INTERNATIONAL STANDARD

ISO 3977-1

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Gas turbines — Procurement —

Part 1: General introduction and definitions

Turbines à gaz — Spécifications pour l'acquisition —

Partie 1: Introduction générale et définitions

Reference number
ISO 3977-1:1997(E)

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 3977-1 was prepared by Technical Committee TC 192, *Gas turbines.*

This first edition of ISO 3977-1, together with subsequent parts, cancels and replaces ISO 3977:1991, which has been technically revised.

ISO 3977 consists of the following parts, under the general title: *Gas turbines – Procurement*

— *Part 1: General introduction and definitions*

— *Part 2: Standard reference conditions and ratings*

— *Part 3: Basic requirements for mechanical drive and electric drive*

— *Part 4: Packaging and auxiliary equipment*

— *Part 5: Controls and instrumentation*

Further parts are in preparation.

Annex A of this part of ISO 3977 is for information only.

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Introduction

ISO 3977 provides technical information to be used for the procurement of gas turbine systems, including combined-cycle systems and their auxiliaries, by a purchaser from a manufacturer.

NOTE — Where the term "manufacturer" is used in this International Standard, it is deemed to mean the gas turbine manufacturer or the appropriate responsible contractor.

This International Standard provides a basis for the submission of proposals in line with the different environmental and safety requirements. It also specifies, wherever possible, criteria to establish whether these are met. It does not attempt to deal with local or national legal requirements to which the installation may be required to conform.

Because of the very widely varying operating modes for gas turbines in practice, distinct categories of operating modes are specified with which a "standard" rating can be associated. These ratings are made on the basis of the ISO standard ambient reference conditions.

The various parts of ISO 3977 define a standard framework for dealing with questions of fuel and other matters, such as the minimum information to be provided by both the purchaser and the manufacturer. They do not, however, purport to include all necessary information for a contract and each gas turbine installation should be considered in its entirety. Attention is drawn to the need for technical consultation between the manufacturer and the purchaser to ensure compatibility of equipment being supplied, particularly where the responsibility for supply is divided.

ISO 3977 is applicable to open-cycle gas turbine power plant using combustion systems, and to closed-cycle, semiclosed-cycle and combined-cycle gas turbine power plants. In the case of turbines using free piston gas generators or special heat sources (e.g. chemical process, nuclear reactors, furnaces for super-charged boilers), it may be used as a basis but will need to be suitably modified.

This International Standard is not applicable to gas turbines used to propel aircraft, road construction and earth-moving machines, agricultural and industrial types of tractors and road vehicles.

Gas turbines — Procurement —

Part 1:
General introduction and definitions

1 Scope

This part of ISO 3977 groups together the terms and definitions given in ISO 11086 that are relevant to the procurement of gas turbine systems, and defines additional terms.

2 Definitions

For the purposes of all parts of ISO 3977, the following definitions apply.

2.1
gas turbine
Machine which converts thermal energy into mechanical work; it consists of one or several rotating compressors, a thermal device(s) which heats the working fluid, one or several turbines, a control system and essential auxiliary equipment. Any heat exchangers (excluding waste exhaust heat recovery exchangers) in the main working fluid circuit are considered to be part of the gas turbine.

NOTE — Examples of gas turbine systems are shown in figures 1 to 9.

2.2
gas turbine power plant
Gas turbine engine and all essential equipment necessary for the production of power in a useful form (e.g. electrical, mechanical or thermal). [ISO 11086]

2.3
open cycle
Thermodynamic cycle in which the working fluid enters the gas turbine from the atmosphere and is discharged into the atmosphere. [ISO 11086]

2.4
closed cycle
Thermodynamic cycle having a recirculating working fluid independent of the atmosphere. [ISO 11086]

2.5
semiclosed cycle
Thermodynamic cycle utilizing combustion in a working fluid that is partially recirculated and partially exchanged with atmospheric air. [ISO 11086]

2.6
simple cycle
Thermodynamic cycle consisting only of successive compression, combustion and expansion. [ISO 11086]

2.7
regenerative cycle
Thermodynamic cycle employing exhaust heat recovery, consisting of successive compression, regenerative heating, combustion, expansion and regenerative cooling (heat transfer from the exhaust to the compressor discharge fluid) of the working fluid. [ISO 11086]

2.8
intercooled cycle
Thermodynamic cycle employing cooling of the working fluid between stages of successive compression. [ISO 11086]

2.9
reheat cycle
Thermodynamic cycle employing the addition of thermal energy to the working fluid between stages of expansion.

2.10
combined cycle
Thermodynamic cycle employing the combination of a gas turbine cycle with a steam or other fluid Rankine cycle.

NOTES

1 In a common example, the gas turbine exhaust heat is used to generate steam for the Rankine cycle.

2 The superior thermal performance of this cycle is due to a combination of the best thermodynamic attributes of each cycle, namely the addition of thermal energy at higher temperatures in the gas turbine cycle and the rejection of thermal energy at lower temperatures in the Rankine cycle.

[ISO 11086]

2.11
single-shaft gas turbine
Gas turbine in which the compressor and turbine rotors are mechanically coupled and the power output is taken either directly or through gearing.

2.12
multi-shaft gas turbine
Gas turbine combination including at least two turbines working on independent shafts.

NOTE — The term includes cases referred to as compound and split-shaft gas turbines.

2.13
bled gas turbine
Gas turbine which has, for external use, extraction of compressed air between compressor stages and/or at the discharge of the compressor, or extraction of hot gas at the inlet of the turbine and/or between turbine stages.

2.14
gas generator
Assembly of gas turbine components that produces heated pressurized gas to a process or to a power turbine.

NOTE — It consists of one or more rotating compressor(s), thermal device(s) associated with the working fluid, and one or more compressor-driving turbine(s), a control system and essential auxiliary equipment.

[ISO 11086]

2.15
compressor
That component of a gas turbine which increases the pressure of the working fluid.

2.16
turbine
Term which when used alone refers to the turbine action only. It is that component of the gas turbine which produces power from expansion of the working fluid.

2.17
power turbine
Turbine having a separate shaft from which output is derived.

2.18
combustion chamber (primary or reheat)
Heat source in which the fuel reacts to increase directly the temperature of the working fluid.

2.19
working fluid (gas or air) heater
Heat source in which the temperature of the working fluid is increased indirectly.

2.20
regenerator/recuperator
Different types of heat-exchanger, transferring heat from the exhaust gas to the working fluid before it enters the combustion chamber.

2.21
precooler
Heat-exchanger or evaporative cooler which reduces the temperature of the working fluid prior to its initial compression. [ISO 11086]

2.22
intercooler
Heat-exchanger or evaporative cooler (spray intercooler) that reduces the temperature of the working fluid between stages of compression. [ISO 11086]

2.23
overspeed trip
Control or trip element which immediately activates the overspeed protection system when the rotor speed reaches a preset value. [ISO 11086]

2.24
control system
General system used to control, protect, monitor and report the condition of the gas turbine in all of its modes of operation.

NOTE — This includes starting control systems, governor and fuel control systems, speed indicator(s), gauges, electrical supply controls and other controls necessary for the orderly startup, stable operation, shutdown, tripping and/or shutdown for abnormal conditions and standby operation.

[ISO 11086]

2.25
governing system
Control elements and devices for the control of critical parameters such as speed, temperature, pressure, power output, etc.

2.26
fuel governor valve
Valve or any other device operating as a final fuel-metering element controlling the fuel input to the gas turbine.

NOTE — Other means of controlling the fuel flow to the turbine are possible.

2.27
fuel stop valve
Device which, when actuated, shuts off all fuel flow to the combustion system.

2.28
dead band
Total range through which an input can be varied with no resulting measurable corrective action of the fuel flow controller. In the case of speed, dead band is expressed in percent of rated speed.

2.29
governor droop
Steady-state speed changes produced by the change of output from zero to the rated output, expressed as a percentage of the rated speed.

2.30
overtemperature detector
Primary sensing element that is directly responsive to temperature and which immediately activates, through suitable amplifiers or converters, the overtemperature protection system when the temperature reaches a preset value. [ISO 11086]

2.31
fuel specific energy (calorific value)
Gross specific energy is the total heat released per unit mass of fuel burned, expressed in kilojoules per kilogram. The net specific energy is the gross specific energy less the heat absorbed by the vaporized water formed during combustion. It is expressed in kilojoules per kilogram.

2.32
heat rate
Ratio of the net fuel energy supplied per unit time to the net power produced in kilojoules per kilowatt hour [kJ/(kW·h)]. [ISO 11086]

NOTE — The rate is based on the net specific energy of the fuel including the sensible heat above 15 °C (see also ISO 2314:1989, 8.2.3).

2.33
specific fuel consumption
Ratio of the mass flow of fuel to the net power output in kilograms per kilowatt hour [kg/(kW·h)] of the specified fuel. [ISO 11086]

2.34
thermal efficiency
Ratio of the net power output to the heat consumption based on the net specific energy of the fuel.

NOTE — See also ISO 2314:1989, 8.2.2 and 8.3.3 e).

2.35
reference turbine inlet temperature
Mean temperature of the working fluid immediately upstream of the first stage stator vanes.

NOTE — For method of determination, see ISO 2314:1989, 8.6.

2.36
self-sustaining speed
Minimum speed at which the gas turbine operates, without using the power of the starting device, under the most unfavourable ambient conditions.

2.37
idling speed
Speed designated by the manufacturer at which the turbine will run in a stable condition and from which loading or shutdown may take place.

2.38
maximum continuous speed
Upper limit of the continuous operating speed of the gas turbine output shaft.

2.39
rated speed
Speed of the gas turbine output shaft at which the rated power is developed.

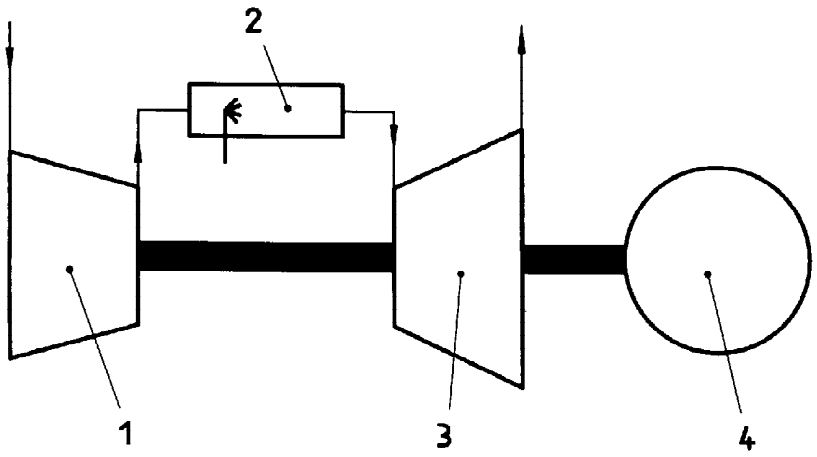
2.40
turbine trip speed
Speed at which the independent emergency overspeed device operates to shut off fuel to the gas turbine. [ISO 11086]

2.41
steam and/or water injection
Steam and/or water injected into the working fluid to increase the power output and/or to reduce the content of oxides of nitrogen (NO_x) in the exhaust.

2.42
mass-to-power ratio (mobile applications)
Ratio of the total dry mass of the gas turbine elements (in accordance with 2.1) to the power of the gas turbine, expressed in kilograms per kilowatt.

NOTE — See also ISO 3977-2.

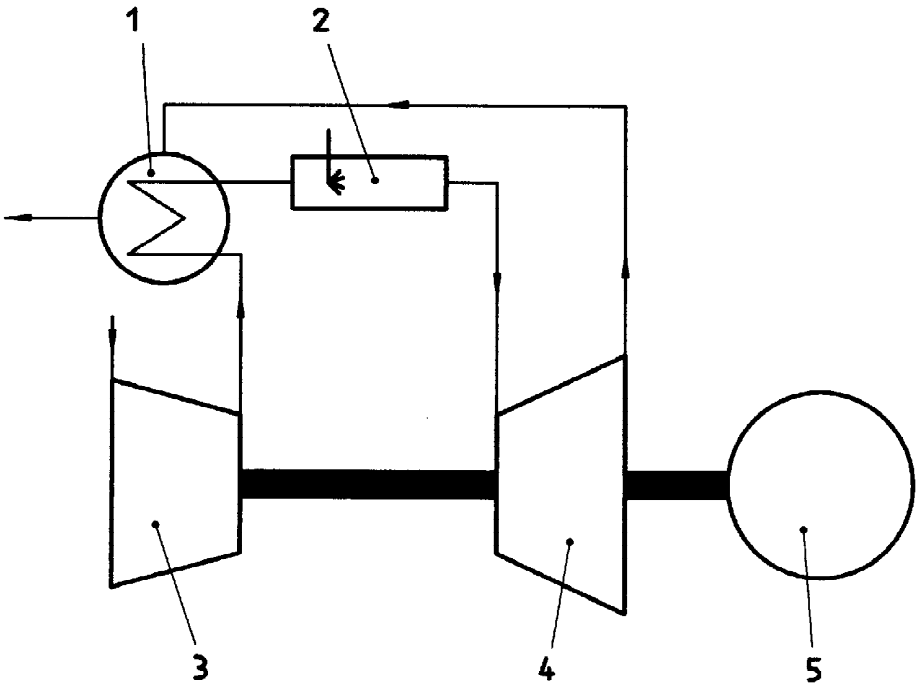
2.43
compressor surge
An unstable condition characterized by low-frequency fluctuations in mass flow of the working fluid in the compressor and in the connecting ducts.



Key

1 Compressor
2 Combustion chamber
3 Turbine
4 Load

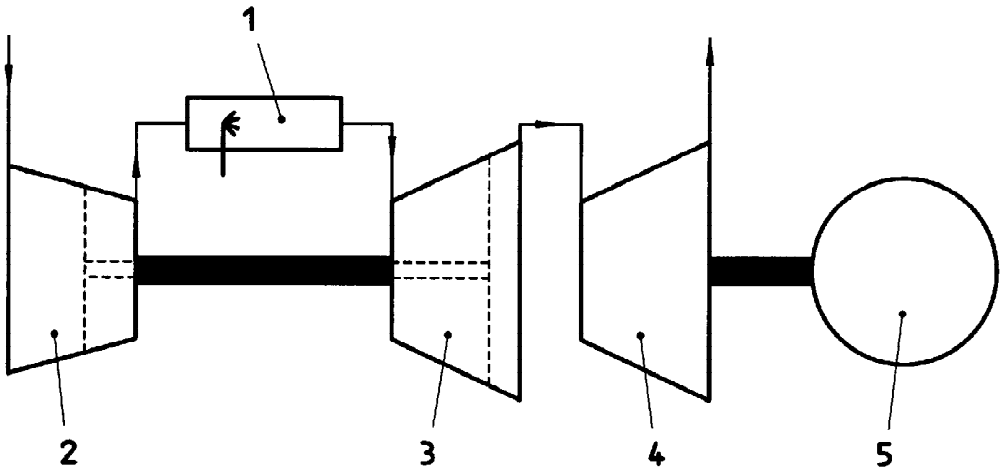
Figure 1 — Simple cycle, single-shaft gas turbine



Key

1 Regenerator or recuperator
2 Combustion chamber
3 Compressor
4 Turbine
5 Load

Figure 2 — Regenerative cycle, single-shaft gas turbine

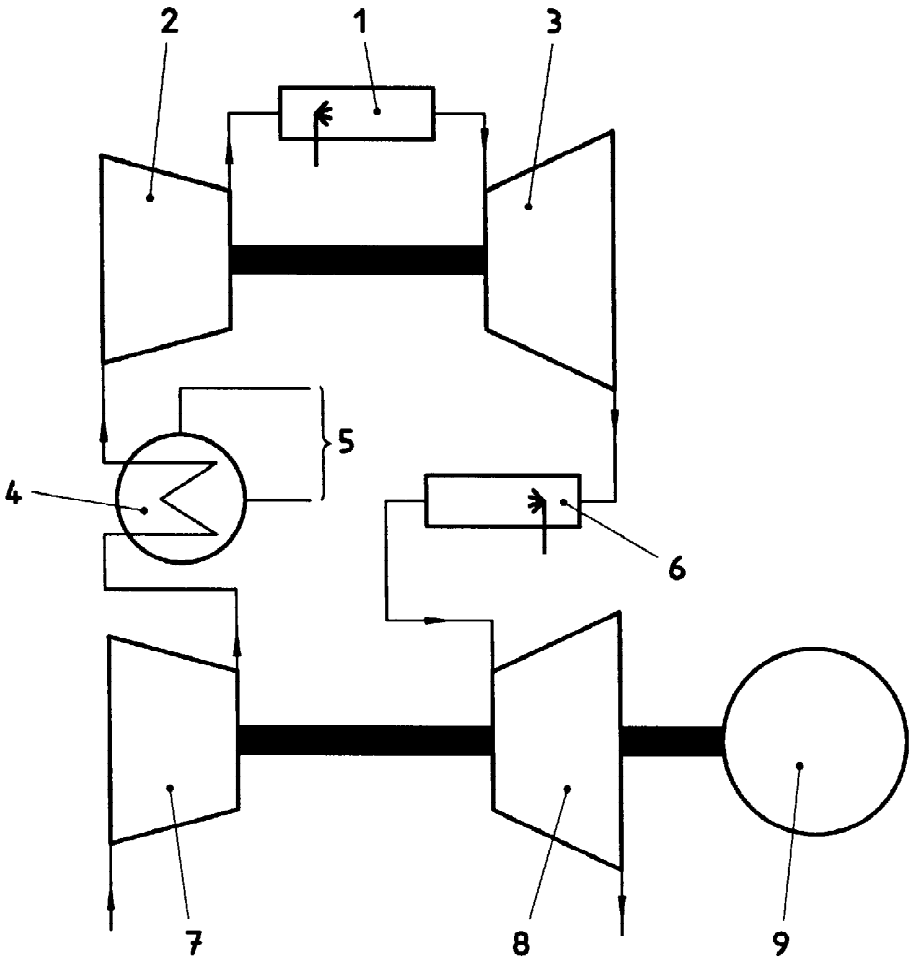


Key

1 Combustion chamber
2 Compressor
3 Compressor turbine
4 Power turbine
5 Load

NOTE — Alternative twin-spool arrangement is shown in dotted lines.

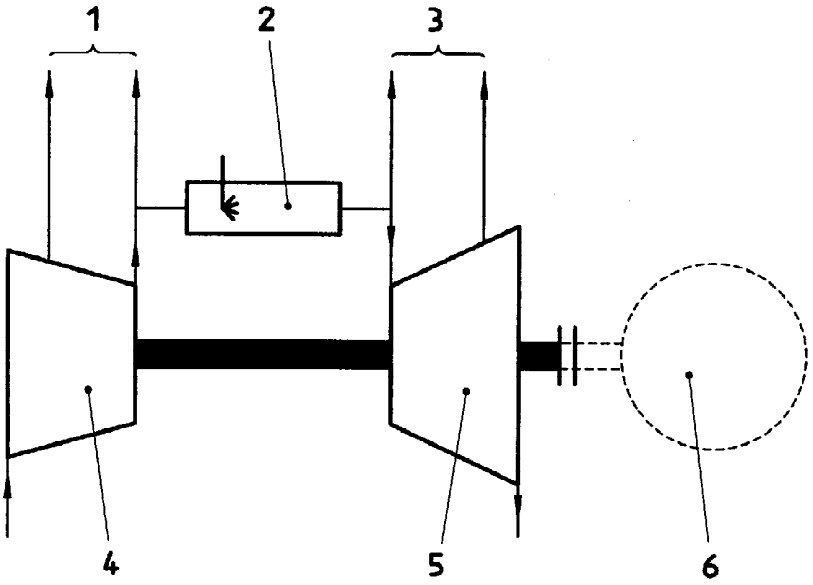
Figure 3 — Simple cycle, split-shaft gas turbine, i.e. with separate power turbine



Key

1 Combustion chamber
2 H.P. compressor
3 H.P. turbine
4 Intercooler
5 Coolant
6 Reheat combustion chamber
7 L.P. compressor
8 L.P. turbine
9 Load

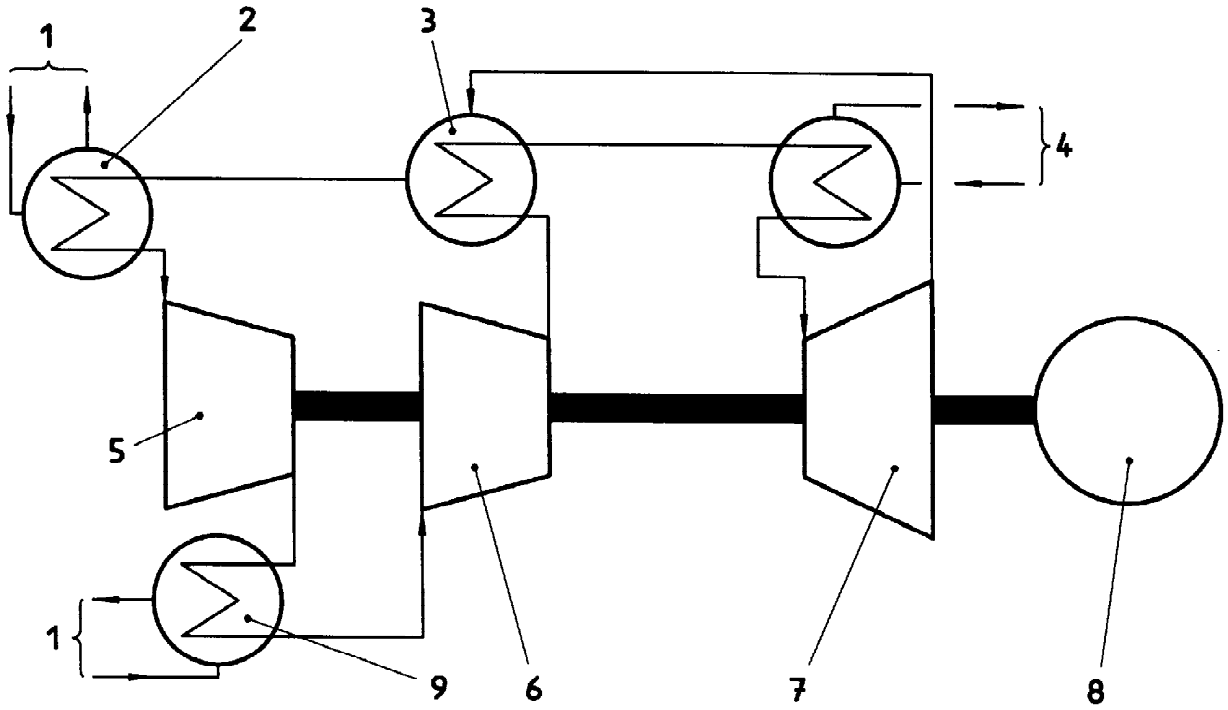
Figure 4 — Intercooled and reheat cycle (compound type), multi-shaft gas turbine with load coupled to low-pressure shaft



Key

1 Air bleed
2 Combustion chamber
3 Hot gas bleed
4 Compressor
5 Turbine
6 Load

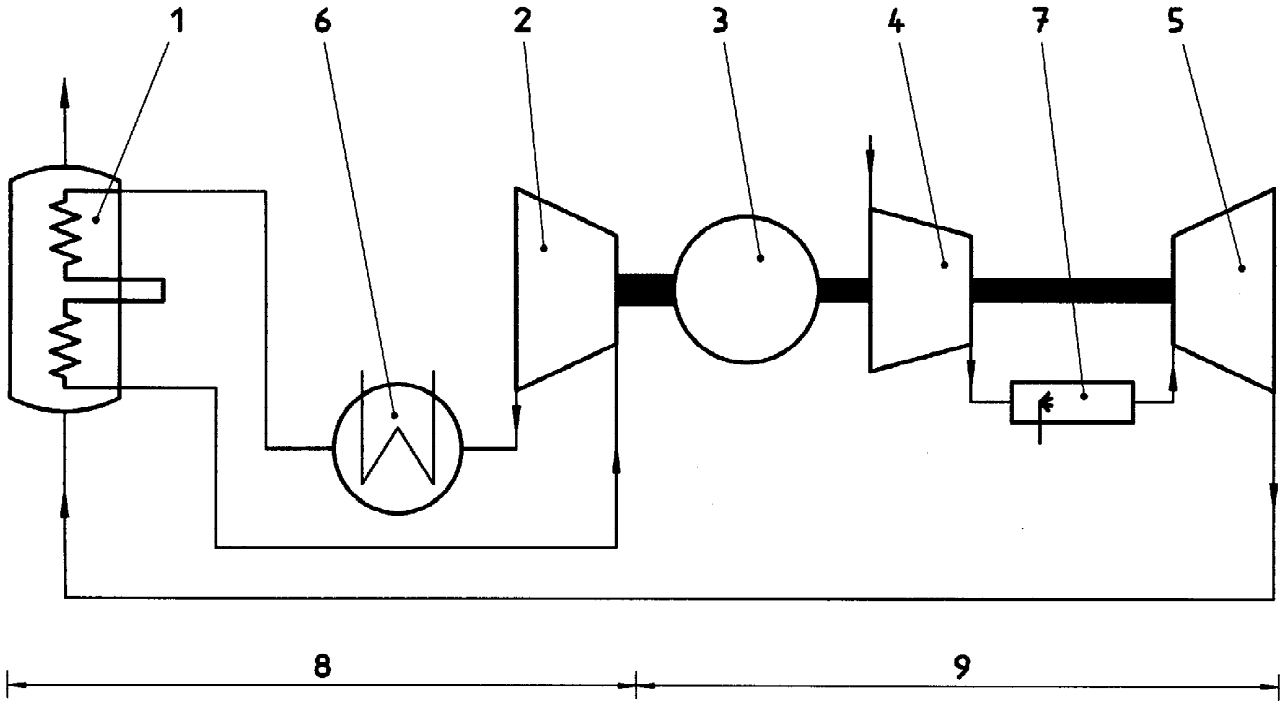
Figure 5 — Single-shaft gas turbine with air bleed and hot gas bleed



Key

1 Coolant
2 Precooler
3 Working fluid heaters
4 Heat source
5 L.P. compressor
6 H.P. compressor
7 Turbine
8 Load
9 Intercooler

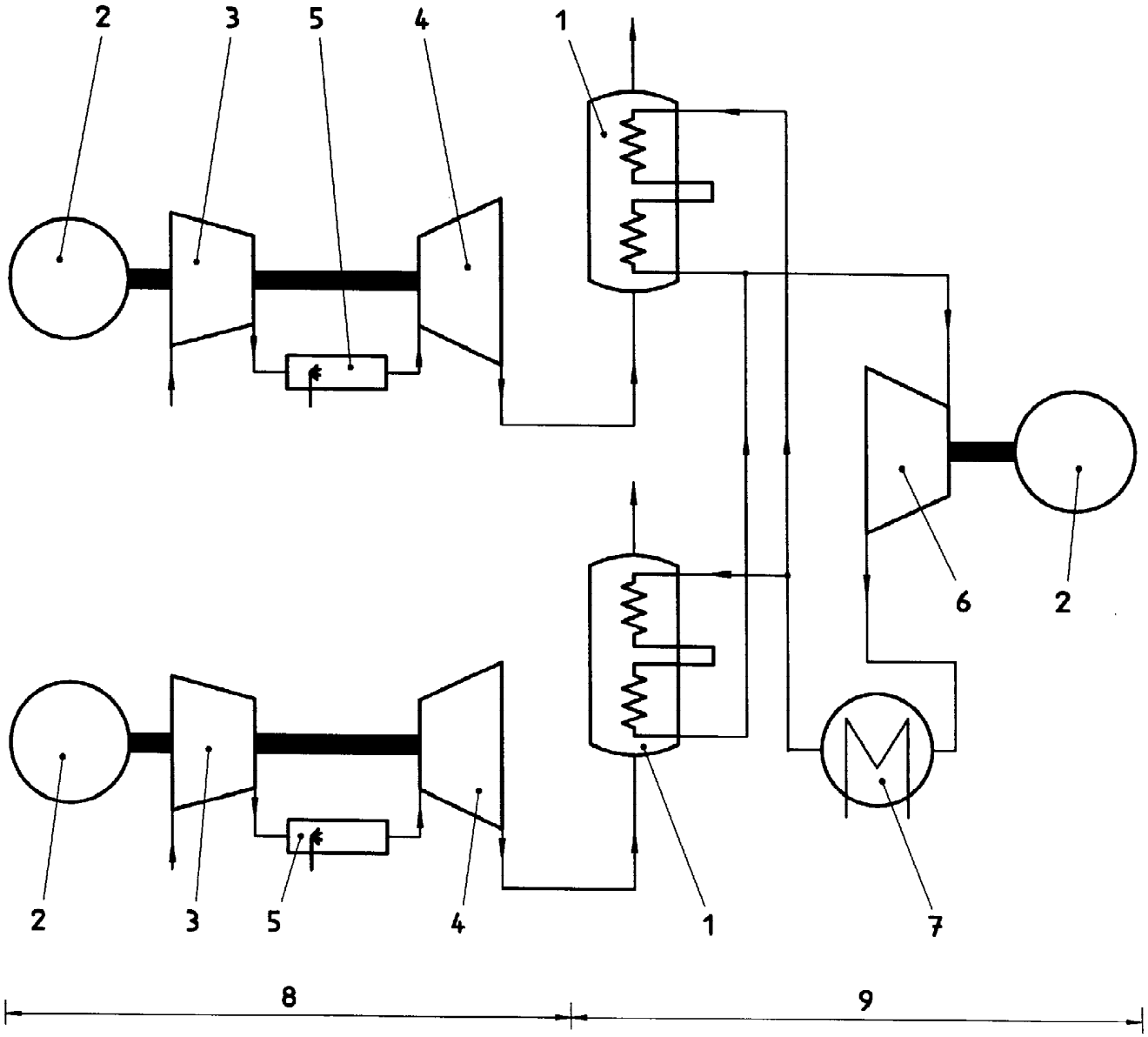
Figure 6 — Single-shaft closed-cycle gas turbine



Key

1 Waste heat recovery boiler
2 Steam turbine
3 Load
4 Compressor
5 Turbine
6 Condenser
7 Combustion chamber
8 Steam turbine section
9 Gas turbine section

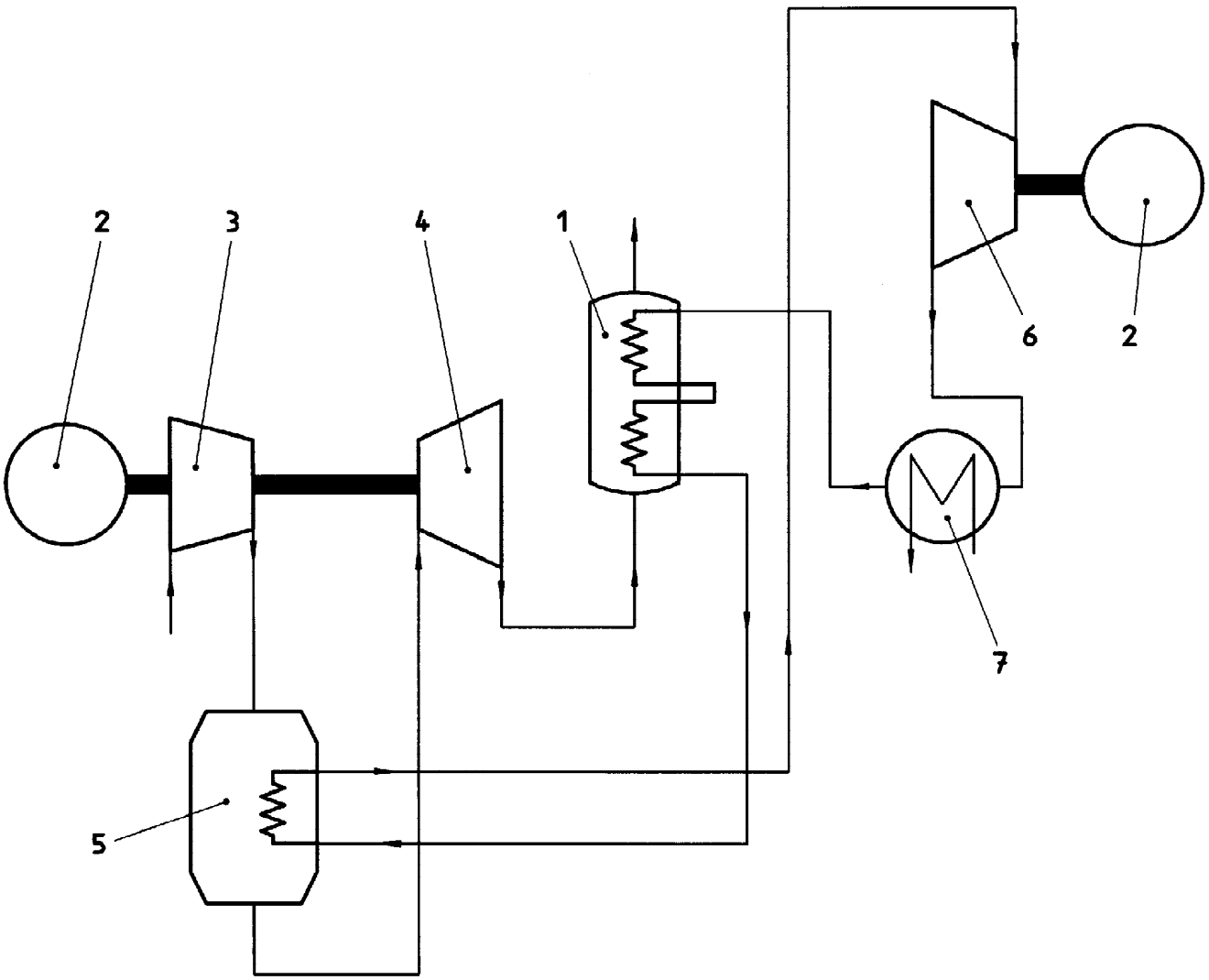
Figure 7 — Single-shaft type, combined cycle



Key

1 Waste heat recovery boiler
2 Load
3 Compressor
4 Turbine
5 Combustion chamber
6 Steam turbine
7 Condenser
8 Gas turbine section
9 Steam turbine section

Figure 8 — Multi-shaft type, combined cycle (Configuration with two gas turbines and one steam turbine)



Key

1 Waste heat recovery boiler
2 Load
3 Compressor
4 Turbine
5 PFB combustor
6 Steam turbine
7 Condenser

Figure 9 — Combined-cycle gas turbine with pressurized fluidized bed (PFB) combustor

Annex A
(informative)

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ICS 27.040

Descriptors: turbines, gas turbine engines, user supplier relations, procurements, generalities, definitions.

Price based on 13 pages