

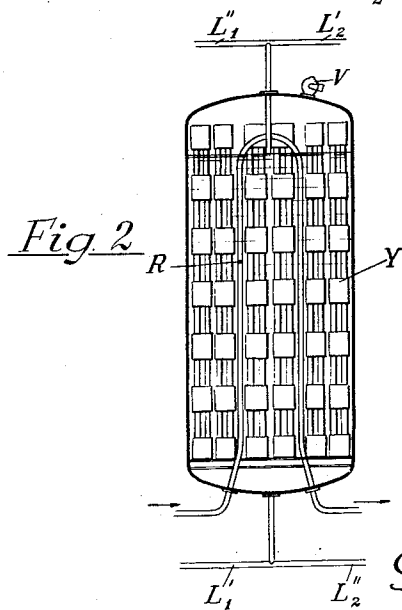
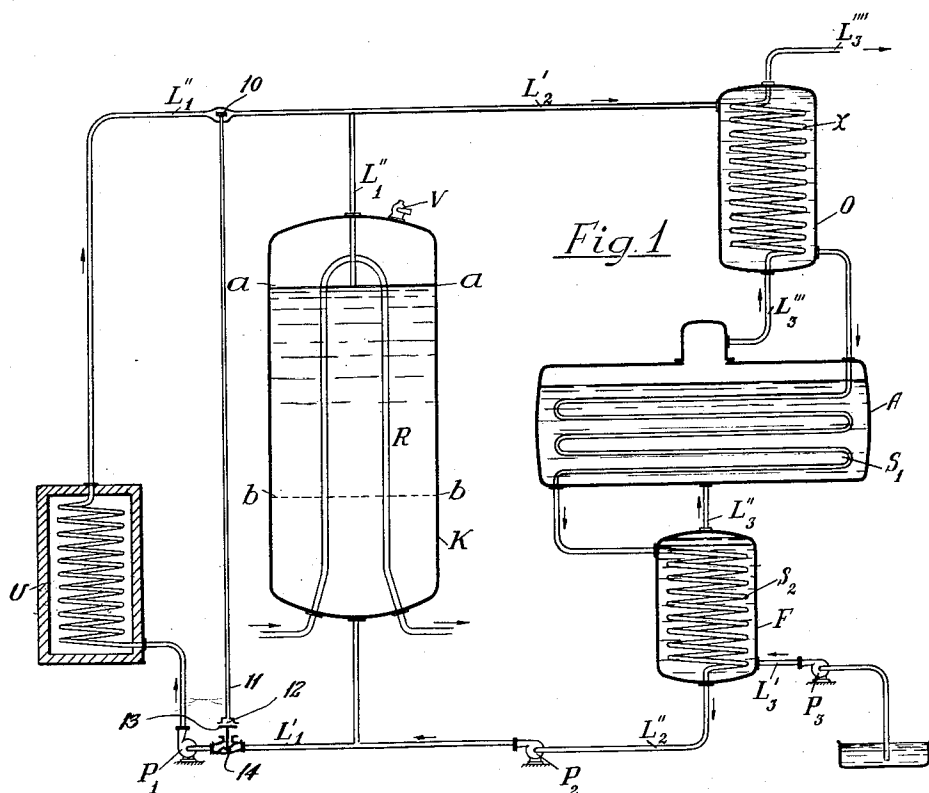
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ACCUMULATOR PLANT

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UNITED STATES PATENT OFFICE

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ACCUMULATOR PLANT.

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My invention relates to heat accumulator plants and more particularly to steam plants wherein there is a variable demand for steam, particularly steam of constant pressure. My invention aims to provide a highly efficient plant wherein a supply of heat can be made independent of the demand for steam. A further object of my invention is to accumulate heat at a low pressure. A still further object of my invention is to regulate the accumulation of heat.

Further objects of the invention will be apparent as the description proceeds.

In the accompanying drawing which illustrates my invention; Fig. 1 shows a steam generating and superheating plant including an accumulator and embodying one form of my invention; and Fig. 2 shows a modified form of accumulator.

In Fig. 1, K designates an accumulator reservoir which contains a liquid having a high specific heat as, for example, oil or a salt solution. U designates a heating device which may be of any desired construction. Pump P₁ draws liquid from the lower part of accumulator reservoir K through conduit L'₁ and forces the same through heating device U. From heating device U the liquid passes through conduit L''₁ and back to the reservoir K. Conduit L''₁ extends downwardly into the reservoir to the level a-a. At the top of the reservoir there is provided a valve V which serves as an inlet and outlet for air or an inert gas, the latter being used in case air oxidizes the particular liquid used.

O designates a steam superheater. A designates a steam generator. F designates a feed water heater. A conduit L'₂ connects conduit L''₁ and consequently the accumulator reservoir with superheater O. Superheater O is connected with a pipe S₁ within generator A. Pipe S₁ is connected with a coil S₂ within feed water heater F. Coil S₂ is connected by means of a conduit L''₂ with conduit L'₁ and consequently with the lower part of reservoir K. It is thus seen that the accumulator reservoir K is coupled in parallel with the heating device and the steam generator.

The accumulator is charged as follows:

Pump P₁ forces liquid from the bottom of

the accumulator through heating device U and back into the upper part of the accumulator. The hot liquid entering the upper part of the accumulator settles on the surface of the relatively cold liquid in the lower part of the accumulator. A distinct separating surface b-b will be obtained which descends during the charging period. The charging of the accumulator is completed when surface b-b has reached the bottom of the same.

The rate of flow of liquid through conduit L'₁ and consequently through the heating device U and conduit L''₁ is controlled in such a manner that the liquid flowing into the accumulator reservoir is of constant temperature. As one means for obtaining this result I have shown a valve 14 in conduit L'₁, which valve is actuated by means of a diaphragm 13 forming one side of a diaphragm chamber 12. Diaphragm chamber 12 is connected by means of tube 11 with a bulb 10 situated in conduit L''₁. Rise of temperature in conduit L''₁ causes an expansion of fluid contained within bulb 10 and within tube 11 and chamber 12, which expansion is transmitted to diaphragm 13 causing increase of flow through valve 14. This valve arrangement thus operates to maintain a constant temperature of fluid flowing from heating device U and into accumulator reservoir K.

The accumulator is discharged as follows:

Pump P₂ causes liquid to flow from the upper part of the accumulator reservoir K through conduit L'₂ and into the superheater O where it gives off heat to steam within coil X. From superheater O the hot liquid passes through pipe S₁ and heat is transferred to water in steam generator A to produce steam. The liquid then flows through coil S₂ and thence back to the accumulator reservoir.

The feed water for generation of steam is pumped by pump P₃ through conduit L'₃ and into feed heater F where it is preheated preferably in accordance with the counter-flow principle. From feed heater F the feed water passes through conduit L''₃ and into steam generator A where it is converted into steam. The steam produced passes through conduit L'''₃ and into coil K in which coil

the steam is superheated. From this coil the steam passes to use through conduit L'''³.

It will be seen that pipe S₁ constitutes a steam generator heating space.

During the discharge of the accumulator the separating surface *b—b* ascends. The accumulator is wholly discharged when this surface has reached the top of the same.

Obviously the charging and discharging operations may take place simultaneously at different rates.

If the reservoir is filled with oil or the like a very high temperature (300° to 400° C. or even higher) may be obtained without a considerable increase of pressure above atmospheric. When using salt solutions or certain acids, however, it may be more suitable, in most cases, to operate with a pressure moderately above atmospheric.

If desired, a substance which is solid at ordinary indoor temperature, such as certain fats or the like, may be used with advantage provided provision is made for melting such substance before operation. For this purpose a steam pipe R is provided which extends through the reservoir K to melt its contents.

Fig. 2 shows an arrangement wherein accumulation is in part effected by means of solid bodies Y, for example, metal plates, stone or coal. In order to obtain a small volume of accumulator, this solid material should be so chosen that the product of its specific weight and specific heat is as great as possible. If, on the other hand, a small weight is desired, a material having a high specific heat should be chosen.

The space between bodies Y is filled with a liquid which serves to convey heat. For this purpose the substances mentioned above in connection with the accumulator of Fig. 1 may be used and, in certain cases, readily melted metals, for instance a mixture of tin and lead, may be used.

It is to be understood that my invention is not limited to the precise arrangements illustrated.

What I claim is:

1. An arrangement for storing heat for the purpose of generating steam, comprising a reservoir containing liquid which consists of a material constituting a solid body at ordinary temperature, the boiling point of which liquid lies above 300° C., means for melting the solid body before starting, a steam generator containing water, and means comprising a circulation conduit for connecting the reservoir with the generator in such a way that one of the liquids may circulate through the other.

2. Accumulator apparatus comprising a liquid having a high temperature at low pressure, a heating device to heat said liquid, a steam generator having a steam and water

space and a generator heating space, a conduit connecting said heating device with said generator heating space and adapted to conduct said liquid from said heating device to said generator heating space, a second conduit connecting said generator heating space with said heating device and adapted to conduct said liquid from said generator heating space to said heating device and an accumulator reservoir connected between said conduits in parallel with said heating device and said generator, whereby heated liquid can be conducted to said accumulator reservoir to be stored when the supply of heat exceeds the demand and can be conducted from said accumulator reservoir to said generator space when the demand for heat exceeds the supply.

3. Accumulator apparatus comprising an accumulator reservoir, heat storing liquid in said reservoir, a liquid heating device, means to conduct said liquid from said reservoir to said liquid heating device, means to conduct said liquid from said heating device to said reservoir, a steam generator, means to conduct said liquid from said reservoir to said generator to heat the same and means to conduct said liquid from said generator to said reservoir.

4. Accumulator apparatus comprising an accumulator reservoir, a liquid in said reservoir having a high temperature at low pressure, a liquid heating device, a steam generator having a generator heating space, means to circulate said liquid from said reservoir through said heating device and back to said reservoir, and means to circulate said liquid from said reservoir through said generator heating space and back to said reservoir.

5. Accumulator apparatus comprising an accumulator reservoir, a liquid in said reservoir having a high temperature at low pressure, a liquid heating device, a steam generator having a generator heating space, means to circulate said liquid from said reservoir through said generator heating space and back to said reservoir, means to circulate said liquid from said reservoir through said heating device and back to said reservoir and means to circulate said liquid from said liquid heating device through said generator heating space and back to said liquid heating device.

6. Accumulator apparatus comprising an accumulator reservoir, heat storing liquid in said reservoir, a liquid heating device, a conduit connecting the outlet of said liquid heating device with the top of said accumulator reservoir, a conduit connecting the lower part of said accumulator reservoir with the inlet of said liquid heating device, a steam generator having a generator heating space, a conduit connecting the top of said accumulator reservoir with the inlet to said generator heating space and a conduit con-

necting the outlet of said generator heating space with the bottom of said accumulator reservoir.

7. Accumulator apparatus comprising a heating device, a reservoir containing an upper layer of hot liquid and a lower layer of cold liquid, said liquid having high temperature at low pressure, means to conduct liquid from the cold layer through the heating device and into the hot layer, a steam generator having a steam and water space and a generator heating space, and means to conduct liquid from the hot layer, through the generator heating space and into the cold layer.

8. The method of equalizing differences between heat supply and heat demand in a plant having a demand for steam which comprises supplying heat to a liquid of high boiling point at a rate different than the rate of steam demand, transferring heat from said liquid to water to generate steam in accordance with the demand, and storing heat in said liquid in proportion to the amount of surplus heat supply over the momentary heat demand.

9. Accumulator apparatus for a plant having a supply of heat and a variable rate of demand for steam different than the rate of supply of heat comprising an accumulator reservoir, the heat content of which varies in accordance with the difference between heat supply and steam demand, heat storing liquid in said reservoir, means to heat the liquid in said reservoir in accordance with the rate of heat supply and independently of the rate of steam demand, a steam generator, a superheater, means whereby the heat storing liquid heats the generator and means whereby the heat storing liquid heats the superheater.

10. Accumulator apparatus for a plant having a supply of heat and a variable rate of demand for steam different than the rate of supply of heat comprising an accumulator reservoir, the heat content of which varies in accordance with the difference between heat supply and steam demand, heat storing liquid in said reservoir, means to heat the liquid in said reservoir in accordance with the rate of heat supply and independently of the rate of steam demand, a steam generator, a superheater, and means to conduct said heat storing liquid through said superheater and generator in series whereby to generate and superheat steam.

11. Accumulator apparatus for a plant having a supply of heat and a variable rate of demand for steam different than the rate of supply of heat comprising an accumulator reservoir, the heat content of which varies in accordance with the difference between heat supply and steam demand, heat storing liquid in said reservoir, means to heat the liquid in said reservoir in accordance with the rate of heat supply and inde-

pendently of the rate of steam demand, a steam generator, a feed water heater, a superheater, and means whereby the heat storing liquid heats the superheater, the generator, and feed water heater.

12. Accumulator apparatus for a plant having a supply of heat and a variable rate of demand for steam different than the rate of supply of heat comprising an accumulator reservoir, the heat content of which varies in accordance with the difference between heat supply and steam demand, heat storing liquid in said reservoir, means to heat the liquid in said reservoir in accordance with the rate of heat supply and independently of the rate of steam demand, a steam generator, a feed water heater, a superheater, and means whereby the heat storing liquid heats the superheater, the generator, and the feed water heater in series.

13. In a plant having a demand for steam, in combination, a heating device, an accumulator reservoir separately disposed from said heating device and containing a heat storing liquid of higher boiling point than water, means to circulate said liquid from said accumulator reservoir through said heating device and back to said reservoir at a different rate than the rate of demand for steam and a steam generator heated by the liquid in the accumulator reservoir.

14. In a steam plant having a demand for steam, in combination, a heating device, an accumulator reservoir separately disposed from said heating device and containing a heat storing liquid of higher boiling point than water, means to circulate said liquid from said accumulator reservoir through said heating device and back to said reservoir at a different rate than the rate of demand for steam, a steam generator, a steam superheater, means whereby the heat storing liquid heats the generator and means whereby the heat storing liquid heats the superheater.

15. In a plant having a demand for steam, in combination, a heating device, an accumulator reservoir separately disposed from said heating device and containing a heat storing liquid of higher boiling point than water, means to circulate said liquid from said accumulator reservoir through said heating device and back to said reservoir at a different rate than the rate of demand for steam, a steam generator, a feed water heater, a superheater and means whereby the heat storing liquid heats the superheater, the generator and the feed water heater in series.

16. In a plant having a demand for steam, a heating device, an accumulator reservoir separately disposed from said heating device and containing a heat storing liquid of higher boiling point than water, means to conduct liquid from said accumulator reservoir

through said heating device and back to said reservoir, means to control flow through the last mentioned means to maintain a constant temperature of liquid entering the accumulator reservoir and a steam generator heated by the liquid in the accumulator reservoir.

17. In a plant having a demand for steam, a heating device, an accumulator reservoir separately disposed from said heating device and containing a heat storing liquid of higher boiling point than water, means to conduct liquid from said accumulator reservoir through said heating device and back to said reservoir, means to control flow through the last mentioned means to maintain a constant temperature of liquid entering the accumulator reservoir, a steam generator, a steam superheater, and means whereby the heat storing liquid heats the superheater so that a constant temperature of superheated steam is obtained.

18. In a plant having a demand for steam, a heating device, an accumulator reservoir separately disposed from said heating device and containing a heat storing liquid of higher boiling point than water, means to conduct liquid from said accumulator reservoir, through said heating device and back to said reservoir, means to control flow through the last mentioned means to maintain a constant temperature of liquid entering the accumulator reservoir, a steam generator, a feed water heater, a superheater and means whereby the heat storing liquid heats the superheater, the generator and the feed water heater in series.

19. In a steam plant, a heating device, an accumulator for storing a heated fluid, a passage for said fluid from said heating device to said accumulator, and a valve operated in response to the temperature of fluid

flowing through said passage and arranged for passage of said fluid therethrough to control the rate of flow therethrough.

20. In a steam plant, a heating device, an accumulator for storing a heated fluid, a passage for said fluid from said heating device to said accumulator, and means responsive to the temperature of fluid leaving said heating device to control the rate of flow through said passage and arranged for passage of said fluid therethrough.

21. In a steam plant, in combination, a heating device, an accumulator for storing a heated fluid, the heat content of which varies in accordance with the difference between heat supply and steam demand, a passage for said fluid from said heating device to said accumulator, valve mechanism arranged for passage of said fluid therethrough and controlling flow of fluid through said passage and a temperature responsive element for controlling movement of said valve to maintain a constant temperature of fluid flowing to said accumulator.

22. In a steam plant, in combination, a heating device, an accumulator, the heat content of which varies in accordance with the difference between heat supply and steam demand, a passage for fluid from said heating device to said accumulator, valve mechanism controlling flow of fluid through said passage adapted to shut off flow therethrough, temperature responsive means for controlling movement of said valve to maintain a constant temperature of fluid flowing into said accumulator and means to utilize the heat content of said accumulator in accordance with the demand for steam.

In testimony whereof I affix my signature.

JOHANNES KARL RUTHS.