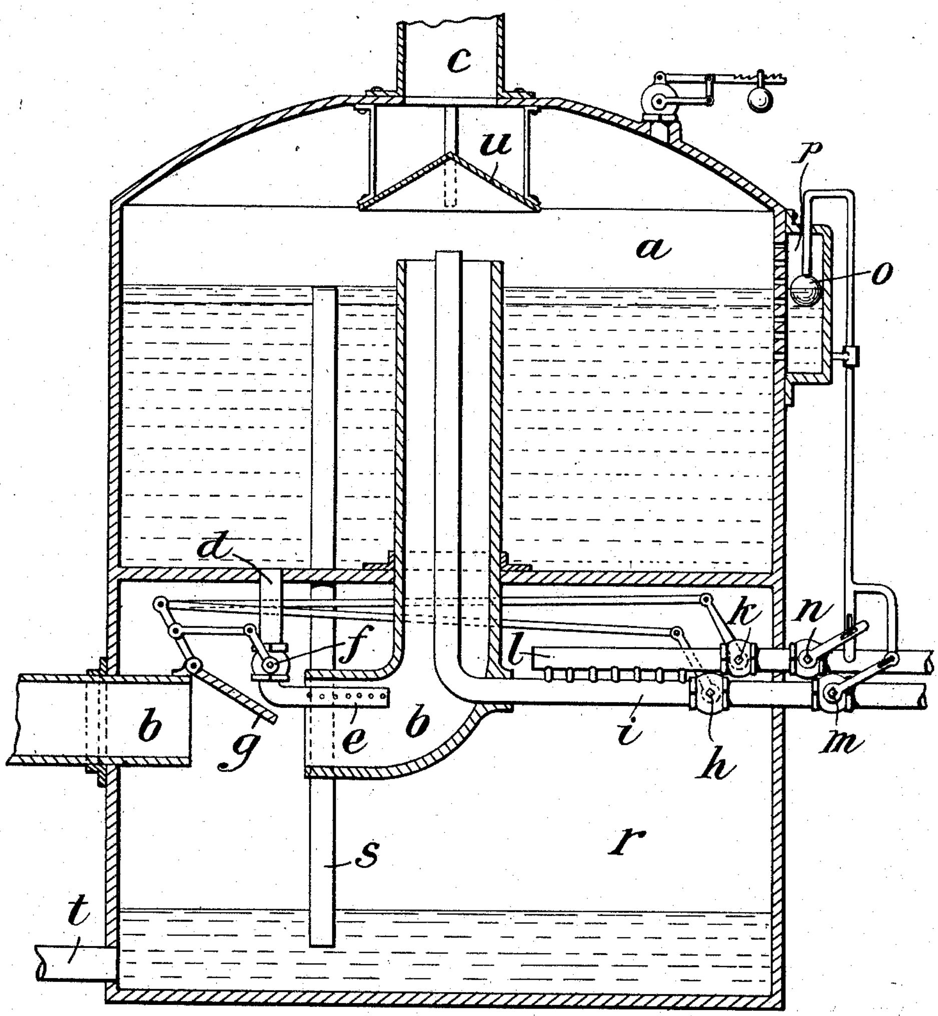
A. SORGE.

STEAM REGENERATION.

APPLICATION FILED FEB. 18, 1909.

1,015,277. Patented Jan. 16, 1912.



Attest:
Walter [signature]
Edgeworth [signature]

Inventor:
Adolph Sorge
by Liddle Wendell & Varney,
Attys.

UNITED STATES PATENT OFFICE.

ADOLPH SORGE, OF ST. JOSEPH, MICHIGAN, ASSIGNOR TO AMERICAN REGENERATOR COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

STEAM REGENERATION.

1,015,277. Specification of Letters Patent. Patented Jan. 16, 1912.

Application filed February 18, 1909. Serial No. 478,718.

To all whom it may concern:

Be it known that I, ADOLPH SORGE, a resident of the city of St. Joseph, in the county of Berrien and State of Michigan, have invented certain new and useful Improvements in Steam Regeneration, of which the following is a specification, reference being had to the accompanying drawings, forming a part hereof.

The principal object of the invention is to provide for the rapid transfer of the heat contained in exhaust steam into the general body of regenerating liquid in a regenerating chamber or accumulator. Unless such transfer be very rapid, the temperature of the regenerating liquid in the accumulator will be subject to sudden and wide variation when the exhaust steam is delivered into the apparatus or apparatuses of this sort in irregular quantities as is often the case in actual practice.

In accordance with the invention, the current of steam, before being introduced into the accumulator, is met by a shower of liquid, as from the main body of liquid in the accumulator; and this liquid is delivered into the current of steam in such finely divided condition or spray as to be thoroughly mixed with the steam which latter is thus made to yield its heat up readily. Moreover, the force of the current of steam is sufficient to carry the steam-ladened liquid back again into the regenerator chamber or accumulator. Besides this main feature, the invention includes the embodiment of the same in an apparatus, and its coördination with other features of the apparatus.

The single figure of the drawings illustrates an apparatus for carrying the improvements into practice, such figure being a vertical section through the apparatus.

The regenerating chamber or accumulator *a* is provided with means *b* to introduce the steam to be regenerated and with a discharge conduit *c* for the regenerated steam, which leads to a turbine or other device for the utilization of such steam. The means *b* may comprise any suitable conduit which preferably is led into the chamber *a* from below and discharges into said chamber at a point above the normal water level, as shown. For the purpose of thoroughly mixing the water of the accumulator with the steam to be regenerated, said water is delivered into the incoming current of steam in the conduit *b* and in such a way that it shall be picked up, thoroughly heated and carried back into the accumulator by said current. To accomplish such circulation of the water by the current of incoming steam, a connection *d* is provided between the tank *a* and the conduit *b*, such connection preferably terminating in a spraying device or nozzle *e*, whereby the water will be delivered onto the steam in a more or less finely divided condition. In this way it will rapidly absorb the heat of the steam and will be borne upon the current of steam and carried back up into the accumulator.

Embodied in the connection *d* may be a valve *f* which is operatively connected with a freely swinging gate *g* in the conduit *b*. Through the operation of some such means as this, the delivery of water from the tank *a* to the conduit *b* may be made to depend upon the delivery of steam through the conduit *b* to the tank *a*. For instance, when steam is being delivered through the conduit *b* from say the exhaust of a reciprocating engine, such delivery may be irregular or it may stop. When the delivery of steam has stopped, this gate *g* will assume a substantially vertical position and will close the valve *f*, while the latter will be governed in the extent of its opening by the degree to which the gate is raised by the incoming steam. Thus, the admission of water from the tank *a* is governed according to the quantity of steam being admitted to the accumulator. During the time that the steam is shut off in conduit *b*, the pressure in chamber *a* gradually drops, and some of the water contained therein evaporates into additional steam to operate the turbine. Such evaporation causes a lowering in the water level in the chamber. There are also preferably connected with the gate *g*, a valve *h* in a pipe *i*, through which live steam may be furnished to the accumulator, and a valve *k* in a pipe *l* provided for the purpose of furnishing water to the accumulator. These arrangements are made in order to introduce live steam to keep the turbine, or other engine depending upon the supply of regenerated steam, in operation, when for some reason or other the reciprocating engine or the particular device furnishing the exhaust steam stops running for any considerable period of time. The connections between

the valves *h* and *k* respectively and the gate *g* are such that when the gate is in a vertical position the valves will be open. The opening of these valves however, will not immediately permit the supplemental steam and water to be introduced into the accumulator, for two other valves *m* and *n* are provided to control the precise instants of admission of the supplemental steam and water. These valves are operatively connected with a float *o* in a small chamber *p* communicating with the accumulator, whereby said valves are opened whenever the water level in the accumulator drops below normal. Moreover, the valve connections are such that the valve *m* will open immediately as the level of the water in the accumulator becomes less than normal, and the valve *n* only after the level has dropped to an abnormally low point. As in the case of the water introduced into the conduit *b*, arrangements are preferably made to have the water from the pipe *l* sprayed upon the steam which is being introduced through the pipe *i*, and the accompanying drawing is made with this preferable arrangement in view.

In the apparatus illustrated in the drawing there is provided, in addition to the chamber *a*, a lower chamber *r*. This lower chamber receives the overflow from the upper chamber *a* through an overflow pipe *s* and discharges it through a draw-off pipe *t* which may be led to a convenient point for utilizing such heated water as may be discharged from the accumulator. It is also preferable to lead the supply conduit *b* through the lower chamber *r*, so that the heat of the exhaust steam being introduced through this conduit may so far as possible be conserved in the apparatus.

The operation of the device is as follows: When the exhaust steam is being delivered through the conduit *b*, the gate *g* will be raised according to the quantity of steam passing underneath it and the valve *f* will permit a proportionate quantity of water from the accumulator to be sprayed upon this current of steam. The latter will pick up the water and carry it back into the accumulator thoroughly impregnated with the heat from the steam. Above the discharge end of the conduit *b* in the accumulator is a deflector *u*, and as the mixture of water and steam strikes this deflector, the water will be deposited thereon and will drip off again into the tank. As soon as the gate *g* has been lifted by the incoming steam, the valves *h* and *k* controlling the supply of supplemental steam and water will be immediately closed thus preventing any admission of supplemental steam or water so long as steam is being introduced through the conduit *b*. When, however, there ceases to be a delivery of steam through the conduit *b* for any reason, the dropping of the gate *g* will cause the valves *h* and *k* to open and the valve *f* to close according to the precise position of the gate. The turbine, or other device for utilizing the regenerated steam, now draws steam from the water in the regenerative chamber until the heat stored in such water is exhausted to a predetermined point. Such action will lower the water level in the accumulator by a corresponding amount and the float *o* will accordingly drop and through its connections will open the valve *m* in the live steam pipe thus admitting steam at a predetermined pressure to the accumulator and keeping the turbine in operation until steam is again supplied through the conduit *b*. If the supply of steam to the accumulator from one source or another is insufficient to prevent the level of water therein from reaching an abnormally low point, then the float *o* through its connections with the valve in the pipe *l* will cause water to be sprayed upon the steam entering through the pipe *i*. The water thus admitted will be heated and carried up into the accumulator until a predetermined level of water has been reached, when the float will operate to shut off the supply of supplemental water. When the water level in the accumulator rises above the normal level, it will be carried off through the overflow pipe and into the lower chamber whence it may be discharged through the pipe *t*.

Various changes may be made in the apparatus herein shown and described for carrying the present improvements into practice. For instance, it will be clear that the delivery of the water upon the incoming current of steam may be made use of in connection with various other devices differing both in construction and utility from the device illustrated and described in the present case. It is also obvious that the invention is not limited to embodiment in the apparatus which has been produced herewith for purposes of illustration and explanation.

I claim as my invention:

1. A steam regenerating apparatus including in combination, a regenerating chamber, a conduit for conveying steam to said chamber, and means for delivering water from said chamber to said conduit in a finely divided state, the conduit being substantially unrestricted beyond the place of delivery of the water, whereby the water is heated and returned to the chamber by the steam flowing through the conduit with only a slight obstruction to the flow of steam.

2. A steam regenerating apparatus including in combination, a regenerating chamber, a conduit for conveying steam to said chamber, and means rendered operative by the steam for delivering water from said chamber to said conduit in amount approximately proportional to the amount of steam flowing

through said conduit, the conduit being substantially unrestricted from the place of delivery of the water, whereby the water is heated and returned to the chamber by the steam flowing through the conduit with only a slight obstruction to the flow of steam.

3. A steam regenerating apparatus including in combination, a regenerating chamber, a conduit for conveying steam to said chamber, and valve controlled means rendered operative by the steam for delivering water from said chamber to said conduit.

4. A steam regenerating apparatus, including in combination, a regenerating chamber, a conduit for conveying steam to said chamber, valve controlled means for delivering water from said chamber to said conduit, a vane located in the path of the steam and connections between said vane and said valve.

5. A steam regenerating apparatus including in combination, a regenerating chamber, a conduit for the introduction of steam, a pipe terminating in a spraying nozzle to deliver liquid from said chamber into said conduit, a valve in said pipe, a vane in said conduit, and operative connections between said valve and vane.

6. A steam regenerating apparatus including in combination, a regenerating chamber, a conduit for conveying steam to said chamber, means for delivering water from said chamber to said conduit whereby the water is heated and returned to said chamber, and means for preventing the water from rising above a predetermined level in said chamber.

7. A steam regenerating apparatus including in combination, a regenerating chamber, an expansion chamber, a conduit for conveying steam from the expansion chamber to the regenerating chamber, means for delivering water from the regenerating chamber to the conduit, and an overflow connection between the two chambers.

8. A steam regenerating apparatus including in combination a chamber, means for introducing steam therein, means for introducing water therein, and valve controlled means for regulating the introduction of both steam and water by variations in the level of the water in said chamber.

9. A steam regenerating apparatus including in combination means for supplying steam to be regenerated, a secondary steam supply, a water supply and means controlled by the steam to be regenerated for regulating the supplies of water and secondary steam to the apparatus.

10. A regenerating apparatus including in combination, means for supplying steam to be regenerated, a secondary steam supply, a water supply and means controlled by variations in the level of water in the apparatus for regulating the supplies of secondary steam and water to the apparatus.

11. A steam regenerating apparatus including in combination, means for supplying steam to be regenerated, a secondary steam supply, a water supply, and means for automatically regulating the supplies of the secondary steam and water to the regenerator whereby the secondary steam supply will start to flow to the regenerator before the water supply begins to flow.

12. A steam regenerating apparatus including in combination means for supplying steam to be regenerated, and a secondary steam supply, a water supply, and means controlled by the flow of steam to be regenerated and also by the variation in level of water in apparatus for regulating the supplies of secondary steam and water.

13. A steam regenerating apparatus including in combination a regenerating chamber, means for supplying the steam to be regenerated to said chamber, means for supplying water and secondary steam to the regenerating apparatus, a valve mechanism in said last mentioned supply means opened and closed respectively by the decrease and increase of the flow of steam to be regenerated, and a second valve mechanism opened and closed respectively by the lowering and rising of water in the regenerating apparatus.

14. A steam regenerating apparatus including in combination means for supplying steam to be regenerated, a second steam supply, means for controlling the second steam supply by water in the apparatus and by the steam to be regenerated.

This specification signed and witnessed this 11th day of February, A. D. 1909.

ADOLPH SORGE.

Signed in the presence of—
MARJORIE ROLLINS,
CARRIE E. JORDAN.