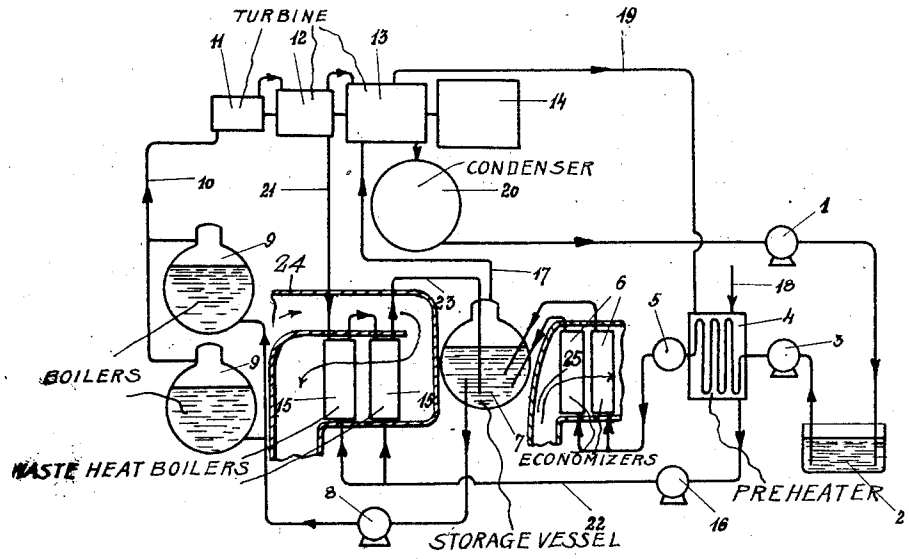
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STEAM PLANT IN CONNECTION WITH TURBINES

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STEAM PLANT IN CONNECTION WITH TURBINES.

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This invention relates to steam plants, particularly to turbine plants. An object of the invention is to utilize waste-heat from boiler furnaces and heat of the steam from turbines as completely as possible, using waste-heat and steam for power and heating purposes and for preheating feed-water to a high degree, whereby the heat content of the steam and the steam is utilized very economically.

The invention principally consists in that steam of relatively considerable pressure is extracted from the turbine to be used in waste heat boilers for producing a larger quantity of steam by introducing at the same time an additional quantity of water and by heating with waste heat and in that a part of the steam generated is used for heating the feed-water to a desired high temperature, while the condensed steam is also used as feed-water.

The invention further consists in that the water injected into the waste-heat boilers is taken from a pre-heater, into which additional fresh water is introduced at a suitable phase. Other features, objects and advantages will hereinafter appear.

In the accompanying drawing, a plant embodying this invention is illustrated diagrammatically.

This plant comprises the steam boilers 9 which supply steam through a pipe 10 to a steam turbine comprising three elements 11, 12 and 13, and driving a generator 14. The exhaust steam from the low pressure element 13 of the turbine flows into the condenser 20. The condensate is pumped from the latter by a pump 1 into a tank 2. From the latter, the condensate is pumped by a pump 3 through a system of coils or tubes of a surface preheater 4 and through a container or collector 5, which may be in certain cases also a purifying device, into the economizers 6 heated by the waste gases, in a flue 25 from the boilers 9, whence it is delivered, preheated to a high degree, into a closed pressure or collector tank 7 which may be preferably insulated against radiation of heat. This tank 7 is also equipped for steam delivery and forms a storage unit or auxiliary steam generator from which the feed-water is forced by pump 8 into the high pressure boilers 9.

In the plant indicated in the diagram, steam of the desired pressure and temperature is extracted from a suitable stage of the turbine element 12 through pipe 21 and passed into the waste-heat boilers 15, which are heated by waste combustion gases in the flue 24 from the boilers 9. Into these auxiliary boilers 15 water is injected. For this purpose, the condensate from the preheater 4 is used. This water is put by pump 16 through pipe 22 into the waste heat boiler 15. The water is quickly transformed into steam, due to the heat which is flowing into the boiler 15 from the waste heat gases in the flue 24, and due to the heat contained in the steam extracted from the turbine element 12. The extracted steam, augmented by the freshly developed steam, is passed from the boilers 15 through pipe 23 into the closed collector tank 7, where it is used for heating the water to a desired temperature, while the excess steam which may escape from the steam space in the storage tank 7 is fed through pipe 17 into the turbine element 13 at a suitable stage, which is indicated in the diagram near the front end of this turbine element 13.

It is obvious that the pressure difference between the extraction point of the turbine element 12 and the admission point of the turbine element 13 may be so selected that just a sufficient pressure difference prevails between the extraction point and that of reintroduction, to maintain the flow of the steam.

The steam for the preheater 4 is extracted from turbine element 13 at a lower pressure stage and passed through pipe 19 into the heat exchanger 4, where it flows in countercurrent around the coil or pipes through which the condensed water (feed-water) is pumped by pump 3 from the tank 2 to the storage tank 7 in the way as already described.

In the heat exchanger 4, which may be a surface heat exchanger or, in certain cases, a mixing heat exchanger, the steam is condensed, and the condensate is pumped by pump 16 into the waste-heat boilers 15, as above described.

The necessary additional fresh water which is required for steam generation to take care for the unavoidable losses is in-

troduced into the heat exchanger 4 through pipe line 18. The waste-heat boilers 15 are preferably arranged in series for counter current as indicated by the arrows in flue 24.

By this cycle in the process the recovery of heat and boiler feed-water is carried to a high point of economy. It is a great advantage of the new system that the feed-water is preheated to a very high temperature, as well by extraction steam as by waste-heat. Loss of heat is avoided to a relatively high degree in this cycle process, as the waste-heat is continuously used in the cycle.

While only one embodiment of the invention is shown, for illustration, it will be understood by those skilled in the art that many modifications in the arrangement of the apparatus and machinery may be possible or suggested according to the purpose and size of the plant. For instance, in certain cases, waste-heat from the boiler may be used for heating other parts of the apparatus.

It should be understood that the boilers, waste-heat boilers, preheaters, heat transmission apparatus and all the other apparatus may be of any suitable construction, according to requirements, local conditions, etc.

Claims—

1. A steam power plant comprising, in combination, steam boilers for producing high pressure steam, a multistage turbine fed with steam from said boilers, auxiliary boilers heated by waste-heat and fed with steam extracted from an intermediate stage of the turbine and with feed water, a condenser for the exhaust steam of the turbine, a preheater for preheating the condensate from the main condenser by steam extracted from a low pressure stage of the turbine, an economizer for further heating the preheated condensate by waste-heat, and a storage vessel for collecting such heated condensate and for receiving the steam from said auxiliary waste-heat boiler to heat the condensate in said storage vessel and for supplying steam therefrom into a suitable stage of the turbine.

2. A steam power plant comprising, in combination, a main steam boiler for producing high pressure steam, a multistage turbine receiving working steam from said boiler, an auxiliary steam boiler of lower working pressure than said main boiler and heated by waste-heat of said main boiler, a condenser for the exhaust steam of the turbine, means for preheating the condensate from the condenser by steam extracted from a low pressure stage of the turbine, means for further heating said preheated condensate by waste-heat, means for collecting such heated condensate together with steam from said auxiliary boiler, and a steam flow connection line for supplying steam from such collecting means to a suitable stage of the turbine.

3. A steam power plant equipment comprising, in combination, a main steam boiler, a multistage turbine fed therefrom, a main condenser for the exhaust steam of the turbine, a heater heated by steam extracted from a low pressure stage of the turbine for heating condensate collected from said main condenser, an auxiliary boiler heated by waste heat of said main boiler and receiving steam extracted from a higher pressure stage of the turbine and condensate obtained in said heater from the heating steam extracted from the lower pressure stage, a storage tank for collecting said heated condensate and steam from the auxiliary boiler, and means including a steam flow line from said tank to a turbine stage of lower pressure than said higher pressure stage to supply steam from said tank to said lower pressure stage of the turbine.

4. A steam power system comprising, in combination, a high-pressure steam boiler, a multistage turbine fed therefrom, a main condenser receiving the exhaust steam of the turbine, a preheater connected with a low pressure stage of the turbine for preheating condensate of the main condenser by steam extracted from such turbine stage, a storage tank for collecting the preheated condensate, and auxiliary boiler heated by waste heat and receiving steam extracted from an intermediate stage of the turbine and of higher pressure than the steam from said low pressure stage, means for supplying water into said auxiliary boiler, means for passing the steam from said auxiliary boiler into said collecting tank, and a steam flow connection line for supplying steam from said storage tank into a suitable stage of the turbine.

5. In a steam power plant, in combination, a turbine, a heater for heating the condensate obtained from the exhaust steam of the turbine by heating with steam extracted from a low pressure stage of the turbine, another heater receiving the condensate of such extracted low pressure steam for evaporating the same by heating with steam extracted from a higher pressure stage of the turbine and by heating with waste heat of said boiler, a storage vessel for collecting heated condensate and the steam of the latter heater, and means including a pipe line for supplying steam from said storage vessel into a suitable stage of the turbine.

6. In a steam plant, in combination with a main boiler, a turbine fed from said boiler, a preheater for the condensate from the exhaust of the turbine, said preheater being connected with a low pressure stage of the turbine to be heated by extracted steam; an auxiliary boiler heated by waste heat from said main boiler and receiving steam extracted from a higher pressure stage of the

turbine for evaporating the condensate of the steam extracted from the low pressure stage of the turbine and also additional feed-water; a storage vessel for collecting the pre-heated feed-water and further the steam from said auxiliary boiler, a steam line for supplying steam from said storage vessel to a suitable stage of the turbine, and means including a feed water line for supplying water from said storage vessel to said main boiler.

7. In a steam power plant the combination of a steam generator, a multistage turbine fed therefrom, a condenser for condensing the exhaust steam of the turbine, a heat exchanger for preheating the condensate, an auxiliary boiler heated by waste heat of said steam generator and connected with an intermediate stage of the turbine to receive steam therefrom, means for injecting condensed water and fresh feed-water into the auxiliary boiler, a closed combined collector and storage vessel for collecting the steam generated in the auxiliary boiler, and the condensate from the turbine, means for heating the condensate before it enters said collector including means for heating by steam extracted from a low pressure stage of the turbine, and means for supplying the surplus steam from said collector into a suitable stage of the turbine.

8. In a steam power plant, the combination of a steam generator, a multistage turbine, a condenser for condensing the steam from the turbine, a preheater for preheating the condensate and additional feed-water by steam extracted from a low pressure stage of the turbine, an auxiliary boiler heated by waste heat and connected with an intermediate stage of the turbine, means for supplying water, such as for example condensate mixed with fresh feed-water, into said auxiliary boilers, a closed accumulator for collecting the steam generated in the auxiliary boiler and the heated condensate from the turbine for use as accumulator liquid and as boiler feed water, a second preheater for preheating the condensate before it enters said accumulator by waste-heat from the boiler, and means including a steam line for supplying steam from said accumulator into a suitable stage of the turbine.

9. In a steam power plant, the combination of a main steam generator, a multistage turbine receiving working steam therefrom, a condenser for condensing the exhaust steam of the turbine, a pre-heater for the condensate, an auxiliary boiler heated by waste heat from said main steam generator, means to lead steam from an intermediate stage of the turbine to the interior of said auxiliary boiler, means for injecting water, such as condensate and fresh feed-water into said auxiliary boiler, a closed collector connected with said waste heat boiler and with the preheater for collecting together the steam generated in the auxiliary boiler and the heated condensate from the turbine, a pipe connection for feeding heated water from said collector into the main steam generator, means for preheating the condensate before it enters said collector by steam extracted from a low pressure stage of the turbine, and means for delivering steam from said collector into a suitable stage of the turbine.

10. A steam power plant comprising, in combination, a main boiler, a turbine unit, means for preheating the feed-water for the main boiler by steam extracted from the turbine, a collector tank forming a closed reservoir for said preheated boiler feed-water, an auxiliary boiler heated by waste heat and fed with extraction steam of the turbine and with additional water supplied thereto, a connection for conveying steam from said auxiliary boiler into said collector tank for further preheating the feed-water therein by the steam supplied thereto from the auxiliary boiler, and a steam supply connection from said collector tank for feeding the surplus of steam not utilized for preheating purposes to a suitable stage of the turbine.

11. A steam power plant comprising, in combination, a main boiler, a condensing turbine provided with steam extraction means, a condensing plant for said turbine, means for preheating the feed-water for the main boiler by extraction steam of the turbine and also by waste heat, a collecting-tank for said preheated boiler feed-water, auxiliary boilers heated by waste heat and fed with extraction steam of the turbine and further with water, such as condensate and boiler feed-water, connecting means for passing the steam from said auxiliary boiler into the collecting tank for further preheating the feed-water therein, and a steam line conveying steam not utilized for preheating the feed-water from said collecting tank to a suitable stage of the turbine.

12. In a steam power plant, the combination of a steam boiler with a turbine, a condenser for condensing exhaust steam from the turbine, a heat exchanger for heating the condensate and feed water by steam extracted from a low pressure stage of the turbine and for condensing said extracted steam, a series of auxiliary boilers heated by the waste heat of said steam boiler and interconnected for the passage of steam in a direction counter to the direction of waste heat flow and fed with feed water and the condensate of the extracted steam from said heat exchanger and further with steam extracted from a higher pressure stage of the turbine, a closed pressure-tank for collecting the steam generated in said auxiliary boiler together with the heated condensate of the exhaust steam of the turbine, and means for conveying

steam from said tank into a suitable stage of the turbine.

13. In a steam power plant, the combination of a steam boiler with a turbine, means for extracting steam from the turbine, means for heating the extracted steam and feed water for the boiler by waste heat of the boiler and means for feeding the steam produced by said heating means into a suitable pressure stage of the turbine.

In testimony whereof I affix my signature.

FRANZ LÖSEL.