to the third fluid line and operative to pass a less dense and more volatile component along the third fluid line to the cooling means.
19. A power plant as claimed in any one of claims 12 to 18, including a load which is electrically connected to the output of the electric generating means, characterised in that the load includes and/or constitutes an energy storage or accumulator system.

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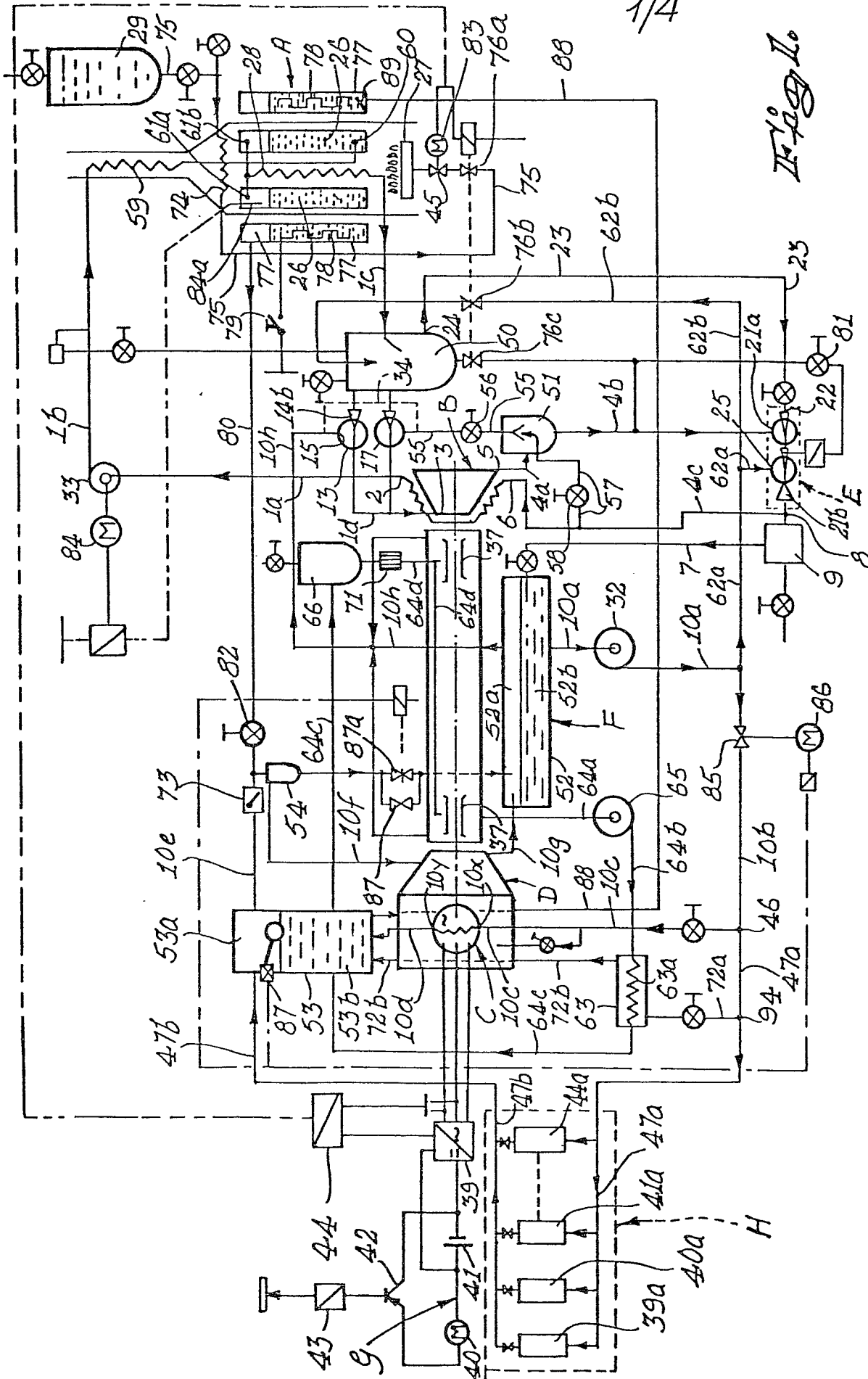
20. A power plant as claimed in any one of claims 12 to 18, including a load connected to the output of the electric generating means, characterised in that the load comprises an electric motor and/or energy accumulator means and/or power conversion means.
21. A power plant as claimed in any one of claims 12 to 20, characterised by control means operative to regulate the operating speed and/or the power output of the prime mover.
22. A power plant as claimed in claim 21, wherein the control means is adapted to vary the heat input to working fluid flowing along the first fluid line.
23. A power plant as claimed in claim 21 characterised in that the control means is adapted to vary a load on the prime mover in accordance with the output of the generating means.

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24. An electrical machine characterised by tubular electric conductors adapted to be connected to a cooling fluid circuit.
- 5 25. Dynamic compressive condenser means, characterised by a tubular body provided with a constricted zone intermediate its ends; a first inlet for condensable fluid located in the interior of the body in the proximity of the constricted zone; a second inlet
10 located within the first inlet, fluid flow into the first inlet through the second inlet being operative to aspirate condensable fluid into the tubular body through the first inlet and impart kinetic motion to the condensable
15 fluid in the constricted zone, the kinetic motion being converted into a pressure condition in an enlarged zone in the body beyond the constricted zone.
- 20 26. Condenser means as claimed in claim 25 characterised in that the tubular body includes means operative to separate condensed fluid comprising two components of different densities into its components; an outlet from the body for the less dense
25 component; and a further outlet for the more dense component.

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Fig. 10



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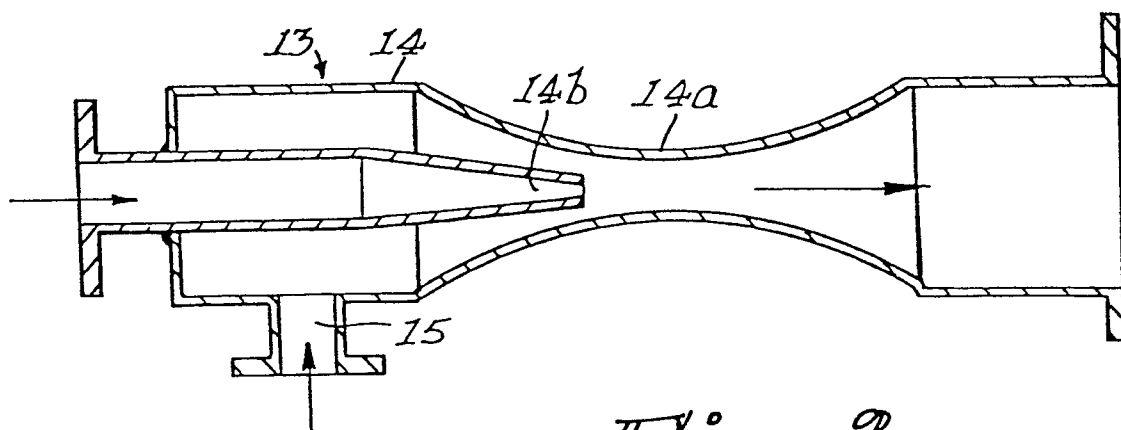


Fig. 2.

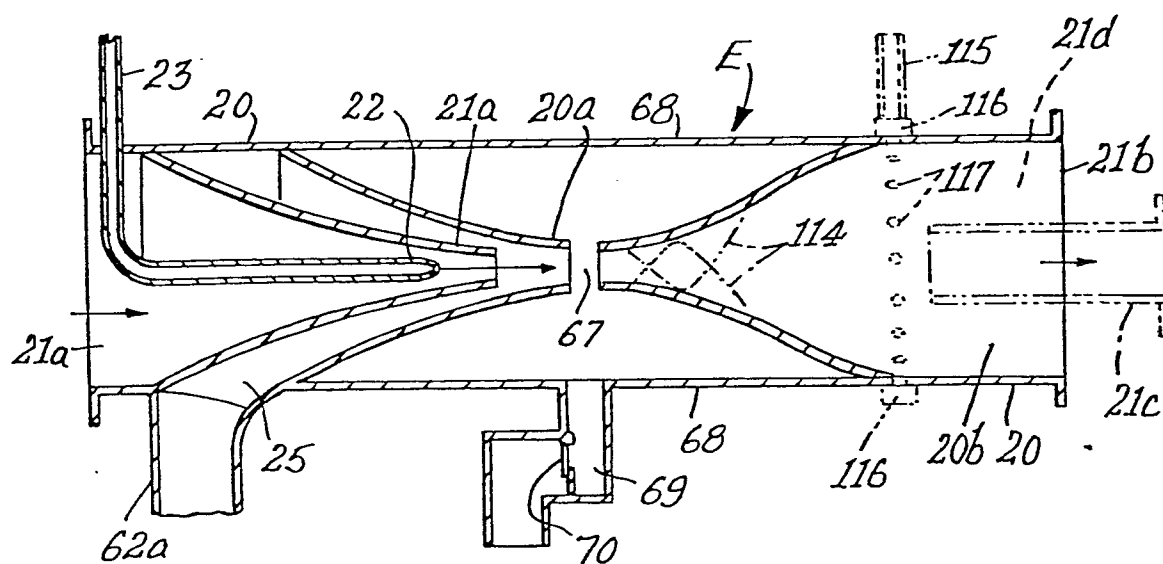


Fig. 3.

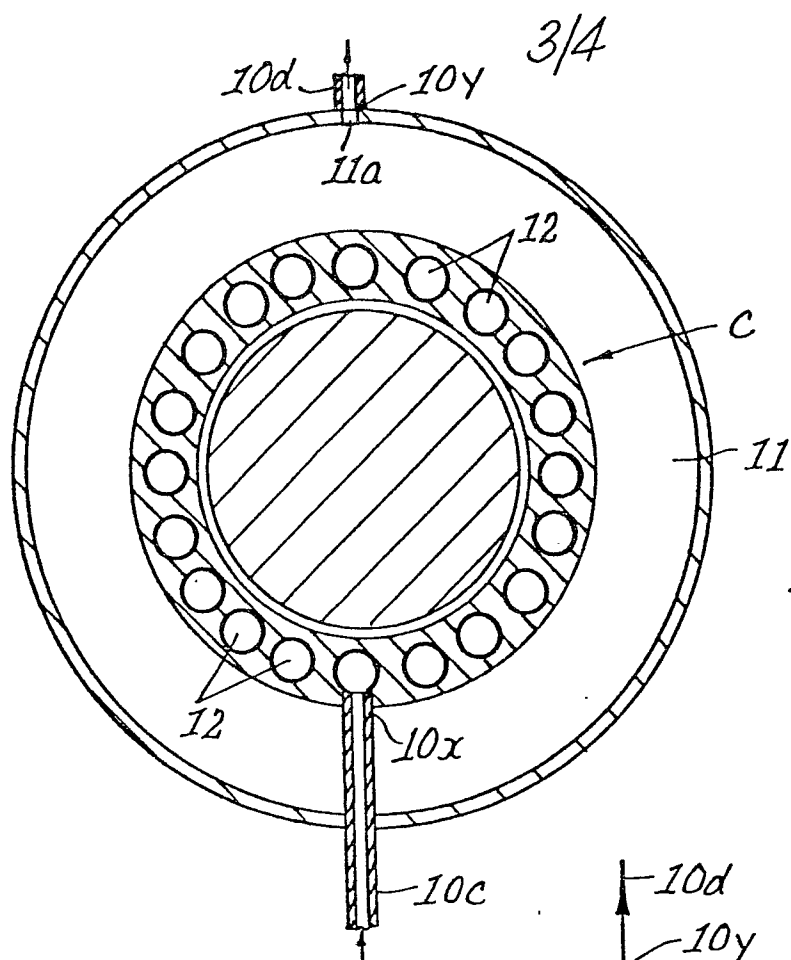


Fig. 4.

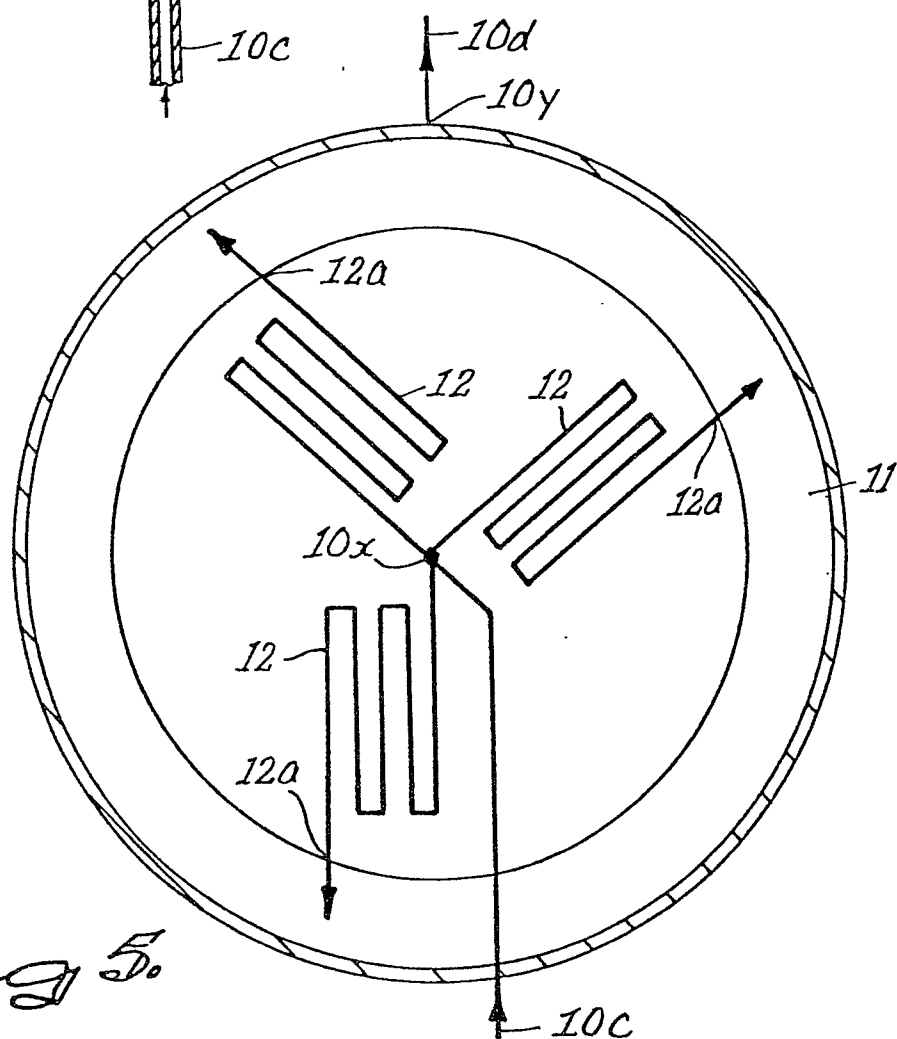


Fig. 5.

