[0008] Referring to FIG. 1, the air lubrication system includes an air ejector 11 disposed at the bow of a hull 20, two air compressors 13, 14 disposed adjacent to the air ejector 11, and two motors 15, 16 disposed adjacent to the air ejector 11 to drive the air compressors 13, 14. In addition, the air lubrication system may include a distribution board 17 to drive the motors 15, 16. Further, the air lubrication system includes an air delivery pipe AP connected between the air ejector 11 and the air compressors 13, 14.

[0009] A power generation engine GE is disposed at the stern of the hull. The distribution board 17 receives electricity from the power generation engine GE and distributes the received electricity to the motors 15, 16. In addition, a main engine ME may be disposed at the stern of the hull.

[0010] The power generation engine GE may include multiple power generation engines. Here, a switchboard SB may be provided to manage electricity generated by the power generation engines GE. That is, the switchboard SB may be electrically connected to the distribution board 17.

[0011] Although not shown, the air lubrication system may further include a device for regulating the amount of air discharged from the air ejector 11, as needed.

[0012] <Related Literature>

[0013] <Patent Document>

[0014] (Patent Document 1) Korean Patent Laid-open Publication No. 10-2020-0063398 (2020.06.05.)

SUMMARY

[0015] It is an object of the present disclosure to provide an air lubrication system for ships, which can reduce frictional resistance during navigation of a ship by ejecting compressed air onto a surface of a ship bottom while ensuring high fuel efficiency, as compared with a conventional air lubrication system.

[0016] In accordance with an aspect of the present disclosure, an air lubrication system includes: at least one electrically driven compressor operated by electricity generated by a power generation engine of a ship; a steam-driven compressor driven by steam generated using exhaust gas from a main engine of the ship; an air ejector disposed at a bow of the ship and discharging compressed air supplied from the at least one

electrically driven compressor and the steam-driven compressor to an outside of the ship; and an air delivery pipe through which the compressed air supplied from the at least one electrically driven compressor and the steam-driven compressor is delivered to the air ejector; and at least one drive motor supplied with electricity generated by the power generation engine and driving the at least one electrically driven compressor, wherein the at least one electrically driven compressor comprises a first air compressor and a second air compressor disposed at the bow of the ship, and the steam-driven compressor comprises a third air compressor disposed at a stern of the ship, wherein the pressure of the compressed air generated by the first air compressor and the second air compressor is determined according to rotational speeds of a first drive motor and a second drive motor among the at least one drive motor, respectively, wherein the air delivery pipe includes a section connected to the air ejector and two sections branched off of the section and connected to the first air compressor and the second air compressor disposed at the bow of the ship, respectively, wherein a flow rate of air in the steam-driven compressor is controlled using an inlet guide vane adapted to adjust a differential pressure between a suction side and a discharge side of the steam-driven compressor for rpm of the steam-driven compressor or using a bypass valve connected between the suction side and the discharge side, and wherein an air supply pressure of the first air compressor and the second air compressor is adjusted through a cross-sectional area adjustment device, and the cross-sectional area adjustment device is adapted to change inlet and outlet cross-sectional areas of the first air compressor, the second air compressor, and the steam-driven compressor.

[0017] The air lubrication system may further include: an exhaust gas economizer connected to the main engine and generating superheated steam through transfer of heat to saturated steam generated using the exhaust gas from the main engine; and a steam turbine having a drive shaft connected to the steam-driven compressor, the steam turbine being driven by the superheated steam generated by the exhaust gas economizer and operating the steam-driven compressor.

[0018] The air lubrication system may further include: an auxiliary boiler supplying steam to the steam turbine when the amount of steam generated by the exhaust gas economizer is insufficient.

[0019] The air lubrication system may further include: a boiler feedwater pump supplying feedwater stored in a cascade tank to the auxiliary boiler to compensate for feedwater consumed by the auxiliary boiler to generate steam.

[0020] The air lubrication system may further include: at least one steam separator receiving a fluid mixture of water and steam from the exhaust gas economizer, separating the steam from the fluid mixture, and discharging only the steam, wherein the exhaust gas economizer generates the superheated steam using the steam supplied from the at least one steam separator.

[0021] The air lubrication system may further include: a vacuum condenser condensing steam at a reduced temperature through creation of a vacuum to increase efficiency of the steam turbine; and a condensate pump delivering condensed water generated by the vacuum condenser to the cascade tank.

[0022] The air lubrication system may further include: an atmospheric condenser condensing steam generated by at least one of the exhaust gas economizer and the auxiliary boiler and supplying water condensed from the steam to the cascade tank.

[0023] The steam-driven compressor may include a gearbox therein to be operated at a constant rpm or at a variable rpm.

[0024] The air lubrication system may further include: at least one drive motor supplied with electricity generated by the power generation engine and driving the at least one electrically driven compressor.

[0025] The at least one electrically driven compressor may include a first air compressor and a second air compressor disposed at the bow of the ship, and the steam-driven compressor may include a third air compressor disposed at a stern of the ship.

[0026] The air lubrication system for ships according to the present disclosure includes the third air compressor additionally disposed at the stern of the hull, connected to the steam turbine, and generating compressed air by being driven by the steam turbine driven by steam generated using waste heat of exhaust gas from the main engine, thereby significantly reducing power consumption thereof.

[0027] In addition, the air lubrication system according to the present disclosure can provide fuel saving benefits through constant supply of compressed air regardless of ship speed.

[0028] Further, the air lubrication system according to the present disclosure can ensure redundancy through additional supply of steam from the auxiliary boiler to the steam turbine.

DRAWINGS

[0029] The above and other aspects, features, and advantages of the present invention will become apparent from the detailed description of the following embodiments in conjunction with the accompanying drawings:

[0030] FIG. 1 is a diagram of a conventional air lubrication system.

[0031] FIG. 2 is a diagram of an air lubrication system for ships according to an embodiment of the present invention.

[0032] FIG. 3 is a diagram illustrating a process of driving an air compressor using exhaust gas in the air lubrication system for ships according to the embodiment of the present invention.

DETAILED DESCRIPTION