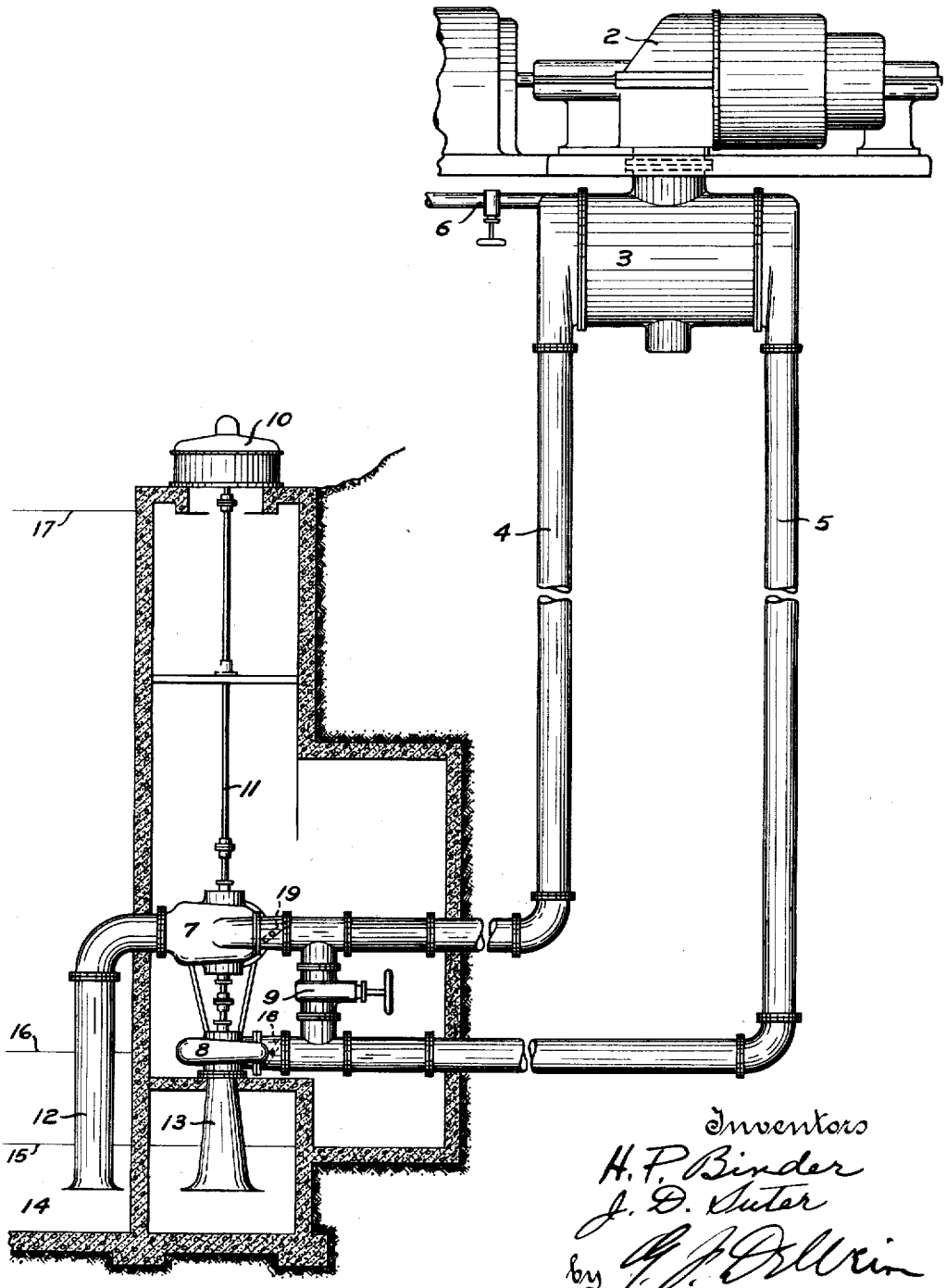
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POWER SYSTEM

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POWER SYSTEM

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The present invention relates generally to improvements in the construction and operation of power plants, and relates more specifically to an improved system of furnishing cooling water for the heat transfer or cooling devices associated with the prime movers of such plants.

An object of the invention is to provide new and useful improvements in power plants or systems, whereby a steam operated prime mover and a cooling device such as a condenser associated with the prime mover, may be placed a considerable distance above the source of supply of the cooling water, and wherein the cooling water may be circulated through the cooling device with minimum loss of power.

It has heretofore been proposed, in connection with a steam power plant wherein condensing water is derived from a source at a considerably lower lever than that of the condensers, to utilize a single motor driven hydraulic pump-turbine unit to circulate the water through the condenser. In this prior system, it was contemplated to utilize the return flow of cooling water from the condenser in a turbine, to generate power and thereby reduce the external power required for driving the pump which supplies the water to the condenser. The system did not, however, make proper provision for starting the hydraulic pump-turbine unit, and for filling the pipes of the circulating system.

It is an object of the present invention, to provide simple and efficient means for placing such systems in operation, and for readily filling the piping thereof. In accordance with the present improvement, a by-pass is provided which connects the discharge of the circulating pump directly with the inlet of the hydraulic turbine, independently of the condenser. This by-pass is further provided with a control valve which permits effective filling of the circulating system during starting of the unit. These and other objects and advantages of the invention will be apparent from the following description.

A clear conception of one embodiment of the invention and of the operation of systems constructed in accordance therewith, may be had by referring to the drawing accompanying and forming a part of this specification in which the various parts are referred to by suitable reference characters.

The single figure of the drawing discloses a side elevation of a steam driven power plant having the improvement applied therein.

The power plant comprises in general a steam engine or turbine 2 the exhaust end of which communicates directly with a cooling device such as a surface condenser 3. The surface condenser 3 is of ordinary construction comprising a nest of tubes through which cooling water may be passed from one end to the other of the condenser. The cooling water is supplied to the condenser 3 from a remote source 14 through a supply pipe 4, and is discharged from the condenser through a discharge pipe 5. The condenser 3 may also be provided with a valve controlled air escape pipe 6 as shown.

The cooling water supply pipe 4 communicates directly with the discharge of a centrifugal pump 7 the suction of which communicates with a cooling water supply source 14 through a suction pipe 12. The centrifugal pump 7 is adapted to be driven directly by any suitable means such as an electric motor 10, through a vertical shaft 11, and is provided with a shut-off valve 19 in the discharge line thereof. Associated directly with the shaft 11 below the centrifugal pump 7, is a hydraulic turbine 8, the runner of which is adapted to be simultaneously operated with the impeller of the pump 7. The intake of the hydraulic turbine 8 is provided with the usual shut-off valve 18 and flow regulating gates, and communicates directly with the cooling water discharge pipe 5. The turbine draft tube 13 which communicates directly with the discharge side of the runner, extends downwardly into the cooling water supply source 14. A valve controlled by-pass 9 directly connects the discharge of the pump 7 with the intake of the hydraulic turbine 8 upstream of the turbine shut-off valve 18, this by-pass being adapted to be closed when desired. The normal water level in the supply source 14 is

indicated at 16, while the low and high water levels are indicated at 15, 17, respectively. The driving means or motor 10 is of such limited capacity that it is not adapted to drive the pump 7 alone in order to supply the condenser 3 with sufficient water, and the turbine 8 is provided for the purpose of utilizing the return flow of water from the condenser 3 to assist in driving the pump 7. It is therefore necessary in starting the unit, to gradually bring the pump 7 up to normal speed, and to utilize the turbine 8 for the purpose of assisting the motor 10 in driving the pump, during such starting operation.

When it is desired to place the unit in operation after a period of rest and with the system free from water, the valve in the by-pass 9 should first be opened, the valves 18, 19 should be opened, the inlet gates of the turbine should be partially opened, and the valve in the air escape line 6 should be opened. The motor 10 may then be started and the speed thereof gradually increased, to approach normal speed. During this starting operation, the pump will function to draw increasing quantities of water, dependent upon the increase in speed, from the supply source 14 through the suction pipe 12, and will deliver the greater portion of its discharge through the by-pass 9 which returns the water to the hydraulic turbine 8 and from thence to the source 14 through the draft tube 13. The turbine 8 thus immediately assists the motor 10 in driving the pump 7, and the degree of assistance increases as the speed of the pump 7 and of the motor 10 increases.

When the pump 7 has been brought approximately to normal speed, the valve in the by-pass 9 should gradually be moved toward closed position, thereby reducing the quantity of water delivered to the turbine 8 and permitting a portion of the water delivered from the pump 7 to rise within the condenser supply pipe 4 and to expel air from the condenser system through the pipe line 6. When the water has risen in the supply pipe 4 sufficiently to fill the condenser 3, the air escape line 6 may be shut off and the water will then flow from the condenser 3 through the discharge pipe 5 and directly to the turbine 8. The valve in the by-pass 9 may then be completely closed, and the gates of the turbine 8 set so as to utilize the head of water delivered from the condenser 3, to its fullest extent.

After the system has been once filled with water, and it becomes desirable to shut down the unit for a short period of time, the turbine shut-off valve 18 and the pump discharge valve 19 may be closed completely just prior to stopping of the pump. With the turbine shut-off valves 18, 19 completely closed, the condenser discharge pipe 5 will be maintained full of water, and restarting of the unit will thus be facilitated as the head of water in the pipe line 5 may then be utilized to assist in bringing the pump 7 up to normal speed and capacity.

From the foregoing description it will be apparent that the steam turbine 2 and its condenser 3 may be located at a remote point relative to the pump 7 and turbine 8 and at an elevation above the water level 14, exceeding the vacuum head of water. The capacity of the driving means or motor 10 need not be sufficient to normally drive the pump 7 without assistance from other sources, and the turbine 8 will function to return considerable energy to the main shaft 11 when the unit is operating normally. The unit will operate effectively during high and low level periods, as well as under normal level of the supply 14. The motor 10 must however be either located a sufficient distance above the high level 17, or totally enclosed, so as to avoid destruction due to flooding. The steam power plant may be located at any convenient place above high water level, thereby permitting selection of a location where relatively inexpensive foundations and power house structure may be utilized. The invention is obviously applicable to other than steam power house condensers, being generally applicable to any heat exchange or cooling device wherein the static head requirements materially exceed the possible syphon head regain ordinarily obtainable.

It should be understood that it is not desired to limit the invention to the exact details of construction and operation herein shown and described, for various modifications within the scope of the claims may occur to persons skilled in the art.

It is claimed and desired to secure by Letters Patent:

1. In combination with a steam actuated prime mover having a heat transfer device, of means providing a closed circuit for cooling water, a pump in said circuit for urging water toward said device, a hydraulic motor in said circuit operable by water leaving said device, operating means for said pump adapted to receive power from said motor, and means forming a conduit connecting said pump and said motor independently of said circuit.

2. In combination with a steam actuated prime mover having a condenser, of means providing a closed circuit for condenser cooling water, a pump in said circuit for urging water toward said condenser, a hydraulic motor in said circuit operable by water leaving said condenser, operating means for said pump adapted to receive power from said motor, and a valve controlled by-pass connecting the pump discharge with the motor inlet independently of said condenser.

3. In combination with a steam actuated prime mover having a condenser and a source

of cooling water located remote from said condenser, of means providing a closed cooling water circuit including said condenser and said source, a pump in said circuit for urging water toward said condenser, a hydraulic motor in said circuit operable by water leaving said condenser, operating means for said pump adapted to receive power from said motor, and a valve controlled by-pass directly connecting the pump discharge with the motor inlet closely adjacent to said pump and motor.

In testimony whereof, the signatures of the inventors are affixed hereto.

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