July 25, 1939. C. G. WALLIN 2,167,469

STEAM PLANT

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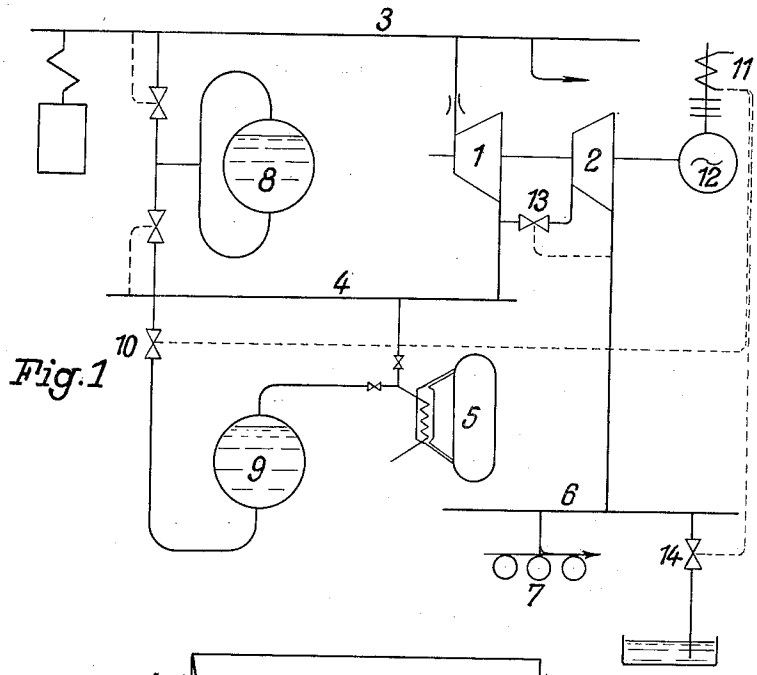


Fig. 1

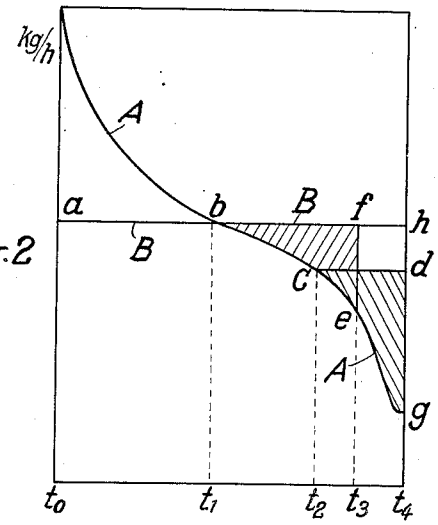


Fig. 2

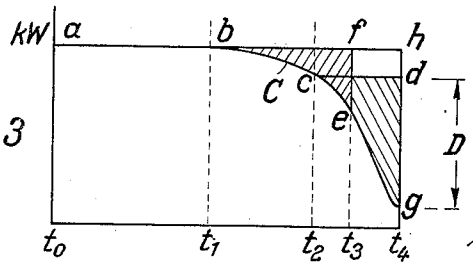


Fig. 3

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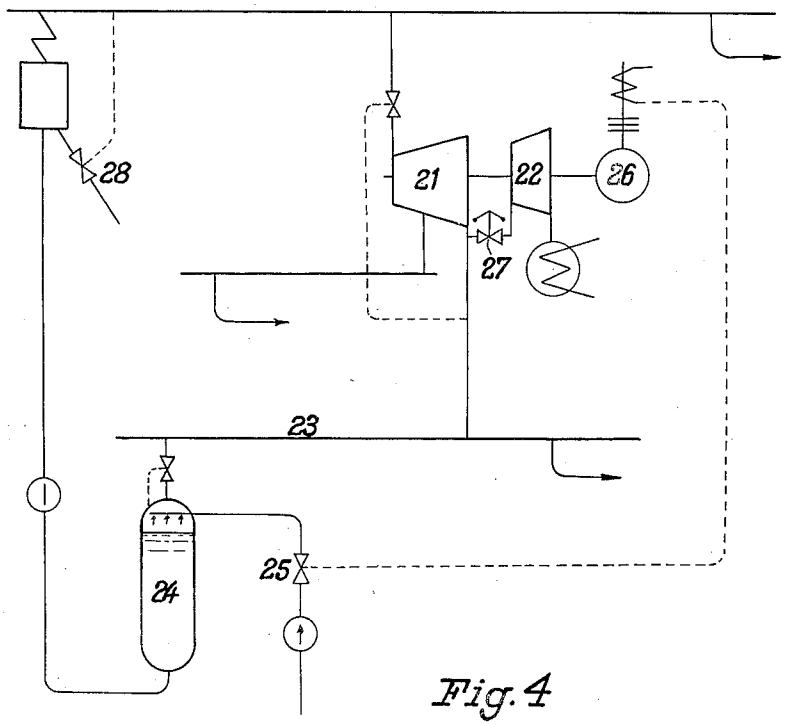


Fig. 4

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STEAM PLANT

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7 Claims. (Cl. 290—2)

The invention relates to a steam plant in which there is a large and somewhat variable demand for low pressure steam. In accordance with the invention high pressure steam is generated and is passed through a back pressure engine before being supplied to the low pressure consumers. The power developed by the engine may be used to generate electric energy to be used to supply the demand for power in the plant, which may be substantially constant. If the amount of electricity thus generated is not sufficient, it may be supplemented by power obtained from an outside source, such as a power company.

Inasmuch as the flow of steam through the engine is dependent upon the demand for low pressure steam, when such demand is low the steam flowing through the engine will be capable of generating only a small quantity of electricity, and hence a large amount must be purchased from the power company. However, in accordance with my invention, a low pressure accumulator is connected to the exhaust of the engine and the charging valve of this accumulator is regulated by the electrical output of the generator driven by the engine in such a way that, if the consumption of low pressure steam is reduced and the consequent reduction in steam flow through the engine causes a reduction in the power generated, the charging valve is opened, thus permitting additional steam to flow through the turbine and be stored in the accumulator. Such steam may be utilized thereafter to supply peaks in the demand for low pressure steam. In this way the output of the engine may remain substantially constant in spite of varying demand for the low pressure steam exhausted from the engine, while at the same time preventing waste of low pressure steam.

Fig. 1 is a more or less diagrammatic view of an embodiment of my invention as applied to a cellulose plant;

Figs. 2 and 3 are diagrams representing certain conditions obtaining in the operation of the apparatus shown in Fig. 1; and

Fig. 4 is a more or less diagrammatic view of another embodiment of my invention.

Fig. 1 is a layout of a cellulose factory. An extraction back pressure turbine 1, 2 serves for power production, this turbine taking the steam from the high pressure line 3 and supplying it to the intermediate pressure line 4 which supplies steam to the consumer 5, the latter being shown as a preheater, and to low pressure line 6 for supplying paper machine 7. Between lines 3 and 4 a high pressure accumulator 8 is inserted. To line 4 is connected a low pressure accumulator 9, in the charging pipe of which is arranged regulating valve 10 which is governed by the electrical output regulator 11 in such manner that the valve begins to open when the output of generator 12 has dropped to a minimum amount of, say, 1000 kw., and closes when the output of the engine rises above 1000 kw.

The steam supply to the turbine from the high pressure line 3 is normally not regulated, the turbine thus taking as much steam as corresponds to the total consumption. When valve 10 is closed the total consumption of steam by the turbine is determined by the demand of the plant for process steam. The flow of steam through the low pressure stage of turbine 2 is governed by a reducing valve 13 the opening of which corresponds to the steam demand of low pressure line 6 which in the present example is assumed to be constant.

In Figs. 2 and 3 the working period of the steam plant and generator is indicated. A is the variable steam consumption of the plant, B the substantially constant steam production of the boiler, and C the output produced by the generator. Between times t_1 and t_4 the steam consumption is lower than the steam production of the boiler. During this period the excess steam passes to the accumulator 9 if valve 10 has been opened. Otherwise it passes to high pressure accumulator 8.

In the described plant the excess steam during the period t_1—t_2 is absorbed by the high pressure accumulator 8, and it is assumed that at the point t_2 the required minimum output of the generator is reached. As the demand of consumer 5 for low pressure steam is reduced, the charging valve 10 of accumulator 9 consequently opens at time t_2 and prevents a further reduction in the steam quantity flowing through high pressure part 1 of the turbine. With decreasing steam demand of the plant the steam supply to accumulator 9 is increased by means of charging valve 10. The produced output thus takes the course according to line a—b—c—d. Accordingly in Fig. 2 the steam quantity flowing through high pressure stage 1 is also indicated by a—b—c—d. High pressure accumulator 8 takes up the quantity of steam represented by the area lying between straight line B and line b—c—d. The steam quantity represented by the area lying between line c—d and line A flows into the low pressure accumulator.

The steam thus accumulated is thus available for use during periods, such as represented by

t_0—t_1, when the demand for low pressure steam is greater than the amount supplied by the boiler. Use of the accumulated steam during such periods reduces the boiler capacity required for any given plant.

Instead of being regulated in the manner described, the charging of the accumulator might for instance take place in such a way that first the low pressure accumulator 9 is charged with the excess steam, the steam quantity represented by the area bordered by the lines *b*—*f*—*e*—*c*—*b* flowing into the low pressure accumulator, which at the point t_3 is filled. At point t_3 the output of the engine is constant (Fig. 3) and would then gradually decrease according to line *e*—*g*.

With this mode of operation the distance *d*—*g* would thus represent the additional amount D of power to be supplied by an outside station.

In Fig. 1 a valve 14 connected to the low pressure line 6 is provided which opens if the low pressure accumulator 9 becomes fully charged too soon and is hence unable to absorb more steam. In this case, when the electrical minimum output is reached, valve 14 allows the excess steam to escape into the open (unless it can be used somewhere else) in order to prevent a further decrease of the engine output. This can occur, for instance, if owing to a disturbance one of the paper machines 7 goes out of action and hence does not require steam.

Fig. 4 illustrates another modification of the invention. Here the turbine consists of an extraction back pressure part 21 and a condensing part 22. To the low pressure line 23 a hot water accumulator 24 is connected. In the cold water supply pipe to the accumulator a regulating valve 25 is arranged which is governed by the output of generator 26. If the output produced reaches a certain lower limit, valve 25 opens and allows water to enter accumulator 24. A valve 30 is disposed in the line between the exhaust of high pressure section 21 and accumulator 24 and is controlled by the pressure within the accumulator so as to open upon a reduction in pressure, which is caused by the introduction of cold water, to thus permit steam to be charged into the accumulator. Therefore steam from low pressure line 23 is condensed and the flow of steam through the machine increased, so that the output does not drop below the desired minimum amount.

In Fig. 4 it is further assumed that firing 28 of the steam boiler is regulated in accordance with the boiler pressure, as accumulator 24 does not equalize all fluctuations and adjustment of the steam production to the demand is necessary.

The scope of my invention is not to be limited by the above described embodiments, which have been given by way of example only, but is to be determined by the appended claims in view of the prior art.

What I claim is:

1. In a steam plant, a source of steam, a back pressure steam engine, a consumer connected to receive steam from the exhaust of said engine, an accumulator connected to the exhaust of said engine, a valve between said engine and said accumulator, and means responsive to decreasing and increasing power output, respectively, of said engine to open and close, respectively, said valve.

2. In a steam plant, a source of steam, a back pressure steam engine, a consumer connected to receive steam from the exhaust of said engine, an accumulator connected to the exhaust of said engine, a valve between said engine and said accumulator, an electric generator operated by said engine, and means responsive to decreasing and increasing electric power output of said generator to open and close, respectively, said valve.

3. In a steam plant, a source of steam, a back pressure engine having a low pressure condensing section of limited capacity and a high pressure section, an accumulator arranged to receive steam from the high pressure section of the engine, a valve between said high pressure section and said accumulator, and means responsive to decrease in the power output of said engine below a predetermined value for opening said valve, whereby to cause steam from said high pressure section to be stored in said accumulator.

4. In a steam plant, a source of steam, a back pressure steam engine, an accumulator connected to the exhaust of said engine, a conduit for supplying relatively cold water to said accumulator, a valve in said conduit, and means responsive to decreasing and increasing power output, respectively, of said engine to open and close said valve.

5. In a steam plant, a source of steam, a back pressure steam engine, an accumulator connected to the exhaust of said engine, a conduit for supplying relatively cold water to said accumulator, a valve in said conduit, means responsive to decreasing and increasing power output, respectively, of said engine to open and close said valve, a valve between said engine and said accumulator, and means responsive to a decrease in pressure in said accumulator for opening the last mentioned valve.

6. That improvement in the art of steam generation and utilization which includes generating comparatively high pressure steam, utilizing said steam to produce power in a prime mover, taking steam from the prime mover and storing it in an accumulator when the power output of the prime mover falls below a predetermined value, thus causing an increase of steam flow through the prime mover in order to increase the power output thereof.

7. That improvement in the art of steam generation and utilization which includes generating comparatively high pressure steam, utilizing said steam for the production of power in a prime mover, supplying steam discharged from the prime mover to a low pressure steam consumer and storing steam discharged from the prime mover when the power output thereof falls below a predetermined value to thereby cause an increase in the steam flow through the prime mover in order to increase the power output thereof.

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