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STEAM POWER PLANT

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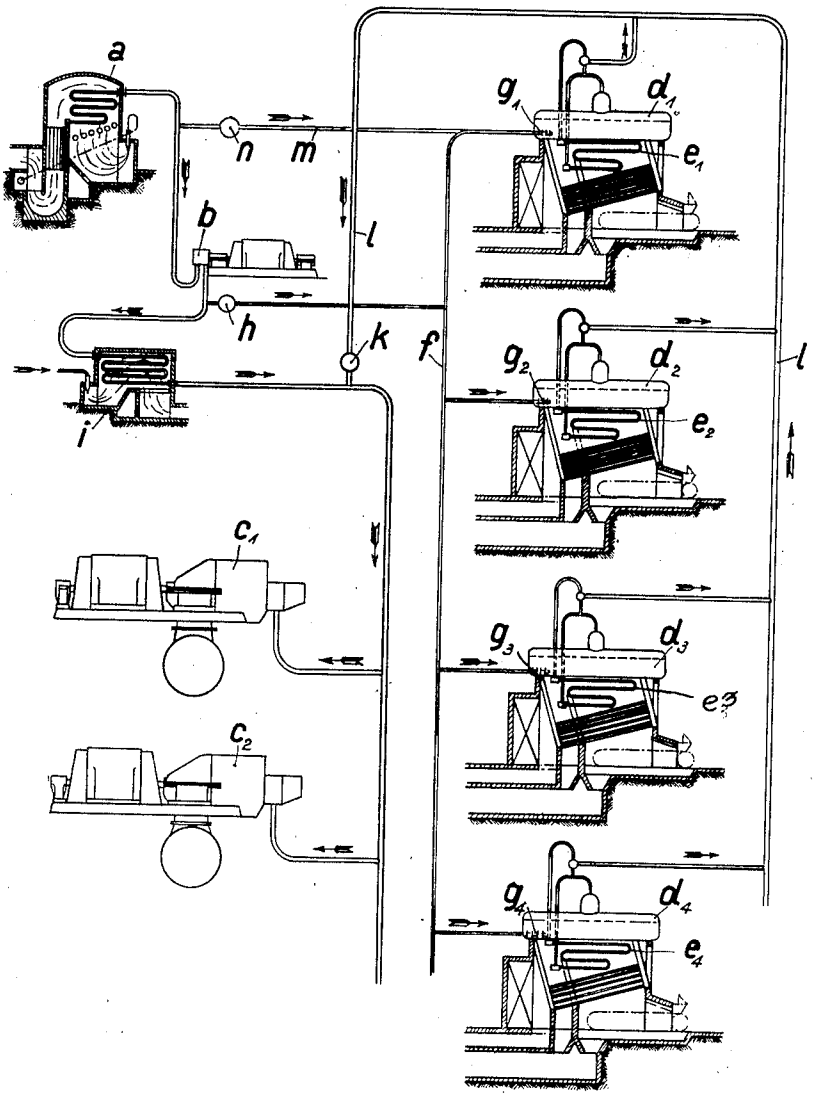

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STEAM-POWER PLANT.

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In steam power plants in which steam of very high pressure is used it is advantageous to design the high pressure steam generators of a size sufficient to supply steam to the engines at normal load, but not large enough to supply all the steam required for the station, any additional quantity of steam required being supplied by low pressure steam boilers and this low pressure steam being led to separate ordinary pressure engines (hereinafter referred to as "low pressure engines"), or in the case of steam turbines as additional steam to the low pressure stages of the high pressure engine. In the high pressure engine (hereinafter referred to as the "primary engine") the steam is expanded down to a pressure equal to that of the low pressure boiler and is then passed either directly to the low pressure engine or in the case of steam turbines to the low pressure stages of the primary turbine or to the steam main of the low pressure boiler after having been previously brought, in most cases in secondary superheaters, to the degree of superheat of the low pressure steam. By connecting the exhaust pipe of the primary engine with the steam main of the low pressure engines sudden variations in load are prevented from affecting the high pressure steam generators, which are not so well adapted for supplying a varying quantity of steam, and are transferred to the low pressure boilers, which can more easily deal with variations in the load owing to their larger water and steam space and their lower pressure. But this connection to the steam main has several disadvantages which the present invention has for its object to obviate.

These disadvantages appear as soon as large variations in the load occur and the steam supply to the low pressure engines differs to a considerable extent from normal. If the low pressure engines cannot take all the exhaust steam from the high pressure engine a return flow occurs to the low pressure boilers, the steam escaping through the safety valves thereof. Since this steam must pass through the secondary superheater and also through the superheater of the low pressure boilers, all the heat supplied in the superheaters is lost, when steam is blown off.

It has been proposed to lead the exhaust from a high pressure engine straight to low pressure boilers and to supply the whole of the steam required by low pressure engines entirely from these boilers. But this arrangement has the disadvantage that the low pressure boilers must be always at work and unless they are kept fired it is impossible to maintain the plant in continuous operation.

Now the subject-matter of the invention provides means to enable the high pressure and low pressure boilers to work in conjunction with the high pressure and low pressure engines so as to avoid the disadvantages of exhausting into the steam main and the low pressure boilers, but to retain the advantages of the two above-mentioned methods of working. The new arrangement consists in dividing the exhaust steam pipe from the high pressure engine into two branches of which one leads to the low pressure engine and the other to the water space of the low pressure boiler from which a second steam pipe is taken through a superheater to the low pressure engine. Non-return valves are provided to maintain the flow of the steam in the several pipes in the proper direction. The steam entering the low pressure boilers is introduced, for example, through distributing nozzles for the purpose of distributing the heat of the steam rapidly through the water in the low pressure boilers and storing the maximum quantity of steam.

The accompanying drawing illustrates diagrammatically a steam power installation in accordance with the invention.

As here indicated, a is a high-pressure steam generator, supplying a high-pressure turbine ("primary turbine") b, c^1, c^2, are low pressure turbines connected in parallel, and d^1, d^2, d^3, d^4, are low pressure boilers with superheaters e^1, e^2, e^3, e^4. The exhaust steam pipe from the primary turbine is denoted by f and discharges (for example) into the water space of the low pressure boilers d^1, d^2, d^3, d^4, through steam distributing nozzles g^1, g^2, g^3, g^4. At h a non-return valve is provided to prevent the return flow of water into the exhaust steam pipe of the primary turbine under any circumstances. The device designated by i is a superheater, k is a non-return valve to prevent the return flow of steam into the auxiliary steam pipe l leading from the low pressure boilers and m is a pipe connecting the high pressure boiler

with the low pressure boilers without passing through the primary turbine and n is a pressure-reducing valve that can be opened both automatically and by hand.

The following working conditions may occur in the plant illustrated:—

1. The generation of steam in the high pressure boiler a may be sufficient for the greatest load to be expected within the next few hours in which case all the steam will be supplied by the high pressure steam generator a and the low pressure boilers will be held in reserve for a later increase in the load.

In that case the exhaust steam from the primary turbine b passes either directly or, if secondary superheating is necessary through the secondary superheater i to the low pressure turbines c^1, c^2. If the load decreases the steam that cannot be taken by the low pressure turbines flows through line f into the low pressure boilers d^1, d^2, d^3, d^4 and is condensed there whilst heating the water in the boilers. If the load becomes still less, in which case the primary turbine is also affected, the high pressure steam flows through the pipe m to the low pressure boilers after having been reduced in pressure by means of the pressure reducing valve n.

2. The generation of steam in the high pressure boiler may not be sufficient for the maximum load.

In this case a portion of the low pressure boilers is under steam and a portion is held in reserve. The steam from the primary turbine b passes through the secondary superheater i into the low pressure turbines and if a still larger quantity of steam is required for the low pressure turbines this low pressure steam is supplied by the low pressure boilers d^1, d^2, d^3, d^4 through the steam main l. When the load decreases the surplus exhaust steam from the primary turbine flows through the pipe f to the low pressure boilers and is stored therein.

3. The steam required may have to be supplied by the high and low pressure boilers together.

In this case the exhaust steam from the primary turbine b passes through the superheater i into the low pressure turbines and at the same time steam flows into the low pressure turbines from the steam main l. In the event of the load being suddenly reduced the safety valves of the low pressure boilers will blow off.

What I claim is:—

1. A power plant installation comprising in combination a high pressure steam generator, a high pressure steam engine supplied therefrom, a low pressure steam generator, a low pressure steam engine, steam connections from the exhaust of the high pressure steam engine to the low pressure steam generator and to the low pressure steam engine, a steam connection from the low pressure steam generator to the low pressure steam engine, and means for heating steam passed from the exhaust of the high pressure engine to the low pressure engine.

2. A power plant installation comprising in combination a high pressure steam generator, a high pressure steam engine supplied therefrom, a low pressure steam generator, a low pressure steam engine, steam connections from the exhaust of the high pressure steam engine to the water space of the low pressure steam generator and to the low pressure steam engine, a superheater between the high and the low pressure steam engines and a steam connection from the low pressure steam generator to the low pressure steam engine, the connection to said water space providing communication between the same and the exhaust of the high pressure steam engine independently of said superheater.

3. A power plant installation comprising in combination a high pressure steam generator, a high pressure steam engine supplied therefrom, a low pressure steam generator, a low pressure steam engine, a steam connection from the exhaust of the high pressure steam engine having two branches, one to the low pressure steam generator and one to the low pressure steam engine, a superheater in the branch to the low pressure steam engine, a superheater connected to the low pressure steam generator and a steam connection from the last mentioned superheater to the low pressure steam engine.

4. A power plant installation comprising in combination a high pressure steam generator, a high pressure steam engine supplied therefrom, a low pressure steam generator, a low pressure steam engine, a steam connection from the exhaust of the high pressure steam engine having two branches one to the low pressure steam generator and one to the low pressure steam engine, a non-return valve in the branch to the low pressure steam generator, a superheater in the branch to the low pressure steam engine, a superheater connected to the low pressure steam generator, a steam connection from the last mentioned superheater to the low pressure steam engine and a non-return valve in this steam connection.

Dated this 7th day of November, 1924.

W. G. NOACK.