Jan. 29, 1929. 1,700,651

J. RUTHS

STEAM PLANT

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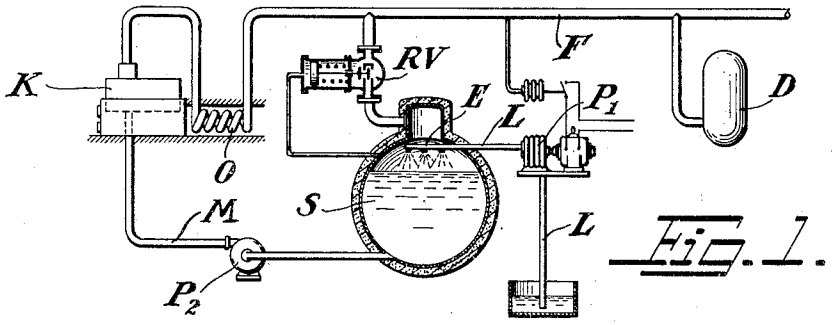


Fig. 1.

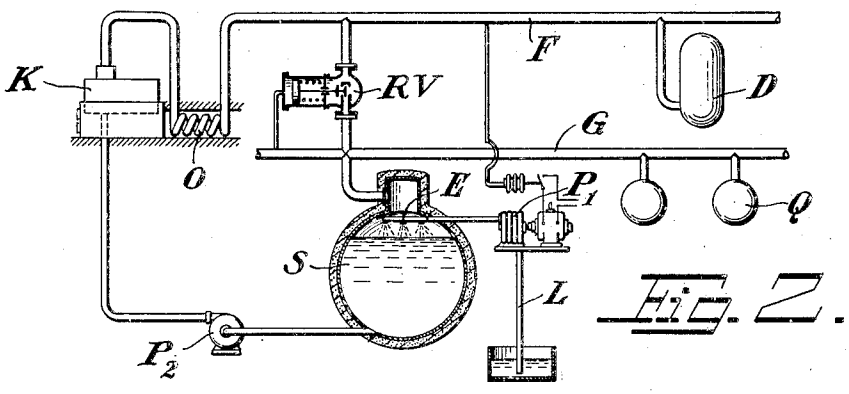


Fig. 2.

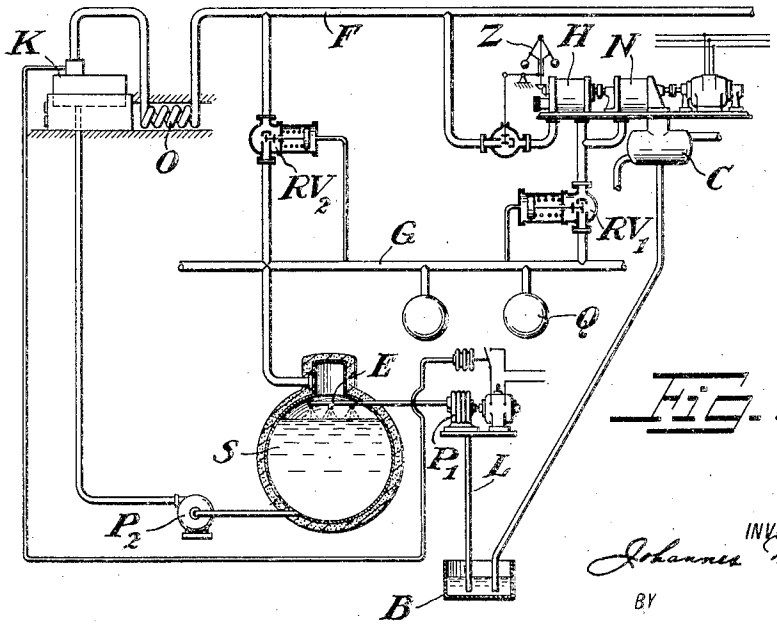


Fig. 3.

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STEAM PLANT.

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In steam plants, where the steam demand varies considerably, it is advantageous to equalize the variations between the generation of steam and the steam consumption in such a manner that a uniform firing of the boilers of the plant is made possible. Such an equalization can be obtained in known manner by condensing surplus steam produced in the boilers during periods of small steam consumption, and storing this surplus steam in the water of a special container; whilst during periods of great steam demand all the generated steam is used by the steam consumers. The boiler is meanwhile suitably fed with hot water from the container, so that, at a constant rate of firing, the rate of steam generation in the boiler also remains constant. It is further known to condense the surplus steam in a container having the same pressure as the boilers, by regulating the cold water supply to the storer in response to the variations of the boiler pressure in such a manner that the water supply increases when the pressure increases so that more steam will be condensed, i. e. when the steam demand of the steam consumers is small and vice versa. In this manner the pressure in the boiler and in the storer or accumulator is kept constant.

The ability of such an arrangement to equalize variations between steam generation and steam consumption is limited due to the relation of the difference between heat contents of the cold and hot water on the one hand and to the heat of steam to be condensed on the other hand. Such arrangements are used more seldom in industrial factories with high peaks in steam load than in power stations where it is desirable, for engineering efficiency, to have steam of constant high pressure. However, power stations often use very high pressure, wherefore an accumulator which operates at the same high pressure as the boilers is very expensive and uneconomical.

This inconvenience is avoided by the present invention in such way that the accumulator operates at a lower pressure than the boiler and the steam supply to the accumulator is controlled, for example, by means of a reducing valve operated by the pressure in the accumulator in such a way that the pressure or the temperature in the accumulator is kept constant or nearly constant.

My invention is illustrated by means of the accompanying drawings, wherein Fig. 1 shows an embodiment of a plant of this type, Fig. 2 shows a modification thereof, and Fig. 3 shows another modification.

In the embodiment of Fig. 1, the steam generated in the boiler K flows through the superheater O into the boiler conduit F, to which conduit consumers D can be connected. This conduit is connected to the hot water accumulator S by means of a conduit including a reducing valve RV, regulated by the pressure in the accumulator. The pump P_1 is regulated by the pressure in the boiler or in a steam conduit from the boiler. When the pressure in this conduit rises, the pump P_1 forces cold water into the accumulator S through the conduit L and the spray device E in order to condense steam in the accumulator, whereby the pressure in the accumulator will drop. The consequence is that the reducing valve RV opens and just as great a steam quantity as corresponds to the amount of the surplus steam, is condensed in the accumulator, thus keeping the pressure in the accumulator constant or nearly constant. The boiler K is fed with water from the accumulator S through the pump P_2 in conduit M.

If a plant has also consumers operating at a lower pressure than the boiler pressure, it would be advantageous to regulate the steam supply to the consumers as well as to the accumulator by means of a joint reducing valve. Such an arrangement is shown in Fig. 2, wherein the consumers Q are connected to the accumulator S through the conduit G and the joint reducing valve RV is operated by the pressure in this conduit, which pressure corresponds with the accumulator pressure. The same reference characters are used in this figure as in Fig. 1.

Fig. 3 shows an embodiment of the invention according to which the accumulator S is connected to a steam conduit G, fed from the high pressure stage H of a turbine for example a bleeding turbine. The quantity of steam coming from the high pressure stage H, which is not required by the consumers Q or by the accumulator, flows into the low pressure stage N and is condensed in the condenser C, the condensate flowing into the storer B. If the steam demand in the plant decreases, the pressure in the boiler K and in

the steam conduit F increases, whereby the pump P_1 forces more cold water from the storer B through the conduit L and the spray device E into the accumulator. The pressure in the accumulator drops and the reducing valve RV_1 opens and admits more steam to pass, so that a greater part of the load of the turbine is taken over by the high pressure stage of the turbine, thus discharging its low pressure stage. As the steam consumption per kw.-hour increases, more steam is drawn off from the steam conduit F. Only when the high pressure stage is fully charged or the speed regulator Z of the engine begins working, does the reducing valve RV_2 also open on account of the continued pressure drop in the conduit G, and steam is passing directly from the boiler into the accumulator.

Having thus described the nature of my invention and the manner in which the same can be performed, what I claim is:

1. In a steam plant, in combination, a boiler, a hot water accumulator working with lower pressure than the boiler, a conduit to supply cold water to said accumulator, means in said conduit actuated by boiler pressure and operating to increase flow of cold water through said conduit upon increase of pressure and decrease flow through said conduit upon decrease of pressure, a steam conduit connecting said boiler to said accumulator, a reducing valve in the last mentioned conduit actuated by the pressure in the accumulator and operating to increase steam flow to the accumulator upon decrease of pressure in the accumulator and decrease flow of steam upon increase of pressure in the accumulator, and means to conduct water from said accumulator to said boiler.

2. In a steam plant, in combination, a boiler, a superheater, a hot water accumulator, a main steam conduit, steam consumers connected to said conduit, a second steam conduit of lower pressure, steam conducting means connected between the steam conduits and the accumulator, a conduit to supply cold water to said accumulator, automatic means responsive to changes of pressure in said boiler operating to increase flow of water through said water conduit upon increase of boiler pressure and decrease flow through said conduit upon decrease of boiler pressure, a reducing valve in said steam conducting means between the main steam conduit and the steam conduit of low pressure actuated by the pressure in the accumulator and means to conduct hot feed water from the accumulator to the boiler.

3. In a steam plant, in combination, a boiler, a superheater, an accumulator, a main steam conduit, a turbine fed with steam from said conduit, said turbine including a high pressure stage, a low pressure conduit, an exhaust conduit connecting the high pressure stage of the turbine with said low pressure conduit, steam conducting means connecting the main steam conduit, the low pressure steam conduit and the accumulator, reducing valves in said steam connecting means and in the exhaust conduit of the turbine actuated by the pressure in the accumulator and by the pressure in the low pressure steam conduit in such a manner that more steam flows into the accumulator upon drop of pressure in the accumulator, a conduit to supply cold water to the accumulator, pressure actuated means in said conduit operating to increase flow through said conduit upon increase of boiler pressure and decrease flow through said conduit upon decrease of boiler pressure and means to conduct feed water from the accumulator to the boiler.

4. In a steam plant, in combination, a boiler, a superheater, a hot water accumulator, a main steam conduit, steam consumers connected to said conduit, a second steam conduit of lower pressure, steam conducting means connected between the steam conduits and the accumulator, a conduit to supply cold water to said accumulator, automatic means responsive to changes of pressure in said boiler operating to increase flow of water through said water conduit upon increase of boiler pressure and decrease flow through said conduit upon decrease of boiler pressure, a reducing valve in said steam conducting means between the main steam conduit and the steam conduit of lower pressure actuated by the pressure in the lower pressure steam conduit and means to conduct hot feed water from the accumulator to the boiler.

5. In a steam plant, in combination, a source of steam, an accumulator, means to supply cold water to said accumulator in accordance with variations of pressure in said source, said means operating to increase the supply of cold water on increase of pressure in said source, a steam conduit connecting said source with said accumulator, a valve in said conduit operating to increase flow of steam from the source to the accumulator on decrease of pressure in the accumulator and means to withdraw hot water from the accumulator for use.

In testimony whereof I hereunto affix my signature.

JOHANNES RUTHS.