W. SCHWARZ.

HEAT ACCUMULATOR.

APPLICATION FILED OCT. 23, 1909.

1,018,083. Patented Feb. 20, 1912.

Fig. 1.

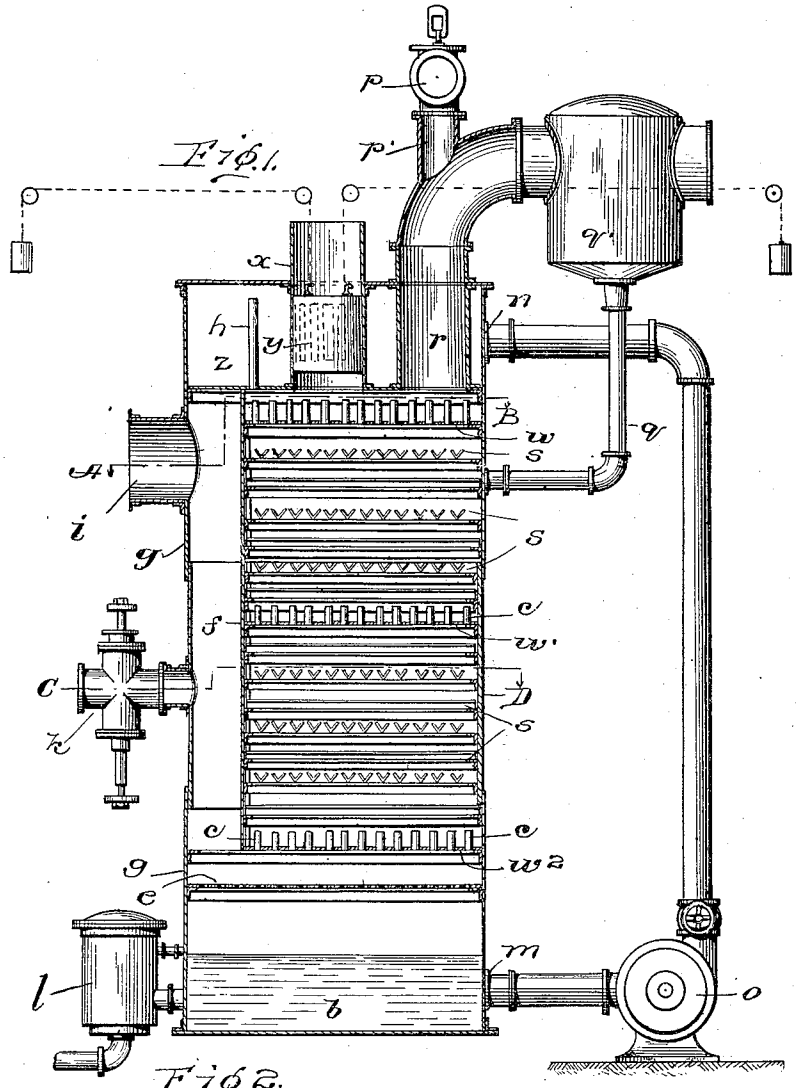


Fig. 2.

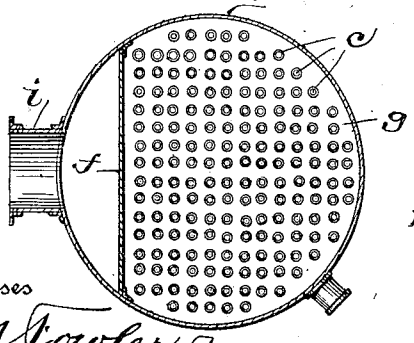
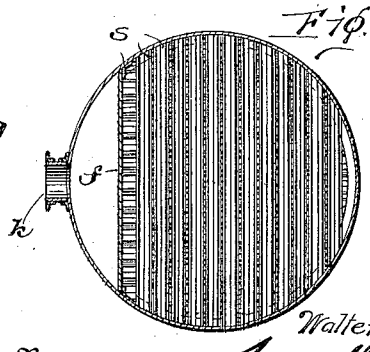


Fig. 3.



Witnesses

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UNITED STATES PATENT OFFICE.

WALTER SCHWARZ, OF DORTMUND, GERMANY.

HEAT-ACCUMULATOR.

1,018,083. Specification of Letters Patent. Patented Feb. 20, 1912.

Application filed October 23, 1909. Serial No. 524,103.

To all whom it may concern:

Be it known that I, WALTER SCHWARZ, of No. 72 Friedenstrasse, Dortmund, in the Kingdom of Prussia, in the German Empire, manufacturer, have invented new and useful Improvements in Heat-Accumulators, of which the following is a full, clear, and exact specification.

The placing on an exhaust steam pipe of heat accumulators or receivers filled with water and masses of iron is already known. These apparatuses are used for storing the superfluous heat when the steam pressure is excessive, that is to say when the exhaust steam is of high temperature, and for increasing the pressure by vaporizing the water contained in the receiver when the steam delivery is insufficient, in order to obtain at the receiver's outlet a continuous supply of steam at practically even pressure which may be utilized for driving steam engines or turbines. A heat accumulator of this kind wherein the exhaust steam entering the accumulator is regenerated, so that it may be drawn off for use in a continuously driven motor is described in my prior British Patent No. 3881 of 1908, and my prior German Patent No. 199,845 of June 27, 1908.

The object of my invention is to reduce the size and consequently the cost of the accumulator and also to avoid the loss of pressure caused by forcing the steam to follow a zig-zag course over the surface of water-trays or by forcing the steam through a compact mass of water, as is the case in different known types of accumulators of this kind. To effect this the fundamental idea of graduation-towers, which produce an artificial rain, is utilized; this heavy shower falls through the steam, to which it offers a continuous new cooling surface, so that the water and steam are brought into the most intimate contact possible and the exchange of heat is practically perfect.

In order to achieve a high efficiency of the heat accumulator, the superficial area is according to my invention variated to the fluctuations of the steam admission.

The drawing shows by way of example an upright or vertical heat accumulator.

Figure 1 is a longitudinal section, Fig. 2 is a cross section on line A—B, Fig. 1, Fig. 3 is a cross section on line C—D, Fig. 1.

The exhaust steam enters the receiver *g* through an inlet *i* placed near the top of the same; it is then led to the bottom between a vertical partition *f* and the outer casing, then it changes its course and passes over a perforated plate *e* placed near the bottom of the receiver and penetrates upward through overflow tubes *c* and the graduation system consisting preferably of layers of ordinary angle irons, wire tresses or any other suitable kind of grate surfaces *s* for spreading the water in the form of a heavy shower.

The tubes *c* are set into and project upwardly from a supporting plate *w*, etc., as shown. The water which falls from above onto this plate accumulates thereon until it rises to the top of the overflow tubes *c* of said plate, through which it passes in drops down into the rain chamber below. The graduation system, as shown in the drawing, consists of horizontal gratings, the bars of which are composed of angle irons of V cross section as shown in Fig. 1, which are set up on their angle edges parallel to one another, forming a series of transverse troughs in which the falling water may be caught and temporarily arrested, thus furnishing additional cooling areas. There are in the present instance, three of these supporting plates, *w*, *w'*, *w²*, dividing the interior of the receiver *g* into three superposed chambers—which I term rain chambers—communicating each with the one next below through the overflow tubes *c* in its bottom, each chamber, below the top chamber, containing a number of grates *s* (in this instance six grates in the intermediate chamber and seven grates in the chamber next below), each composed of V or trough shaped bars parallel with and at a small interval apart from one another. The grates are superposed, being separated from one another by an interval, and the bars of one grate extend at right angles to the bars of the next adjoining grate or grates, as indicated in Figs. 1 and 3.

The perforations in plate *e* are of such size that a slight pressure in the chamber above the plate is necessary in order to force the water through the same, and consequently there is always a thin layer of water on this plate. An intimate contact and exchange of heat are obtained between the steam on the one hand (which spreading over the water layer on perforated plate *e* passes through the tubes and gratings above but slowly on account of the accumulator's large longitudinal section) and the water on

the other hand which falls through it from above. The steam leaves the apparatus through the outlet *r*.

The water passing down through the minutely perforated plate *e* collects in the bottom chamber *b* and is drawn off at *m* by any suitable circulating device, such as the pump *o*, and reënters the receiving tank *z* through the opening *n* at the top. If the water is drawn off by the pump quicker than it gathers at the bottom the motor driving the pump—an electric motor for example—may, as soon as the water in chamber *b* falls below a certain level, be stopped automatically in any suitable way, as for example by a lever arm operated by a float in the chamber and controlling contacts in the motor circuit, which are opened and closed accordingly as the float falls or rises. The quantity of water to be employed and circulated is but small since the drops of falling water are continually being drawn upward by the rising steam.

A water separator *q'* placed on the steam outlet pipe *r* brings back to the apparatus through an opening *q* any water that the steam might have carried with it. The excess of water furnished by the condensation of the steam is removed by a suitable automatic regulator, indicated diagrammatically at *l*. A safety valve *p*, on a branch *p'* of the steam outlet pipe *r* of the accumulator, allows the steam to escape as soon as the pressure is too great. On the other hand, when the steam pressure in the receiver falls below a fixed standard, either during lengthy stoppages of the engine, or from any other cause, a return-valve *k*, connected to a source of live steam supply, opens and lets such steam into the receiver until the pressure is again normal.

Before starting the motor connected with the accumulator (a steam turbine for instance) the circulating pump *o* is started and the top chamber or tank *z* of the accumulator filled; the water which is then supplied by means of an outlet valve *y* (hereafter more fully described) to the top plate *w* falls through the overflow tubes *c* of this plate and penetrates through the gratings *s* into the second rain chamber which it fills up to the edge of the overflow tubes in its bottom plate *w'*, and so on down to and through and out from the third rain chamber. The exchange of heat takes place as soon as the exhaust steam reaches the accumulator, not only through the bottoms *w*, *w'*, *w*², etc., of the chambers and along the tubes, but also through the water showers, it being in consequence very rapid and complete.

Owing to the rapid exchange of heat which takes place in this apparatus, only a small quantity of water is required, which permits of a greater regularity in the service than is obtained with heat accumulators in which large quantities of water must be used. In the apparatus thus organized and operating, water or steam impacts are not occasioned; the loss of pressure by obstructions, etc., is hardly noticeable; and access to the pump is easy since it is erected outside the accumulator.

When large volumes of steam enter, a large body of water is brought into circulation, that is, spread out and distributed over a large surface, as for example in the following manner. The accumulator as before described has an upper chamber or tank *z* in which the circulating water is stored and from which its discharge is controlled by a suitable outlet valve *y*. This valve in this instance is represented as a piston valve, which is located and designed to work up and down in a vertical cylindrical valve case *x*, which has in its sides slots or ports controlled by said valve. The valve is suspended in its case by counter-balance weights as shown, and is lifted by the steam pressure in the chamber below. When lifted it opens the ports in the valve case *x*. The centrifugal pump *o* discharges continuously into the water chamber *z*. The valve *y* opens only upon rise of pressure in the steam chamber. As soon as the valve rises, the valve case ports are opened and the stored water in chamber *z* rushes through these ports into the steam chamber below and thence on to the distribution construction. Ultimately the water collects at the bottom of the apparatus.

Any suitable means may be provided for equalizing the steam pressure in the system. As, for example, there may be provided a connecting pipe *h*, of small diameter, reaching from the top of the steam chamber below to near the top of the chamber *z* above, through which pipe steam may enter from the steam accumulator below to the water chamber above, to equalize the pressure. The interposition of the plate *w* with its overflow tube *c* between the water chamber *z* and the graduation system of gratings *s* serves to secure good and effective distribution of the water over the whole graduation system, the water from the chamber passing downward through these numerous tubes and being thereby spread equally over the whole system, and presenting extensive contact surfaces to the incoming steam. The use of the additional tube plates *w'*, *w*², in the manner indicated, enhances the efficiency of this distributing action. The water collected in the lower part *b* of the heat accumulator forms a large reserve of water which is superheated to a considerable depth and remains at this temperature so long as the pressure of the steam remains; when the pressure lessens the heat is liberated and steam is generated. The circulating

pump *o* takes the water from the lowest part of the bottom chamber *b*, and raises it in a constant stream to the top chamber *z*. If any intervals in the steam supply occur the large quantity of superheated water in the accumulator will supply the steam for a certain time.

What I claim as new and desire to secure by Letters Patent is:

1. In a heat accumulator of the kind referred to, the combination of a receiver, a graduation system within the receiver whereby the water passing down through the receiver is evenly and thoroughly divided and distributed throughout the receiver, a perforated plate adapted to form a water chamber at the bottom of the receiver, a water chamber on top of the receiver above the graduation system, a water circulating device outside of the receiver, communicating on the one hand with the bottom water chamber, and on the other hand with the top water chamber, means for automatically opening the top water chamber into the graduation system and means for conducting the steam from bottom to top through the graduation system, substantially as and for the purposes hereinbefore set forth.

2. In a heat accumulator of the kind referred to, the combination of a receiver, a graduation system within the receiver whereby the water passing down through the receiver is evenly and thoroughly divided and distributed throughout the receiver, a perforated plate adapted to form a water chamber at the bottom of the receiver, a water chamber on top of the receiver above the graduation system, a water circulating device outside of the receiver, communicating on the one hand with the bottom water chamber, and on the other hand with the top water chamber, means for automatically opening the top water chamber into the graduation system, means for conducting the steam from bottom to top through the graduation system and means for introducing steam from the graduation system chamber into the top water chamber above the level of the water therein, substantially as and for the purposes hereinbefore set forth.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

WALTER SCHWARZ. [L. S.]

Witnesses:
OTTO KÖNIG,
WILLY KLEIN.