Diverter Damper For Waste Heat Recovery Boiler System

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Abstract— In industries like steel mills, rolling mills, cement plant the exhaust of the engine is not utilized. Unused heat is lost. Waste heat recovery boiler system is used to recover the heat from engine exhaust. Diverter damper is a box having flap for diverting flue gases from engine to the waste heat recovery boiler system and bypass system. Valves can be replaced by the dampers if the working medium is gases where working pressure is low and cent percent sealing is not required. This paper discusses the working of diverter damper in waste heat recovery boiler system and need of it. Sealing of the shut off type diverter damper is discussed.

Keywords-*diverter damper; waste heat recovery; sealing*

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I. INTRODUCTION

Diverter damper is an important component in waste heat recovery boiler system. Diverter damper is shut off or on off type damper. Diverter damper is used to divert the flue gases from engine to waste heat recovery boiler system or bypass stack with the help of flap which operates with 90 degree rotation.

Md. A. A. Mamun, Subrato Biswas explained the waste heat recovery system using an organic Rankine cycle. The environment friendly plant recover the unused engine exhaust and generate electricity on continuous basis displacing large amount of CO_2 yearly, without interfering the production process. In a closed cycle, the organic working medium is re heated and vaporized through heat exchanger. The generated vapor expanded in turbine that drives generator. The organic working medium is again used to preheat the organic liquid before vaporizing. The low temperature heat is normally discharged to the atmosphere. The organic liquid has low evaporation energy and no longer require superheating [1].

A. Mohaer, A. Noroozi, S. Norouzi discussed that combined cycle power plant have become a serious alternative for standard coal and oil-fired power plant because of their high thermal efficiency. For combine cycle power plant, the diverter box used to direct the exhaust gas of the gas turbine either into waste heat recovery boiler or when running under open cycle mode, exits directly to the bypass stack. The effect of using turning vanes on the performance of bypass exhaust system in combined cycle or exhaust system in gas turbine cycle is evaluated. The effect of diverter box turning vanes on the energy loss and pressure reduction in exhaust system of a combined cycle is investigated [2].

Sagar R. Dharmadhikari, Sachin G. Mahakalkar, Jayant P. Giri, Nilesh D. Khutafale discussed that, drive shaft are used as power transmission tubing in many applications. In the design of metallic shaft, knowing the torque and allowable shear stress for the material, the size of shaft cross section can be determined. Composite consist of two or more material phase that are combined to produce material that has superior properties to these of its individual constituent. Finite element analysis is done to predict the deformation of shaft [3].

Niyati Patil, Mukund Kavade, Amol Patil researched that, related to global warming and availability of primary energy source, there is requirement to reduce CO_2 emissions and energy consumption. Important part is there should be increased use of waste heat of industrial application. Heat recovery steam generator produces steam from another process to produce electricity. The combination of the gas turbine and Rnakine cycle is called as combine cycle. The flue gas flow in the gas turbine and HRSG is analyzed. It is challenge to get balance between uniform flows in the HRSG and optimize pressure drop loss in gas turbine [4].

Naimul Hasan, Jitendra Nath Rai and Bharat Bhushan Arora researched that, combine cycle gas turbine consists of two units: steam turbine unit and gas turbine unit. The gas turbine unit is fired first. The hot exhaust gas is used to operate the boiler of the steam turbine generating system. Conversion of the hot gases from the exhaust of the gas turbine to heat required for the boiler is done by the heat recovery steam generator unit. A model of CCGT was developed and variation of efficiency by varying various parameters is studied [5].

II. DIVERTER DAMPER SYSTEM

Diverter damper is intermediate between gas turbine, heat recovery boiler system and bypass system. There is flow of flue gases from gas turbine to the waste heat recovery boiler and the combine cycle is operated. Flue gases are diverted to the bypass system in case there is maintenance in the waste heat recovery boiler system. There is need of diverter damper because if such case occurs, we have to stop the whole system of gas turbine and waste heat recovery boiler in absence of diverter damper. So there is diverter damper to direct the flue gases directly to the bypass stack or exhaust if waste heat recovery boiler system is not working.

Fig. 1 represents the block diagram showing working of diverter damper.

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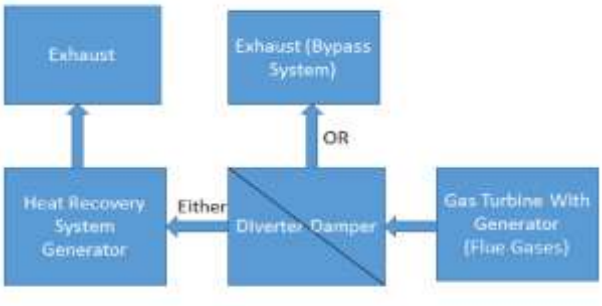

Figure 1. Block diagram of DIVERTER DAMPER

Diverter damper is a box having flap for operating the opening of either waste heat recovery boiler system or bypass system. Since most industrial systems cannot be shut down for normal periodic maintenance, diverter damper is designed to facilitate the easy maintenance while the system is operational.

Diverter damper is operated by the electrical actuator of suitable size. If in case supply to actuator is stopped it can be operated by the handle provided.

III. COMPONENTS OF DIVERTER DAMPER

Main components of diverter damper are:

Casing: Box of diverter damper

Flap: For closing either bypass system or waste heat recovery boiler system.

Shaft: For operating flap

Actuator: For operating shaft with 90 degree rotation.

Fig. 3 explains the components of diverter damper.

The torque that is required to operate a damper depends upon the size, type, quality and condition of damper. It is also dependent on the differential pressure and air flow. The maximum requires torque is not always at the closed position. Typically, the maximum torque requirement is found at about 30% open position. Refer Fig. 2.

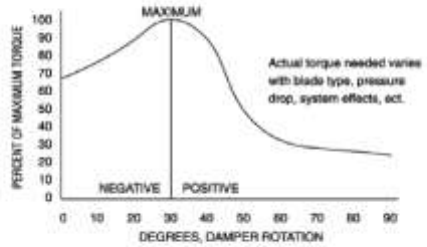

Figure 2. Typical torque requirement

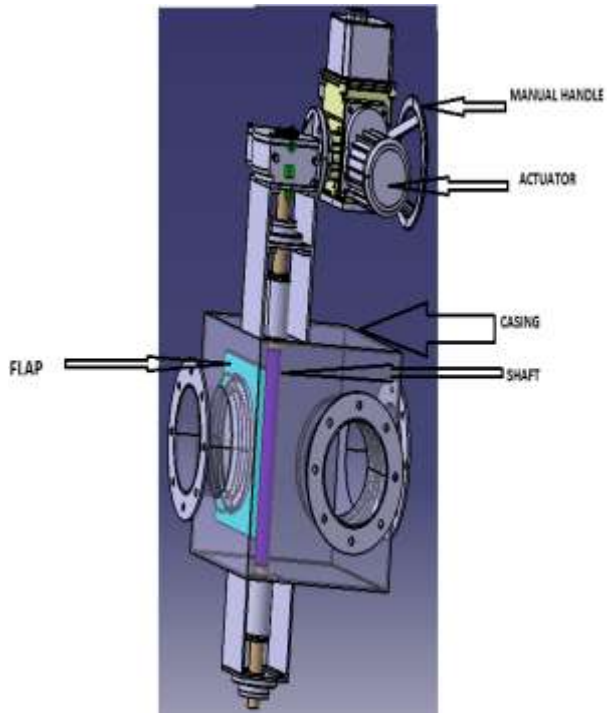

Figure 3. COMPONENTS OF DIVERTER DAMPER

IV. SEALING OF DIVERTER DAMPER

Diverter dampers do not require cent percent sealing efficiency. That's why valves can be replaced by diverter dampers where working medium is gas and sealing efficiency is less than 100%. But there are dampers which can also provide 100% sealing efficiency.

The required sealing efficiency of such type of diverter damper is 99.5%. Ceramic fiber material rope is used for sealing.

Fig. 4 explains the sealing type of diverter damper.

Type	Damper	Seat	Efficiency	Press (mm/Aq)	Temp. (°C)	Application					Example
						Clean Air	Flue Gas	Abrasive Dusty	Waste Dusty	Corrosive Gas	
A	Butterfly Louver		98.5%	2,000	560	✓	✓	✓	✓		Cement Plant Power Plant
B	Butterfly Louver		98.5%	2,000	560	✓	✓	✓	✓		Air Supply System (HVAC)
C	Butterfly Louver		99.7%	2,000	560	✓	✓		✓	✓	Power Plant Incinerator
D	Butterfly Louver		*100%	2,000	560	✓	✓		✓	✓	Power Plant Incinerator
E	Butterfly Louver		99.8%	2,000	560	✓	✓	✓	✓	✓	De-Sox & De-Nox Incinerator
F	Butterfly Louver		99.5%	2,000	560	✓	✓	✓	✓	✓	De-Sox & De-Nox
G	Butterfly Louver		*100%	2,000	560		✓		✓	✓	De-Sox & De-Nox Chemical Plant
H	Diverter		*100%	2,000	350		✓		✓	✓	De-Sox & De-Nox Power Plant
I	Diverter		*100%	2,000	560	✓	✓	✓	✓	✓	Power Plant (HRSG)
J	Slide Gate Guillotine		99.5%	2,000	350		✓	✓			Power Plant
K	Sealing Film Guillotine		*100%	2,000	650		✓	✓	✓	✓	De-Sox & De-Nox Chemical Plant
L	Butterfly Louver		98.0%	2,000	100	✓	✓	✓	✓	✓	Petro Chemical Plant
M	Butterfly Louver		99.5%	2,000	560	✓	✓	✓		✓	Power Plant

Figure 4. Sealing types for dampers

V. CONCLUSION

For the increasing price of fuel, waste heat recovery boiler system is better option for utilizing waste heat

Diverter damper's need in waste heat recovery boiler system is studied.

Sealing system of diverter damper is studied for obtaining required efficiency.

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