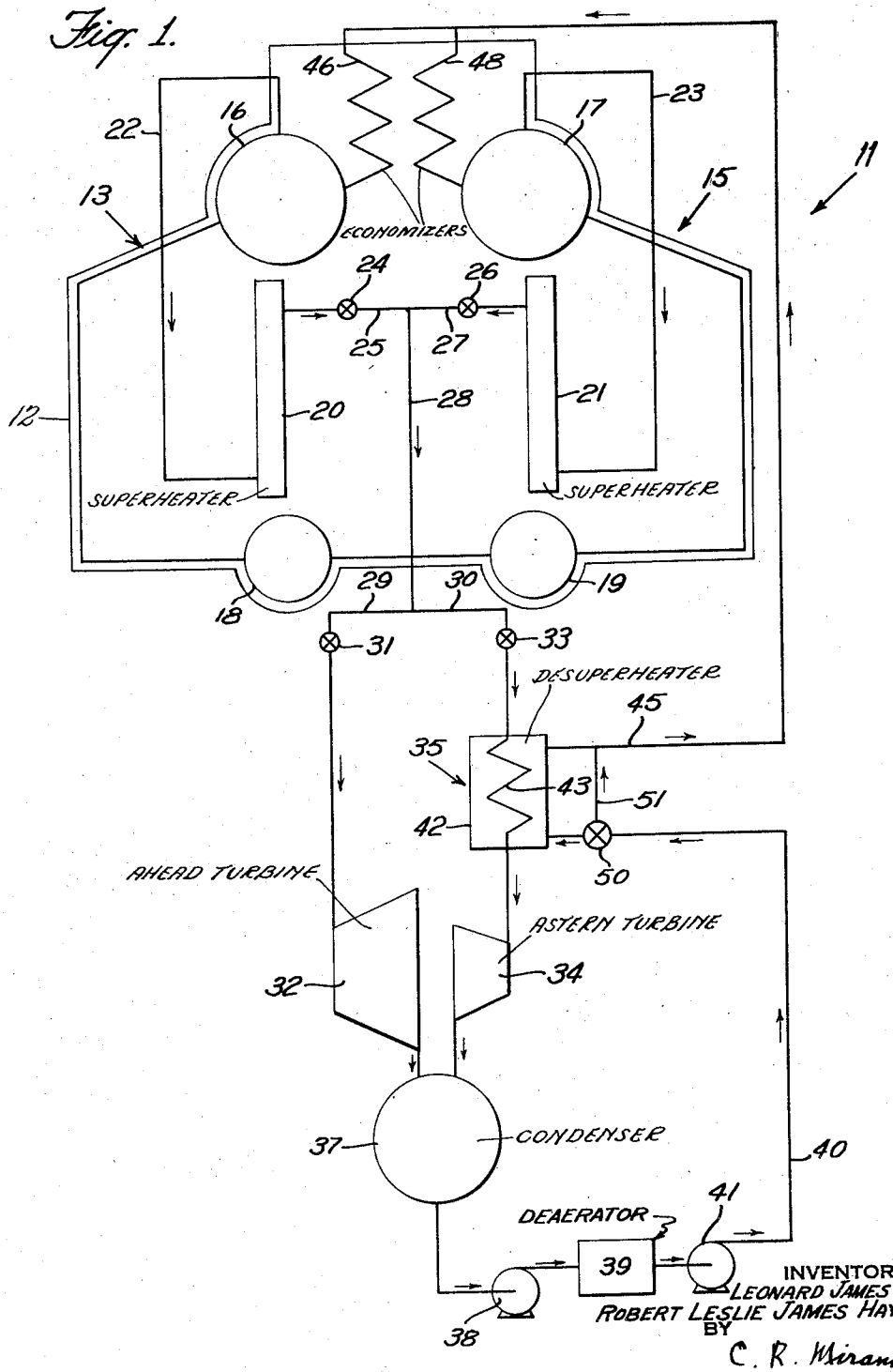
Oct. 14, 1958 R. L. J. HAYDEN ET AL 2,855,756

APPARATUS FOR THE CONTROL OF VAPOR TEMPERATURE

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Fig. 1.



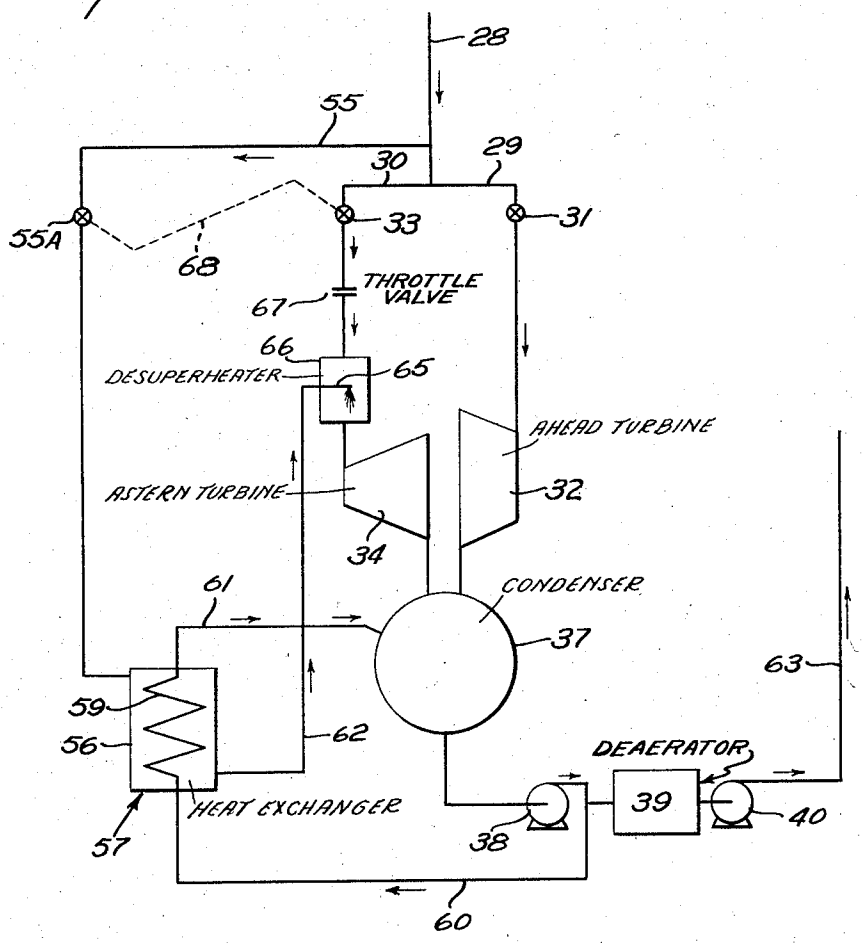
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Fig. 2.



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APPARATUS FOR THE CONTROL OF VAPOR TEMPERATURE

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This invention relates to apparatus for the control of vapor temperature and more particularly to boiler installations for alternately operating a pair of power generators.

In some marine boiler installations vapor, or steam, is provided for operating the ship's propulsion apparatus which comprises a pair of power generating elements, as for example, vapor or steam operated turbines. The turbines are drivably connected to the ship's propeller or propellers and one turbine is employed for effecting movement of the vessel in a forward or "ahead" direction while the other turbine operates to effect movement of the vessel in a rearwardly or "astern" direction; the turbines being generally referred to as the "ahead" turbine and the "astern" turbine, respectively. It is customary to desuperheat the superheated steam in the boiler and to supply the astern turbine with desuperheated steam while the ahead turbine is provided with superheated steam. With the desuperheater in the boiler, it is necessary to stop and restart the flow of desuperheating medium, or alternatively, alter the path of flow of the superheated steam when switching operation of the ahead and astern turbines.

The present invention contemplates a novel boiler installation which comprises an ahead turbine and an astern turbine and means outside the boiler for desuperheating the superheated steam flowing to the astern turbine. The superheated steam from the boiler flows through a tubular member which is connected to a juncture of conduits outside the boiler leading to the ahead turbine and the astern turbine, respectively. A desuperheater is arranged in the conduit leading to the astern turbine to desuperheat or temper the steam flowing thereto. In one embodiment of the present invention, feed water is employed in a tube and shell heat exchanger for desuperheating the steam, and in a second embodiment, condensate from a main condenser is used to condsense steam which is then sprayed into the steam supplied to the astern turbine.

The invention will be understood from the following description when considered in connection with the accompanying drawings in which:

Fig. 1 is a schematic illustration of a marine boiler installation constituting one embodiment of the present invention; and

Fig. 2 is a schematic illustration of a marine boiler installation constituting a second embodiment of the invention.

Referring now to the drawings for a more detailed description of the present invention and more particularly to Fig. 1 wherein one embodiment hereof is schematically illustrated, a marine boiler installation generally designated by the numeral **11**, includes a casing or enclosure **12**. Boiler installation **11**, comprises a pair of water tube boilers **13** and **15** which include upper steam and water vessels **16** and **17**, respectively, and lower water drums **18** and **19**, respectively. Superheaters **20** and **21** are provided in boilers **13** and **15**, respectively, and are connected by steam off-take conduits **22** and **23**, respectively, to the upper steam spaces of vessels **16** and **17**. Superheated steam flows from super heater **20** through a main stop valve **24** in a conduit **25** and superheated steam flows from superheater **21** through a main stop valve **26** in a conduit **27**. A common steam pipe **28** is connected to conduits **25** and **27** and extends outside of the boilers where it is connected to a juncture of two conduits **29** and **30**.

An "ahead" control valve **31** is disposed in conduit **29** for regulating the flow of steam to an "ahead" or main steam operated turbine **32** which is drivably connected by means, not shown, for effecting movement of a ship (not shown) in a forward direction, or ahead. An "astern" control valve **33** is disposed in conduit **30** for regulating the flow of steam to an "astern" turbine **34** by way of a desuperheater **35**, to be more fully described hereinafter, disposed for cooperation with and in conduit **30**. Astern turbine **34** is drivably connected by means, not shown, for effecting movement of the ship in a rearwardly direction, or astern. The steam discharged from turbines **32** and **34** is conducted to a main condenser **37** which changes the steam to water and the latter passes through a pump **38** to a direct contact heater or deaerator **39**. The water in deaerator **39** is heated to a temperature above 212° F., for a reason to be set forth, and the water is fed through a conduit **40** by a feed water pump **41**. Conduit **40** is connected to the interior of a shell **42** of desuperheater **35** which includes tubular means **43** connected in conduit **30**. The feed water entering shell **42** flows in heat exchange relationship with the steam flowing through tubular means **43** to provide for desuperheating of the steam prior to passage to astern turbine **34**. The feed water leaves shell **42** through a conduit **45** whence it flows into economizers **46** and **48** of boilers **13** and **15**, respectively. Economizers **46** and **48** communicate with vessels **16** and **17**, respectively, to provide the latter with feed water. A by-pass valve **50** is disposed in conduit **40** and communicates with a by-pass conduit **51** connected to conduit **45** to vary the proportion of total flow of feed water passing through the desuperheater.

In operation, when it is desired to change the direction of the ship from forward to astern, valve **31** is closed to stop flow of steam to main turbine **32**. Thereafter, valve **33** is opened to provide flow of steam through conduit **30** into tubular means **43** of desuperheater **35** and in indirect heat exchange with boiler feed water condensate in main condenser **37** from turbines **32** and **34**; the feed water being conducted to the desuperheater through conduit **40**. It is to be noted that when astern valve **33** is opened, moderation of the temperature of the steam supplied to astern turbine **34** through desuperheater **35** automatically takes place and is largely self-regulating since the volume of water passing through shell **43** is determined by the volume of steam condensed from turbine **34**. When it is desired to resume operation of ahead turbine **32**, astern valve **33** is closed and ahead valve **31** is opened. As soon as valve **33** is closed, the pressure in tubular means **43** decreases to a value corresponding to that of the astern turbine outlet. The saturation temperature of the steam at this pressure is lower than that of the feed water (above 212°) circulating within the shell, whereby no condensation takes place when the desuperheater is not in use. Consequently, there is no risk of water being passed into astern turbine **34** when valve **33** is opened again.

Fig. 2 illustrates a second embodiment of the present invention similar to the first embodiment, but differing in the desuperheating means. The embodiment of Fig. 2 is adapted for use with the two-boiler arrangement of Fig. 1 and only those parts necessary to an understanding of the second embodiment are disclosed in Fig. 2; the

reference characters of Fig. 1 designating parts identical with those of Fig. 2, being retained. In Fig. 2, a conduit 55 having a regulating valve 55A is connected to common steam pipe 28 and communicates with the interior of a shell 56 of a heat exchanger 57 to provide for flow of steam into shell 56. Heat exchanger 57 includes tubular means 59 having an inlet communicating with the discharge side of pump 38 through a conduit 60 and an outlet communicating with main condenser 37 by way of a conduit 61. By reason of the foregoing arrangement, the superheated steam entering shell 56 by way of conduit 55 passes in heat exchange with the feed water in tubular means 59 and is condensed. The condensate leaves the heat exchanger through a conduit 62 while the feed water, heated in the tubular means, is returned to the main condenser 37 by way of conduit 61. If desired, the feed water may be fed to a feed water conduit 63 which has one end connected to feed water pump 40 and the other end connected to economizers 46 and 48 (not shown in Fig. 2).

Conduit 62 has another end 65 which extends into a spray type desuperheater 66 and the end is provided with means (not shown) for spraying pure water into the desuperheater. Desuperheater 66 simply comprises a large pipe to accommodate the spray and is connected in conduit 30 leading to astern turbine 34. The necessary pressure differential in desuperheater 66 is obtained by throttling the steam entering the latter by a throttle 67. Astern valve 33, in conduit 30, is coupled to regulating valve 55A by a mechanical connection 68, shown as a broken line, to provide for simultaneous operation of both valves. The steam is desuperheated in desuperheater 66 and is fed to astern turbine 34.

In operation, when it is desired to commence operation of astern turbine 34, valve 31 in conduit 29 is closed and thereafter, valve 33 in conduit 30 is opened to provide flow of steam in the latter. Simultaneous with the opening of valve 33 regulating valve 55A also is opened through mechanical connection 68 to provide flow of steam in conduit 55 and in shell 56 of heat exchanger 57. The steam passes in heat exchange with the feed water in tubular means 59 where it is condensed and drawn off through conduit 62 for spraying in desuperheater 66. The steam in desuperheater 66 is thus desuperheated and conducted to astern turbine 34 whence it is discharged for delivery to main condenser 37. It will be apparent that automatic control of the condensate rate is achieved in heat exchanger 57. The covering of tubular means 59 by any excess condensate controls the effectiveness thereof and in this way the rate of admission of steam to exchanger 57 is automatically controlled by the rate at which the condensate is drawn-off. The rate at which condensate is drawn-off automatically increases and decreases as the rate of steam flow to the astern turbine 34 is raised or lowered. Shell 56 provides a reserve of condensate for the spray which is useful when astern valve 33 is first opened.

An advantage of the boiler installation of Fig. 2 is that there is no danger of feed water, which may contain solids, being admitted to the conduit 30 in the event of a leak in heat exchanger 57 because cooling water, under a lower pressure than the steam being condensed, can be drawn directly from the condenser 37. Furthermore, heat exchanger 57 can be more compact than the desuperheater 35, used in the first embodiment, because the cooling water is at a lower temperature.

Although two embodiments of the invention have been illustrated and described in detail, it is to be expressly understood that the invention is not limited thereto. Various changes can be made in the design and arrangement of parts without departing from the spirit and scope of the invention as the same will now be understood by those skilled in the art.

What is claimed is:

1. In a boiler installation of the class described, a boiler for producing a vapor and having an enclosure, a superheater in said enclosure connected for superheating vapor, conduit means connected to the superheater and extending outside said boiler, a first turbine, a second turbine, a second conduit means in communication with said first mentioned conduit means and with said first turbine for delivering vapor to the latter to provide operation thereof, third conduit means communicating with said first conduit means and with said second turbine for delivering vapor to the latter to provide operation thereof, means for regulating the flow of vapor in said second and said third conduit means, cooling means communicating with the first conduit means for receiving a portion of vapor therefrom and condensing the latter to a liquid, a desuperheater arranged in communication with said third conduit means and receiving vapor therefrom prior to passage of the vapor to said second turbine, said desuperheater being connected to said cooling means for receiving the liquid therefrom in direct contact with the vapor within the desuperheater, a condenser connected to receive vapor discharged from said first and said second turbines for condensing the vapor, and means communicating with the condenser and with the boiler for delivering condensate to the latter.

2. In a boiler installation of the class described, a boiler for producing vapor and having an enclosure, a superheater connected for superheating the vapor, first conduit means connected to the superheater and extending outside said boiler, a first turbine, a second turbine, a second conduit means in communication with the first conduit means and with the first turbine for delivering vapor to the latter to provide operation thereof, third conduit means in communication with the first conduit means and with the second turbine for delivering vapor thereto to provide operation thereof, means for regulating the flow of vapor within the second and the third conduit means, a condenser connected to receive discharged vapor from both said first and said second turbines, a heat exchanger communicating with the first conduit means for receiving a portion of vapor therefrom, said heat exchanger being also in communication with said condenser for receiving condensate therefrom in indirect heat exchange relationship with the vapor to effect condensation of the latter to a liquid, a desuperheater arranged in communication with said third conduit means and receiving vapor therefrom prior to passage of the vapor to said second turbine, said desuperheater being connected to said heat exchanger for receiving liquid therefrom in direct contact with the vapor within the desuperheater and means in communication with the condenser and with the boiler for delivering condensate to the latter.

3. The boiler installation of claim 2 wherein the heat exchanger is a tube and shell exchanger wherein the vapor passes on the outside of the tubes and the condensate flows through the tubes.

4. The boiler installation of claim 3 wherein means are provided in communication with tubes in said exchanger and with the condenser for returning condensate leaving the exchanger to the condenser.

5. In a marine boiler installation of the class described and having an enclosure, a boiler for producing vapor, a superheater connected for superheating the vapor, first conduit means communicating with the superheater for receiving superheated vapor therefrom for passage therein, said conduit means having an outlet portion extending outside said boiler enclosure, an ahead turbine, an astern turbine, second conduit means in communication with the outlet portion of the first conduit means and with said ahead turbine for delivering vapor to the latter to provide operation thereof, third conduit means in communication with the outlet portion of the first conduit means and with said astern turbine for delivering vapor to the latter to provide operation thereof, a condenser connected for receiving and condensing vapor discharged from both said turbines, a valve arranged in said second

conduit means for regulating flow of vapor therein, a second valve arranged in said third conduit means for regulating flow of vapor therein, a heat exchanger, fourth conduit means having one end connected to the outlet portion of the first conduit means for receiving a portion of the vapor therein prior to passage of the vapor to the second and the third conduit means, said fourth conduit means having another end connected to said heat exchanger for delivering vapor thereto, a third valve in said fourth conduit means for regulating flow of vapor therein, means connecting said second and said third valves for conjoined operation, said heat exchanger being connected to said condenser to receive condensate therefrom for indirect heat exchange relationship with the vapor therein to provide a liquid, a desuperheater arranged in said third conduit means and receiving vapor therefrom prior to passage of the vapor to said astern turbine, said desuperheater being connected to said heat exchanger for

receiving the liquid therefrom in direct contact with the vapor within the desuperheater, a throttle valve in said third conduit means between said second valve and said desuperheater for reducing the pressure of the vapor entering the desuperheater, and means for returning the condensate from said condenser to the boiler.

References Cited in the file of this patent

UNITED STATES PATENTS

2,024,761	Fraser	Dec. 17, 1935
2,103,685	Kuhner	Dec. 28, 1937
2,431,177	Iager et al.	Nov. 18, 1947

FOREIGN PATENTS

210,051	Great Britain	Aug. 14, 1924
416,091	Great Britain	Sept. 10, 1934