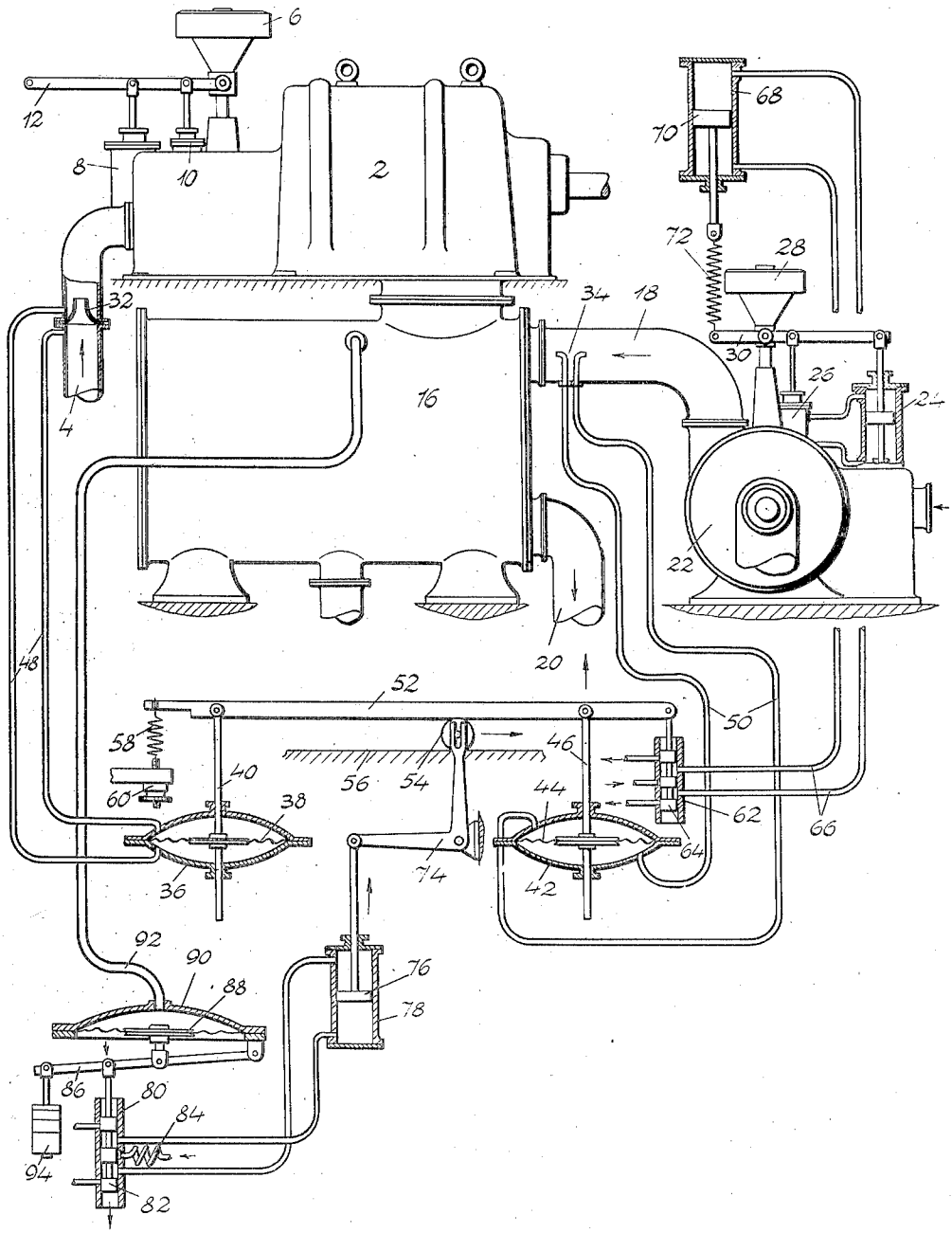
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REGULATING APPARATUS FOR STEAM CONDENSERS

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REGULATING APPARATUS FOR STEAM CONDENSERS.

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This invention relates particularly to the regulation of the flow of the cooling water through surface condensers utilized on the exhaust of steam engines especially steam turbines. It is known to those skilled in the art that a certain quantity of cooling or condensing water at a given temperature is necessary to condense one pound of steam, and that for efficient operation the flow of cooling water must be varied in accordance with variations in the load and from time to time in accordance with other changing conditions, such as variations in temperature of the cooling water, accumulations of foreign matter on the condensing surfaces, etc.

One object of my invention is to provide novel and improved apparatus for regulating the flow of condensing water through condensers of the character described, whereby said flow shall always have an efficient relation to variable conditions such as steam flow or load, temperature of the cooling water, etc.

Another object is to provide apparatus of the character described whereby the flow of water through the condenser is regulated by means influenced differentially by both the steam flow or load and the flow of cooling water.

Other objects are to provide such apparatus whereby the flow of cooling water is also varied in accordance with variations in conditions within the condenser, for instance the vacuum; to provide in such apparatus means for producing a certain relation between the steam flow and the flow of cooling water, and means for varying said certain relation in accordance with another condition, and to obtain other results and advantages as may be brought out by the following description.

In the accompanying drawings I have shown two systems for regulating the flow of condensing water through condensers of steam turbines, and while I have shown these two systems embodying certain details of construction and arrangement of the parts, it will be understood that this is mainly for the purpose of illustrating the principles of the invention and that many modifications and changes may be made in the detail construction and arrangements of the apparatus without departing from the spirit or scope of the invention.

Referring to said drawings in which corresponding and like parts are designated throughout the several views by the same reference characters,

The figure is a schematic partial sectional and partial side elevational view of one system embodying the invention.

Specifically describing the embodiment of the invention shown in the figure of the drawings, the reference character 2 designates a steam turbine the exhaust steam from which is condensed by a condenser 16 of the known surface type in which cooling water is flowed through tubes over which the exhaust steam passes from the turbine. The turbine is provided with the usual regulator 6, governor 10 and pilot motor 8, which parts are connected together in known manner by the lever 12 so that the flow of steam into the turbine is automatically regulated. The steam supply for the turbine flows through a pipe 4 in which is disposed an orifice flow throttling device 32.

The condensing water for the condenser 16 is pumped into the condenser by a centrifugal pump 22 driven by another steam turbine, the water entering the condenser through pipe 18 and flowing from the condenser through pipe 20. The turbine for the pump is provided with the usual regulator 28, governor 26 and pilot motor 24 connected together by a lever 30 by means of which the steam supply to the turbine is automatically regulated.

In accordance with the invention, the flow of condensing water into the condenser is controlled in accordance with the differential relation between the steam flow to the turbine 2 and the flow of the condensing water through the pipes 18 into the condenser. Accordingly, a device 36 sensitive to differences in pressure at opposite sides of the orifice 32 in the steam supply pipe 4 is provided to cooperate with a device 42 sensitive to variations in the flow of condensing water through the pipe 18. The device 36 is of known form and includes a diaphragm 38 arranged in a casing which is connected at opposite sides of the diaphragm by pipes 48

to opposite sides of the orifice device 32. The device 42 is similar to the device 36 and includes a diaphragm 44 arranged within a casing connected at opposite sides of the diaphragm by pipes 50 to a Pitot tube 34 arranged within the pipe 18. The diaphragms 38 and 44 have connected thereto the respective rods 40 and 46 which are pivotally connected to a lever 52 at opposite sides of the fulcrum 54 thereof.

To one end of the lever 52 is connected the valve piston 64 of a governor valve 62 which controls the flow of fluid through pipes 66 to and from a fluid motor 68 including a piston 70 which is connected through a tension spring 72 to one end of the lever 30. The other end of the lever 52 is connected by a tension spring 58 to a fixed support through an adjusting nut 60.

When a certain flow of steam obtains in the pipe 4, a certain difference in pressure is produced upon opposite sides of the diaphragm 38, and similarly when a certain flow of cooling water obtains in the pipe 18, a certain difference in pressure occurs at opposite sides of the diaphragm 44. When these differences in pressure bear a certain relation to each other, the valve piston 64 is maintained in its neutral position whereby flow of fluid to and from the fluid motor 68 having a piston 70 is prevented. Accordingly, a uniform supply of steam to the turbine driving the pump 22 and a uniform flow of condensing water through the pipe 18, are produced. For obtaining a certain definite relation between the flow of steam through pipe 4 and flow of water through pipe 18, the tension of the spring 58 and/or the position of the fulcrum roller 54 may be varied.

When the steam flow through pipe 4 varies, for example increases, the said definite relation between the devices 36 and 42 is disturbed by a variation in the pressure difference on the diaphragm 38, whereupon the lever 52 is moved in one direction or the other about its fulcrum 54, in the specific example described in the direction of the arrow, so that the valve piston 64 is moved to permit the flow of fluid to one side of the piston 70 and from the other side thereof which causes movement of said piston to vary the tension of the spring 72, in this specific instance to decrease said tension. This action in turn actuates the governor 26, whereupon the pilot motor 24 is operated and changes the flow of steam through the turbine driving the pump 22 whereby the flow of water through the pipe 18 is varied, in this instance increased. This action continues until the flow of water is such as to again establish the certain definite relation between the devices 36 and 42, in this instance until the device 42 is actuated by the pressure difference to influence the lever in the direction opposite to that indicated by the arrow and the valve piston 64 is returned to neutral position.

The flow of water into the condenser is further controlled in accordance with variations in the vacuum within the condenser. For this purpose, the fulcrum 54 of the lever 52 is preferably in the form of a roller mounted on a flat fixed support 56 and movable longitudinally of the lever by means of a bell crank lever 74 connected to the piston 76 of a fluid motor 78, the flow of oil to and from which is controlled by a valve piston 82 arranged in a cylinder 80 and connected to a lever 86 pivotally connected at one end to a casing 90 and intermediate its ends to a diaphragm 88 closing one side of said casing. The casing 90 is connected by a pipe 92 to the interior of the condenser 16, and the free end of the lever 86 has connected thereto a counter-weight 94. The diaphragm 88 is thus sensitive to differences in the pressure of the vacuum in the condenser 16 and the influence of the counter-weight 94. The counterweight is adjusted to balance a certain vacuum pressure in the condenser 16, and when this balance obtains the valve piston 82 is in its neutral position. Upon variations in said vacuum pressure the lever 86 is moved in one direction or the other to actuate the valve piston 82 which permits flow of oil to one side of the piston 76 and from the other side thereof. The piston 76 is thereby moved in one direction or the other to oscillate the bell crank 74 and vary the relation of the fulcrum 54 to the lever 52. This variation in the position of the fulcrum 54 disturbs the certain relation between the devices 36 and 42, and accordingly when the fulcrum 54 is moved, the flow of cooling water through pipe 18 is varied upon changes in the vacuum pressure within the condenser 16. It will thus be understood that the flow of water into the condenser will be varied upon each change in the flow of steam to the turbine 2 and also upon each change in the vacuum pressure.

Preferably, the governor valve 80 is so arranged that a slight motion of the piston 82 will not result in movement of the piston 76; in other words, the governor valve is not extremely sensitive, so as to compensate for the slight and quick variations in the vacuum pressure and prevent changes in the flow of water except upon definite variations in the vacuum pressure.

Having thus described the invention, what I claim is:

1. Apparatus for controlling the flow of cooling water through condensers for steam engines, comprising means actuated in accordance with the flow of steam to an engine, means actuated in accordance with the flow of cooling water to the condenser, a differential gearing connection between said two

means to establish a predetermined relation between the operation of said two means, means for varying the flow of cooling water through said condenser, and a governor actuated by said gearing upon variations from said predetermined relation for controlling the last-mentioned means.

2. Apparatus for controlling the flow of cooling water through condensers for steam engines, comprising means actuated in accordance with the flow of steam to an engine, means actuated in accordance with the flow of cooling water to the condenser, a differential gearing connection between said two means to establish a predetermined relation between the operation of said two means, means for varying the flow of cooling water through said condenser, a governor actuated by said gearing upon variations from said predetermined relation for controlling the last-mentioned means, and a movable member cooperating with said differential gearing so that variations in the position of said member causes variations in the relation between the steam flow and the flow of cooling water.

3. Apparatus for controlling the flow of cooling water through condensers for steam engines, comprising means actuated in accordance with the flow of steam to an engine, means actuated in accordance with the flow of cooling water to the condenser, a differential gearing connection between said two means to establish a predetermined relation between the operation of said two means, means for varying the flow of cooling water through said condenser, a governor actuated by said gearing upon variations from said predetermined relation for controlling the last-mentioned means, a movable member cooperating with said differential gearing so that variations in the position of said member causes variations in the relation between the steam flow and the flow of cooling water, and a device actuated in accordance with a condition in said condenser for automatically varying the position of said movable member.

4. Apparatus for controlling the flow of cooling water through condensers for steam engines, comprising means actuated in accordance with the flow of steam to an engine, means actuated in accordance with the flow of cooling water to the condenser, a differential gearing connection between said two means to establish a predetermined relation between the operation of said two means, means for varying the flow of cooling water through said condenser, a governor actuated by said gearing upon variations from said predetermined relation for controlling the last-mentioned means, a movable member cooperating with said differential gearing so that variations in the position of said member causes variations in the relation between the steam flow and the flow of cooling water, a device actuated in accordance with a condition in said condenser for automatically varying the position of said movable member, and a manually movable member cooperating with said differential gearing to produce a certain base relation between the flow of steam and the flow of cooling water.

5. Apparatus for controlling the flow of cooling water through condensers for steam engines, comprising means actuated in accordance with the flow of steam to an engine, means actuated in accordance with the flow of cooling water to the condenser, means for varying the flow of cooling water through the condenser, a governor for the last-mentioned means, and an operative connection between the first-mentioned two means and said governor so that the last-mentioned means is automatically operated to maintain a certain relation between the flow of steam and the flow of cooling water.

6. Apparatus for controlling the flow of cooling water through condensers for steam engines, comprising means actuated in accordance with the flow of steam to an engine, means actuated in accordance with the flow of cooling water to the condenser, means for varying the flow of cooling water through the condenser, a governor for the last-mentioned means, an operative connection between the first-mentioned two means and said governor so that the last-mentioned means is automatically operated to maintain a certain relation between the flow of steam and the flow of cooling water, and means actuated in accordance with a condition in the condenser for changing said operative connection to vary the relation between the steam flow and the flow of cooling water.

7. Apparatus for controlling the flow of cooling water through condensers for steam engines, comprising means actuated in accordance with the flow of steam to an engine, means actuated in accordance with the flow of cooling water to the condenser, a differential lever system connecting said two means so that when a predetermined magnitude of flow of steam and a predetermined magnitude of flow of water obtain said lever system is at rest, means for varying the flow of cooling water through said condenser, and a governor actuated by said lever system upon movement thereof due to variations in the flow of steam from said predetermined magnitude for controlling the last-mentioned means.

8. Apparatus for controlling the flow of cooling water through condensers for steam engines, comprising means actuated in accordance with the flow of steam to an engine, means actuated in accordance with the flow of cooling water to the condenser, a differential lever system connecting said two

means so that when a predetermined magnitude of flow of steam and a predetermined magnitude of flow of water obtain said lever system is at rest, said lever system including a variable fulcrum, means actuated in accordance with a condition in said condenser for varying said fulcrum to influence the operation of said lever system, means for varying the flow of cooling water through said condenser, and a governor actuated by said lever system for controlling the last-mentioned means.

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