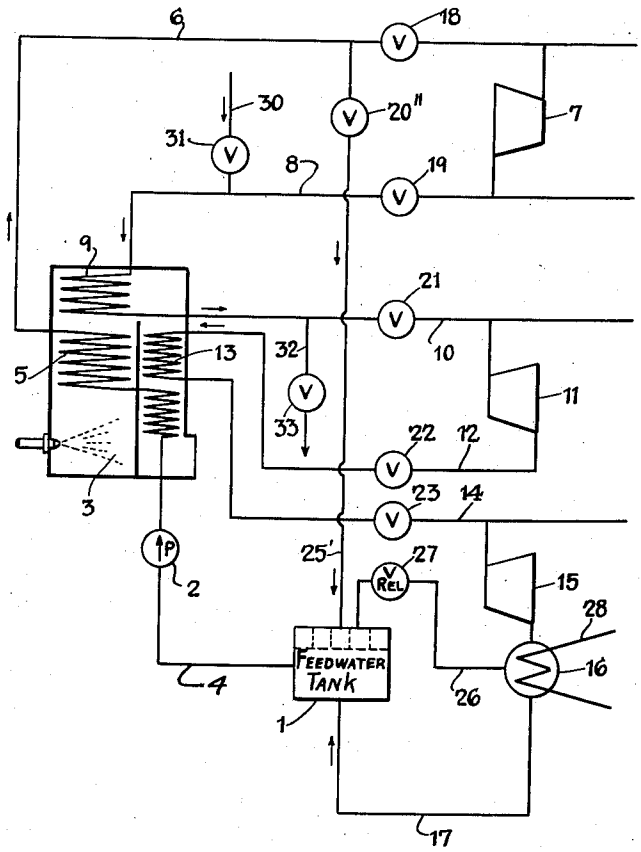
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SYSTEM FOR STARTING FORCED FLOW STEAM GENERATORS INCLUDING A PLURALITY OF RESUPERHEATERS

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SYSTEM FOR STARTING FORCED FLOW STEAM GENERATORS INCLUDING A PLURALITY OF RESUPERHEATERS

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2 Claims. (Cl. 60—73)

The present invention relates to a system for starting a forced flow steam generator including a plurality of intermediate or resuperheaters heated by the same combustion gases as the generator.

The present application is a division of my copending application, Serial No. 433,746, filed June 1, 1954, now Patent No. 2,844,004 of July 22, 1958.

It is an object of the invention to provide a system for starting a forced flow steam generator, particularly one producing steam at at least the critical pressure and temperature and including a plurality of resuperheaters interposed in the path of the combustion gases heating the generator, the resuperheater which is placed in the relatively hottest part of the combustion gas stream being cooled during the starting-up period, and the other resuperheaters not being cooled during the starting of the generator. Steam may be taken from the steam generator as coolant for the superheater in the hottest combustion gas zone. Alternatively, steam or water from other sources may be used as a coolant.

It is conventional to cool the superheater and a convection heated resuperheater in a forced flow steam generator by passing the operating liquid of the generator through the superheater and through the resuperheater from the beginning of the starting operation of the generator. Convection heated resuperheaters are sometimes cooled by filling the resuperheaters with water and evaporating the water during the starting period, as is conventional in the case of boilers having a drum. This, however, calls for special starting maneuvers which are relatively complicated and difficult to perform.

The aforementioned difficulties and disadvantages are avoided with the system according to the invention. When starting a forced flow steam generator including several resuperheaters according to the invention, the resuperheater exposed to the relatively hottest combustion gases is cooled whereas the other resuperheaters are left dry and are not cooled during the starting period. In this way, the starting maneuvers are simplified and the operating safety is increased because faulty connections are avoided.

The novel features which are considered characteristic of the invention are set forth with particularity in the appended claims. The invention itself, however, and additional objects and advantages thereof will best be understood from the following description of an embodiment thereof when read in conjunction with the accompanying drawing, the single figure of which diagrammatically illustrates a plant according to the invention.

Referring more particularly to the drawing, numeral 1 designates a starting-up feed water tank from which feed water is supplied to a forced flow steam generator 3 by means of a pump 2 through a conduit 4. After passing through a superheater 5, the steam flows through a conduit 6 to consumers, for example, to a high pressure

turbine 7, and therefrom, through a conduit 8, to a resuperheater 9 which is exposed to radiant heat. A conduit 10 conducts the resuperheated steam to a medium pressure turbine 11. The exhaust steam of the latter flows through a conduit 12, a resuperheater 13, which receives heat by convection, and a conduit 14 to a low pressure turbine 15. Thereupon, the steam is condensed in a condenser 16 and conducted therefrom through a conduit 17 to the starting tank 1.

When the forced flow steam generator is started, the high pressure turbine 7 is disconnected by closing valves 18 and 19, the steam flowing through a conduit 25' and a valve 20'' arranged therein, from the superheater 5 to the feedwater tank 1. To prevent building up pressure in the tank 1, the latter is connected with the condenser by means of a conduit 26 in which a relief valve 27 is provided. The coolant for the condenser 16 is supplied through a conduit 28.

By closing a valve 21 in the conduit 10 the medium pressure turbine 11, the low pressure turbine 15, and the resuperheater 13 are cut off from the steam supply.

Conventional shut-off valves 22 and 23 are provided in the conduits 12 and 14, respectively. Conduit 8 receives steam or water from an outside source through a conduit 30 and a valve 31. The steam or water is removed from the reheater 9 through a conduit 32 and a valve 33 therein.

The starting arrangement illustrated in the drawing in which the most heated resuperheater is cooled by a liquid or steam, and in which the other resuperheater is dry, requires a minimum of operating instructions because only a few valves must be operated. Since the second resuperheater (13) is heated by combustion gas of a temperature which is considerably lower than the temperature to which the resuperheater 9 is exposed, the resuperheater 13 need not be cooled during the starting-up period.

The system according to the invention is not only suitable for starting a steam generator, but can also be used when operating the steam generator at very low load. Starting resuperheaters dry greatly facilitates operation, particularly in plants in which steam is produced at super-critical pressure and at a very high temperature, and in which usually two resuperheaters are provided.

While a specific embodiment of the invention has been shown and described, it will be apparent to those skilled in the art that various changes, modifications, substitutions, additions and omissions may be made therein without departing from the spirit and scope of the invention as set forth in the appended claims.

I claim:

1. A forced flow high pressure steam generator including a combustion chamber, a combustion gas passage connected to said combustion chamber for receiving combustion gas therefrom and having zones consecutively passed through by the combustion gases and having consecutively reduced temperatures, steam generating and superheating tubes located in said gas passage, a plurality of resuperheaters for reheating steam at different pressures, one of said resuperheaters being located in the relatively hottest zone of said passage and being exposed to combustion radiant heat, the other of said resuperheaters being located in subsequent temperature zones of said passage and being heated by convection only, a coolant supply conduit connected to the inlet of the resuperheater which is located in the relatively hottest zone of said gas passage, a coolant discharge conduit connected to the outlet of said resuperheater which is located in the relatively hottest zone of said gas passage, and control valves in said conduits for closing said conduits during normal operation of the steam generator and for opening said conduits during starting of the steam generator for cooling the resuperheater which is located

in the relatively hottest zone of said passage and leaving the other resuperheaters uncooled during starting of the steam generator.

2. In a steam power plant having a plurality of turbines operating at different steam pressures and arranged in series relation with respect to the flow of the steam, a forced flow high pressure steam generator including a combustion gas passage having consecutive zones of consecutively reduced temperatures, steam generating tubes and steam superheating tubes located in said gas passage, said superheating tubes being connected with said generating tubes for receiving steam therefrom and having an outlet, a steam main connecting said outlet with that one of said turbines which operates at the highest pressure, a plurality of resuperheaters individually interposed for steam flow between said turbines and being individually entirely placed in different temperature zones of said combustion gas passage, the resuperheater which is located in the relatively hottest zone being at least in part exposed to combustion radiant heat, the other resuperheaters, which are located in subsequent temperature zones, being heated by convection only, a coolant supply conduit connected with the inlet of the resuperheater which is located in the relatively hottest zone of said gas passage, a coolant discharge conduit connected with the outlet of said resuperheater which is located in the relatively hottest zone of said gas passage, and control valves in said conduits for closing said conduits during normal operation of the steam generator and for opening said conduits during starting and low load operation of the steam generator for cooling the resuperheater which is located in the relatively hottest zone of said gas passage and leaving the other resuperheaters uncooled during starting and low load operation of the steam generator.

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