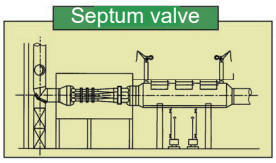
Kawasaki Heavy Industries, Ltd.

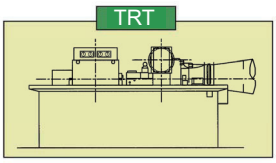
Top-Pressure Recovery Turbine Plant (TRT)

Features

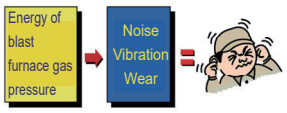
- Energy-saving equipment used for a blast furnace of a steel plant.
- Power-generating equipment furnished with a function to control the top pressure of a blast furnace.
- Power is generated by driving a turbine using blast furnace gas generated in a blast furnace.
- No fuel is needed for power generation.
- No fuel is burned; hence, no CO_2 or other greenhouse gases are generated.
- Contributes to CO_2 reduction in accordance with the power generation volume.
- Generates less noise in comparison with a conventional septum valve, contributing to the improvement of the environment around a blast furnace.
- No sophisticated technology is needed for operation and maintenance, which can easily be performed by blast furnace operators and maintenance personnel.
- Only small amounts of water, nitrogen, etc. are required for operation, which can easily be covered by existing equipment for a blast furnace.

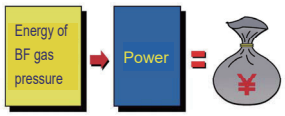


Top-pressure control



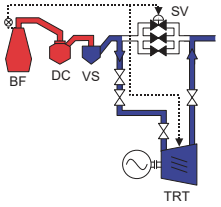
Power generation + Top-pressure control



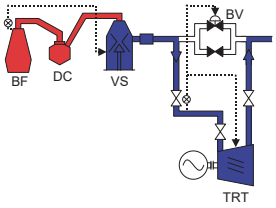


Basic Concept or Summary

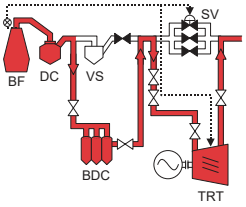
- A top-pressure recovery turbine plant is installed in the downstream of gas-cleaning equipment for a blast furnace. There are two types of gas-cleaning equipment: a wet type that uses water and a dry type that does not use water. After dust is collected by either of them, blast furnace gas is led to the turbine and drives it while expanding from around the furnace top pressure to atmospheric pressure. The power generated by the turbine is transferred to the generator and converted to electric power. In conventional practice, the energy of blast furnace gas was wasted by pressure reduction at a septum valve. It is now recovered as electric power, realizing significant energy saving.



(a) Wet-type top-pressure recovery turbine plant



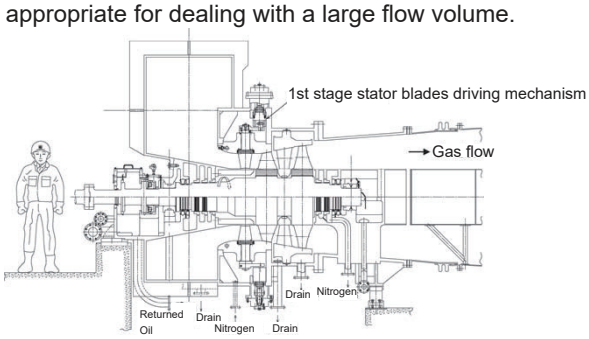
(b) Wet-type top-pressure recovery turbine plant



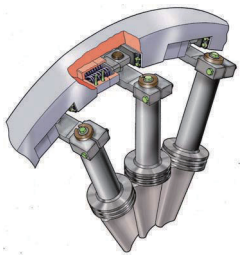
(c) Dry-type top-pressure recovery turbine plant

BF : Blast furnace
TRT : Top-pressure recovery turbine
BDC : Blast furnace gas dry cleaning equipment (dry-type gas-cleaning equipment)
VS : Venturi scrubber (Wet-type gas-cleaning equipment)
DC : Dust catcher
SV : Septum valve
BV : Bypass valve

- There are two types of turbines: radial and axial turbines. Currently, axial turbines are widely used because they are more appropriate for dealing with a large flow volume.

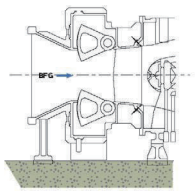
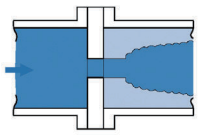
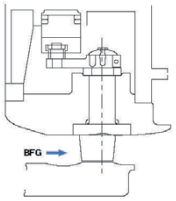
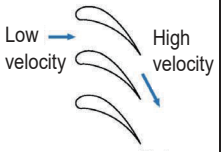


Axial turbine



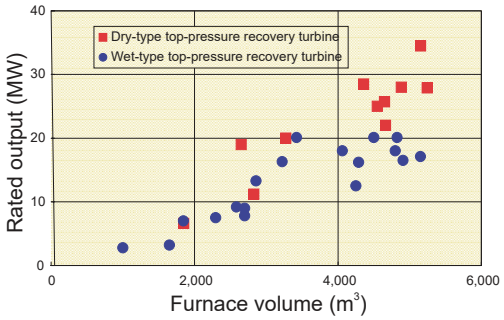
1st stage stator blades driving mechanism

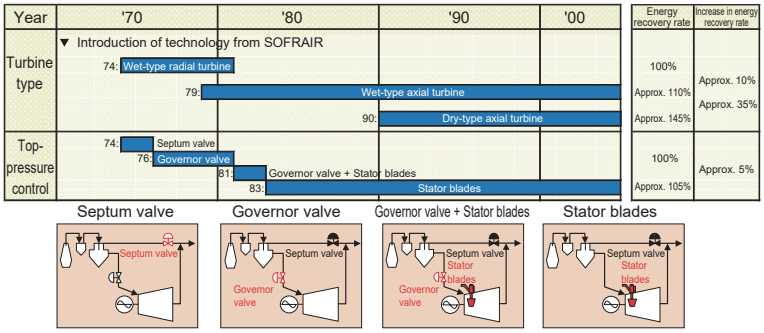
- The top pressure is controlled by opening or closing the 1st stage stator blades of the turbine in accordance with the increase or decrease of the blast furnace gas volume. With a conventional turbine, a governor valve was also used in combination for controlling the top pressure. A governor valve, however, induces a larger pressure loss in comparison with stator blades and thus was disadvantageous in view of power recovery and noise prevention. Hence, in the system widely used now, the governor valve is eliminated and the top pressure is controlled only by the 1st stage stator blades.

Governor valve		Stator blades	
			
Pressure loss = Large → Larger output decrease		Pressure loss = Small → Smaller output decrease	

Effects or Remarks

- Generally, electric power up to 35,000kW can be supplied depending on the size of the blast furnace. In recent years, the size of the blast furnace has been increasing. As a result, the volume of power generated by a top-pressure recovery turbine plant is increasing.
- In September 1974, we delivered the first top-pressure recovery turbine plant in Japan, Since then, we have continued various technological improvements for realizing better top-pressure control and higher energy recovery such as the development of an axial-flow reaction turbine and the adoption of a control system where only the 1st stage stator blades are used.

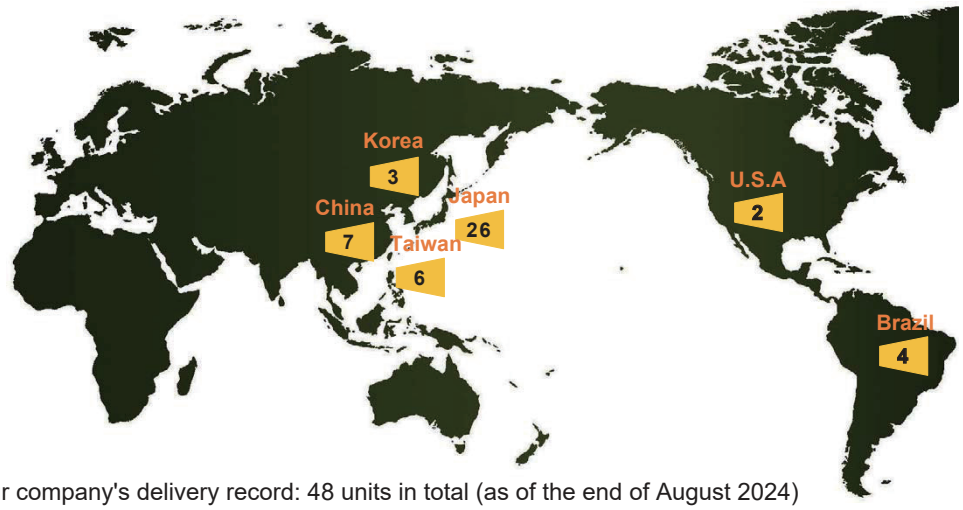




Installation in Practice or Schedule

Domestic

- To date, 26 units have been delivered in total, out of which 19 units were wet-type top-pressure recovery turbine plants and 7 units were dry-type top-pressure recovery turbine plants.



Our company's delivery record: 48 units in total (as of the end of August 2024)

Overseas

- To date, 22 units were exported in total, out of which 18 units were wet-type top-pressure recovery turbine plants and 4 units were dry-type top-pressure recovery turbine plants.
- Top-pressure recovery turbine plant for USIMINAS (Photo)
  Ipatinga, Minas Gerais, Brazil
  No. 3 Blast Furnace: Volume 3,180 m^3
  Wet-type top-pressure recovery turbine plant
  Rated output 18,800 kW
  Started power generation on June 14, 2003.

Contact: **Kawasaki Heavy Industries, Ltd.,**
Section 1, Power Plant Sales Department
Marketing & Sales Division
Energy Solution & Marine Engineering Company
Tel: +81-3-3435-2267 Fax: +81-3-3435-6601
URL: http://global.kawasaki.com/en/energy/equipment/blast.html