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POWER PLANT

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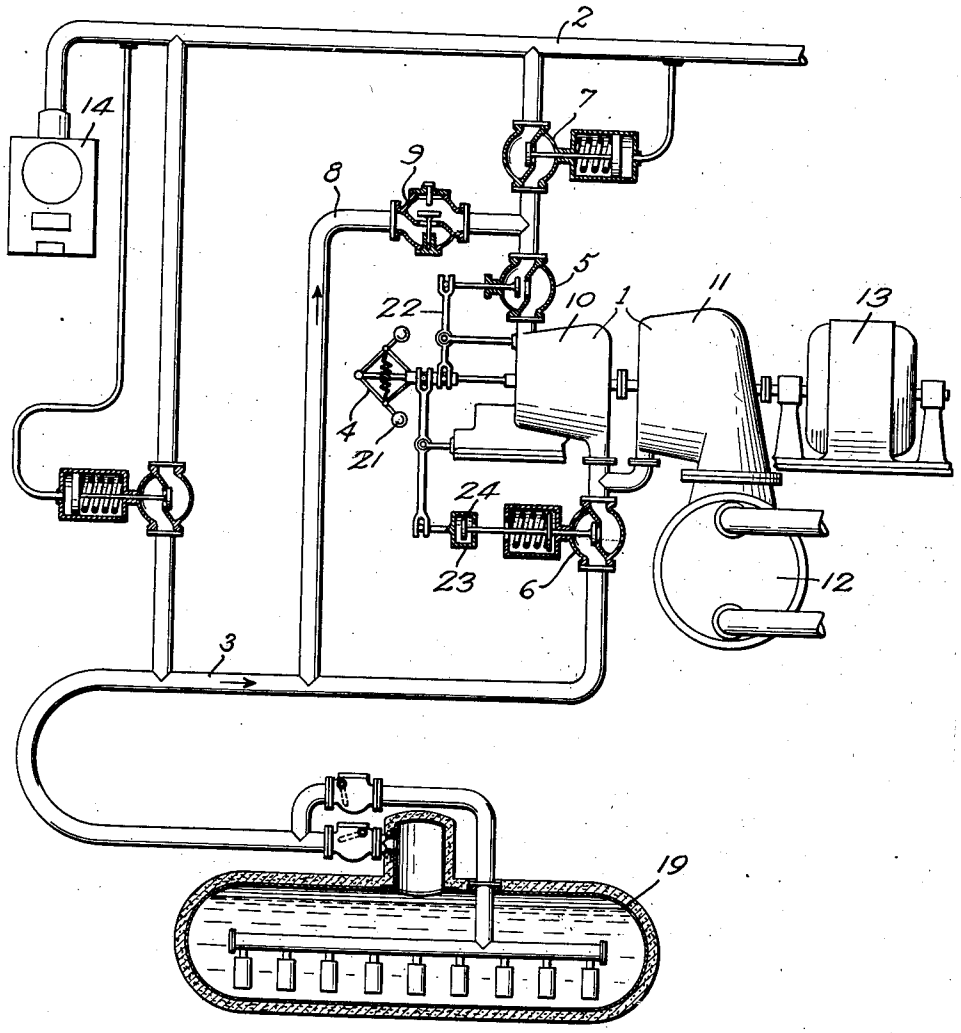

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POWER PLANT

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My invention relates to use of steam of different pressures in a prime mover such as a steam turbine, and more particularly to an arrangement for the introduction of steam from an accumulator to the highest pressure stages of the prime mover.

In known arrangements, the regulation of mixed pressure turbines when the load is increasing is such that a speed responsive governor operates to first open the high pressure steam admission valve and then to open the low pressure steam admission valve. Usually it is the practice in systems of this kind to employ an overflow valve ahead of the high pressure steam admission valve for the purpose of maintaining the pressure of the steam in the high pressure conduit constant. In the operation of plants of the type above referred to, if a shortage of high pressure steam occurs it is balanced by supplying low pressure steam to the turbine.

Under certain operating conditions this method of control or governing has been unsatisfactory. If, for example, there is an increase in load and the overflow valve is closed, the governor will first open the high pressure admission valve and then the low pressure admission valve. In such a situation the turbine must meet the demands for power entirely from steam supplied by the low pressure source, since the overflow valve in the high pressure supply conduit is closed. Let it be assumed that at this time the overflow valve opens. This would result in full admission of high pressure steam to the turbine and a dangerously high speed before the governor could act to close the admission valve to correspond with the load, since in the arrangement just described it is necessary to first close the low pressure admission valve.

On the other hand, when the turbine is operating at low load and the overflow valve cuts off the supply of high pressure steam, the turbine may slow down too much before the low pressure admission valve can be opened to supply the turbine with low pressure steam.

The purpose of the present invention is to avoid the foregoing unreliable regulation and to provide means for admitting steam from a Ruths type accumulator to the high pressure steam admission valve. As is well known, the steam pressure in an accumulator may vary over a wide range of pressures, the highest of which may be nearly as high as the live steam pressure. If the overflow valve closes in the arrangement according to the present invention, steam of relatively high pressure may be supplied immediately to the high pressure or live steam admission valve. This results in the advantage that useful work is performed in the first stages of the turbine which acts as a means for throttling the accumulator steam down to the pressure required by the lower pressure stages. Furthermore, delay in the action of the speed responsive governor is avoided when the overflow valve closes, and there will be a reduction in steam consumption due to the more efficient utilization of the steam from the accumulator.

The accompanying drawing, which is to be considered as a part of this specification, shows more or less diagrammatically, a power plant in accordance with the invention.

Referring now to the drawing, reference character 1 designates a prime mover, preferably a turbine. The turbine comprises two sections, 10 and 11. Each section includes the usual turbine wheels and guides. Section 10 is the high pressure section and section 11 the low pressure section. The exhaust steam from section 11 is discharged into and condensed by condenser 12. The turbine drives an electric generator as indicated at 13.

The turbine is supplied with both live steam of relatively high pressure and accumulator steam which may be of a pressure approaching the live steam pressure. The high pressure steam is supplied through the conduit 2, connected to a boiler 14. Steam flows from the boiler 14 or other high pressure source through conduit 2 to the first stage of the turbine. At the inlet to the first stage of the turbine and controlling the supply of steam thereto from the high pressure source

is a high pressure admission valve mechanism 5.

Steam from the accumulator 19 is conducted to the lower pressure turbine section 11 through a conduit 3. The supply from the accumulator is controlled by a low pressure admission valve mechanism 6. Valve mechanisms 5 and 6 are controlled by a speed governor 4 responsive to the speed of turbine 1. The governor operates in the usual manner to first open the high pressure admission valve upon increase of load and then to open the low pressure admission valve upon further increase of load. As diagrammatically indicated in the drawing, when the balls 21 of the governor move closer together due to decrease of speed on increase of load, lever 22 opens valve 5 and then the loose coupling member 23 engages the abutment 24 on the stem of valve 6 and opens this valve mechanism.

In conduit 2 is an overflow valve 7 which is responsive to variations of pressure in conduit 2 and operates to maintain this pressure constant. When the pressure in conduit 2 is below a predetermined value, valve 7 is closed.

A connection 8 connects the low pressure or accumulator steam conduit 3 with a point in conduit 2 ahead of the valve mechanism 5 and behind the overflow valve 7. In connection 8 is a check valve 9, which permits flow therethrough toward conduit 2, but prevents flow therethrough in the opposite direction.

The operation of the plant is as follows:

Assume that accumulator 19 is fully charged and its pressure is nearly as high as the live steam pressure. Assume also for the purpose of illustration that the turbine is operating under normal conditions when overflow valve 7 closes. The speed of the turbine will drop slightly, opening valve mechanism 5 slightly, and steam from the accumulator enters conduit 2 through conduit 8 and check valve 9. With steam of slightly lower pressure and greater opening of valve mechanism 5, the same power output from the turbine is obtained as before. While the accumulator is carrying the load, provision for an increasing load may be made by increasing the rate of steam generation in the boiler 14. Assume that the load is increasing. The governor has opened valve 5 to its limit and is ready to open valve 6. At this time, however, the pressure and rate of steam generation in the boiler has been given an opportunity to build up to a point where the overflow valve again opens and the live steam supply replaces the accumulator steam supply which is now considerably reduced in pressure. Flow of high pressure steam through valve 7 closes valve 9. Assume now that still more power must be generated. Valve 6, as just stated above, is ready to open and does open, allowing the reduced pressure steam from the accumulator to enter therethrough.

On decreasing load, the reverse operation occurs. First valve 6 closes and valve 5 controls the steam admission. However, during the time valve 5 is controlling, the high rate of steam generation in the boiler which was necessary on increasing load, may be supplying more steam than is needed at the moment, and this steam is absorbed by the water in the accumulator. This increases the pressure in the accumulator to its initial point, which may be nearly as high as the live steam pressure. If the load continues to decrease and the generation of steam in the boiler has dropped to a point where overflow valve 7 again closes, steam from the accumulator may again be supplied to the first stage of the turbine through conduit 8.

From the foregoing it will be clear that I have provided a means for maintaining the speed of a mixed pressure turbine operating at variable load substantially constant. Furthermore, by the expansion of accumulator steam in the first section of the turbine to a pressure suitable for the second section, a considerable saving in steam consumption is made, because the loss due to throttling the initial accumulator pressure down to the pressure required for the second section is avoided.

It will be understood that the invention is not to be limited to the specific parts and arrangement described, but that various other plant arrangements are possible and readily apparent to those skilled in the art to which the invention belongs.

What I claim is:

1. A steam plant comprising a relatively high pressure source of steam, a relatively low pressure source of steam, a prime-mover having a plurality of stages, a first steam supply conduit for conducting steam from the first mentioned source to an initial stage of said prime-mover, an overflow valve arranged in said first conduit, a second steam supply conduit for conducting steam from the second mentioned source to a lower pressure stage of said prime-mover, valve mechanism controlling flow of steam through said first steam supply conduit to said initial stage, valve mechanism controlling supply of steam through said second steam supply conduit to said lower pressure stage, means responsive to speed of said prime-mover for successively controlling said valve mechanisms, a connection connecting said second steam supply conduit with said first steam supply conduit ahead of the speed controlled valve mechanism controlling flow to the initial stage and behind said overflow valve, and means permitting flow of steam through said connection toward said first supply conduit and preventing flow from said first sup-

ply conduit through said connection to said second supply conduit.

2. A steam plant comprising a boiler, an accumulator, a prime-mover having a plurality of stages, a first steam supply conduit for conducting steam from said boiler to an initial stage of said prime-mover, an overflow valve arranged in said first conduit, a second steam supply conduit for conducting steam from said accumulator to a lower pressure stage of said prime-mover, valve mechanism controlling flow of steam through said first steam supply conduit to said initial stage, valve mechanism controlling supply of steam through said second steam supply conduit to said lower pressure stage, means responsive to speed of said prime-mover for successively controlling said valve mechanisms, a connection connecting said second steam supply conduit with said first steam supply conduit ahead of the speed controlled valve mechanism controlling flow to the initial stage and behind said overflow valve, and means permitting flow of steam through said connection toward said first supply conduit and preventing flow from said first supply conduit through said connection to said second supply conduit.

3. A steam plant comprising a relatively high pressure source of steam, a relatively low pressure source of steam, a prime mover having a plurality of stages, a first steam supply conduit for conducting steam from the first mentioned source to an initial stage of said prime-mover, a second steam supply conduit for conducting steam from the second mentioned source to a lower pressure stage of said prime-mover, valve mechanism controlling flow of steam to said initial stage, valve mechanism controlling supply of steam to said lower pressure stage, means responsive to speed of said prime-mover for successively controlling said valve mechanisms, a connection connecting said second steam supply conduit with said first steam supply conduit, and means permitting flow of steam through said connection toward said first supply conduit and preventing flow from said first suply conduit through said connection to said second supply conduit.

4. A steam plant comprising a boiler, an accumulator, a prime-mover having a plurality of stages, a first steam supply conduit for conducting steam from said boiler to an initial stage of said prime-mover, a second steam supply conduit for conducting steam from said accumulator to a lower pressure stage of said prime-mover, valve mechanism controlling flow of steam to said initial stage, valve mechanism controlling supply of steam to said lower pressure stage, means responsive to speed of said prime-mover for successively controlling said valve mechanisms, a connection connecting said second steam supply conduit with said first steam supply conduit, and means in said connection permitting flow of steam through said connection toward said first supply conduit and preventing flow from first supply conduit through said connection to said second supply conduit.

5. A steam plant comprising a relatively high pressure source of steam, a relatively low pressure source of steam, a first prime-mover element, a second prime-mover element, a first steam supply conduit for conducting steam from the first mentioned source to said first prime-mover element, a second steam supply conduit for conducting steam from the second mentioned source to said second prime-mover element, valve mechanism controlling flow of steam to said first prime-mover element, valve mechanism controlling supply of steam to said second prime-mover element, means responsive to speed of said prime-mover elements for successively controlling said valve mechanisms, a connection connecting said second steam supply conduit with said first steam supply conduit, and means permitting flow of steam through said connection toward said first supply conduit and preventing flow from said first supply conduit through said connection to said second supply conduit.

6. A steam plant comprising a relatively high pressure source of steam, a relatively low pressure source of steam, a first prime-mover element, a second prime-mover element, a first steam supply conduit for conducting steam from the first mentioned source to said first prime-mover element, an overflow valve arranged in said first conduit, a second steam supply conduit for conducting steam from the second mentioned source to said second prime-mover element, valve mechanism controlling flow of steam to said first prime-mover element, valve mechanism controlling supply of steam to said second prime-mover element, means responsive to speed of said prime-mover elements for successively controlling said valve mechanisms, a connection connecting said second steam supply conduit with said first steam supply conduit ahead of the valve mechanism controlling flow to the initial stage and behind said overflow valve, and a check valve in said connection permitting flow of steam toward said first supply conduit and preventing flow from said first supply conduit through said connection to said second supply conduit.

7. A steam plant comprising a relatively high pressure source of steam, a relatively low pressure source of steam, a prime-mover having a plurality of stages, a first steam supply conduit for conducting steam from the first mentioned source to an initial stage of said prime-mover, an overflow valve arranged in said first conduit, a second steam supply conduit for conducting steam from the second mentioned source to a lower pres-

sure stage of said prime-mover, valve mechanism controlling flow of steam to said initial stage, valve mechanism controlling supply of steam to said lower pressure stage, means responsive to speed of said prime-mover for successively controlling said valve mechanisms, a connection connecting said second steam supply conduit with said first steam supply conduit ahead of the speed valve mechanism controlling flow to the initial stage and behind said overflow valve, and a check valve in said connection permitting flow of steam toward said first supply conduit and preventing flow from said first supply conduit through said connection to said second supply conduit.

In testimony whereof I affix my signature.

RUNE HELLBORG.