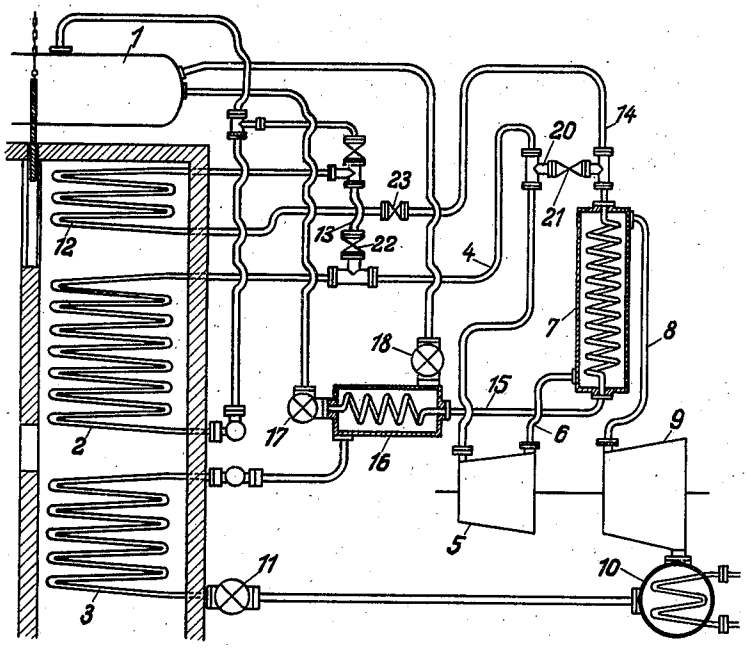
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RESUPERHEATING OF INTERSTAGE STEAM

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RESUPERHEATING OF INTERSTAGE STEAM

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My invention relates to apparatus for re-superheating interstage steam to a high temperature, and is especially applicable to high-pressure installations in which a high-pressure stage has been added to existing steam-power plants.

At the present time, such plants work with steam pressures of about 12 to 18 atmospheres and temperatures of about 350° C., and from the commercial standpoint, it is necessary to reheat the exhaust steam from the added high-pressure stage to a point at least as high as the temperature of the original working steam.

To provide interstage temperatures as indicated, a high degree of technical and commercial skill is required in the manufacture and operation of the plant especially when of large power.

In interstage superheaters with steam heating, single-stage superheaters are known for the lower interstage temperatures with heating by means of high-pressure saturated steam or by superheated working steam for high-pressure engines, and for higher degrees of superheating two-stage interstage superheaters, which effect a preliminary superheating of the interstage steam by utilizing part of the working steam and complete the superheating by means of the whole quantity of working steam admitted to the high-pressure stage of the engine; for this latter purpose, the working steam in the boiler superheater is given a higher superheat than is necessary for the working of the engine.

According to the present invention, the problem indicated above is solved by effecting the reheating of the interstage steam in a single interstage superheater by heating steam supplied for the purpose, the pressure of this heating steam being equal to that of the superheated boiler steam, while its degree of superheat is higher than that of the boiler steam.

For the purpose of effecting this reheating, a second steam superheater smaller than the working steam superheater is provided in a suitable part of the working steam boiler. The steam necessary for the interstage heating is preferably led to this second superheater through a branch from the main superheated-steam pipe, in order to be raised to the required higher temperature for effecting the interstage superheating.

This after-superheating of the heating steam may also be effected by a superheater with independent firing separate from the working steam boiler or from a group of such boilers.

With the material available at the present time for superheater tubes and with the comparatively high steam pressures now ruling, this superheating can be carried to 470–500° C. and with improved materials, a correspondingly higher temperature may be expected in the future.

Thus, each re-superheating operation is effected by means of a single interstage superheater with the advantage over the two-stage interstage superheater that the second interstage superheater, the cross-sectional areas of which must be large enough to accommodate the whole quantity of working steam, is eliminated, and with the further advantage that the necessary large temperature drop between the heating steam and the highly-superheated interstage steam occurs only in the small after-superheater with small cross-sectional areas and not in the main superheater which would have to be correspondingly enlarged.

A further advantage of the present invention lies in the fact that any danger arising from the high heating-steam temperatures is confined to the small after-superheater, so that if this superheater is damaged, it can be cut out and the plant can be provisionally worked with the main superheater alone, though with a lower degree of interstage superheating.

According to the difference in the interstage superheater between the temperature of the high-pressure working steam and the temperature of saturation of the heating-steam, the latter will be more or less condensed.

With equal interstage steam pressures, the quantity of heating steam which condenses is greater with high than with low working pressures, since the temperature of the inter-

stage steam temperature is lower in the former case.

As the return of a mixture of steam and condensate at the higher pressures and temperatures is difficult and causes trouble in the working of the pumps, the mixture is preferably first led under gravity to a feed-water heater arranged after the usual feed-water heater in the flue in order to complete the condensation of the residual steam, and forced from this preheater by means of a feed pump into the boiler with a small pressure difference.

In the drawing, an illustrative constructional form of an arrangement for carrying out the new method of working is shown diagrammatically.

The main steam drum of the working steam boiler is indicated by the numeral, 1, the main superheater, 2, and a feed-water heater, 3, being arranged in the flue. The superheated high-pressure working steam passes through a pipe, 4, to the added high-pressure stage of the engine, indicated in the drawing by way of example as a steam turbine, 5. The interstage steam flows through the pipe, 6, and through a single interstage superheater, 7, in order to pass as reheated steam through the pipe, 8, into the low-pressure turbine, 9, from the condenser, 10, of which the condensate is forced by means of a pump, 11, into the flue feed-water heater, 3.

According to the present invention, a small after-superheater, 12, is arranged in the flue gases in front of the main superheater, 2, into which after-superheater the highly-superheated working steam passes from the pipe, 4, through a branch pipe, 13, in order to be further superheated to the higher temperature desired for the interstage superheating. The heating steam from the after-superheater passes through the pipe, 14, into the heating coil of the interstage superheater, 7. The mixture of heating steam and condensed water flows through the pipe, 15, into the heating coil of a feed-water heater, 16, connected to the delivery of the flue preheater, 3, where it is completely condensed and fed back into the boiler by a pump, 17. The preheated feed-water after further heating in the supplementary preheater, 16, is likewise fed by means of a high-pressure pump, 18, into the boiler drum.

Between the pipe, 4, and the pipe, 14, is arranged a cross-connection, 20, with a shut-off valve, 21. In addition, shut-off valves, 22 and 23, are provided in the pipes, 13 and 14.

If damage occurs to the small superheater, 12, which is subjected to particularly high stresses, the valves, 22 and 23, are closed and the valve, 21, opened so that in a known manner the interstage superheating can be continued though to a reduced extent by means of working steam, and the working of the plant is not interrupted.

The heating steam which is branched off through the pipe, 13, and has the same pressure and the same temperature as the working steam, is given in the superheater, 12, a considerably higher superheat.

As mentioned above, if for any reason the after-superheater, 12, is not built into the boiler, it may be constructed separately with independent firing, the steam connections and method of working remaining otherwise unaltered.

The preheater, 16, is not essential to the invention in cases where it pays to withdraw sufficient heat from the heating steam in the interstage superheater to effect complete condensation. In general, however, it is of advantage to use the after-preheater heated by the heat of evaporation of the residual steam.

What I claim is:

1. In a steam power plant having two or more engine stages the combination of a steam generator, a main superheater, a steam heated interstage superheater, an additional after superheater, means to connect the main superheater alternatively with the after superheater or with the interstage superheater and means to connect the after superheater, when in connection with the main superheater, with the interstage superheater, substantially as set forth.

2. In a steam power plant having two or more engine stages the combination of a steam generator, a main superheater, a steam heated interstage superheater, an additional after superheater, means to connect the main superheater alternatively with the after superheater or with the interstage superheater and means to connect the after superheater, when in connection with the main superheater, with the interstage superheater, the main superheater and the after superheater being arranged within the flue of the steam generator, substantially as set forth.

3. In a steam power plant having two or more engine stages, the combination of a steam generator, a main superheater, a steam heated interstage superheater, an additional after superheater, means to connect the main superheater with the after superheater, means to connect the after superheater with the interstage superheater, and means to connect the main superheater with the high pressure stage of the engine.

In testimony whereof I affix my signature.

ROBERT UHDE.