E. HARLÉ.

REGULATOR FOR STEAM ACCUMULATORS.

APPLICATION FILED SEPT. 30, 1910.

1,023,376.

Patented Apr. 16, 1912.

2 SHEETS—SHEET 1.

Fig. 1.

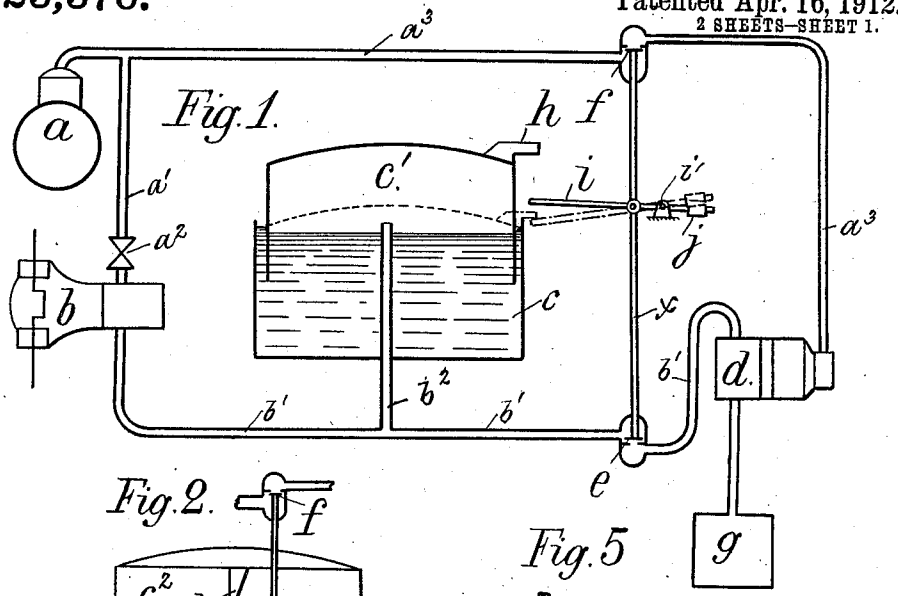


Fig. 2.

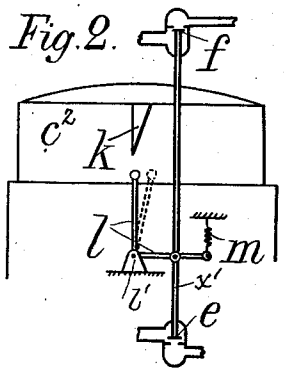


Fig. 5

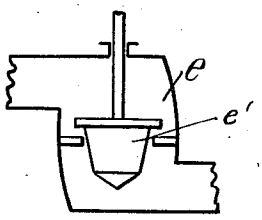
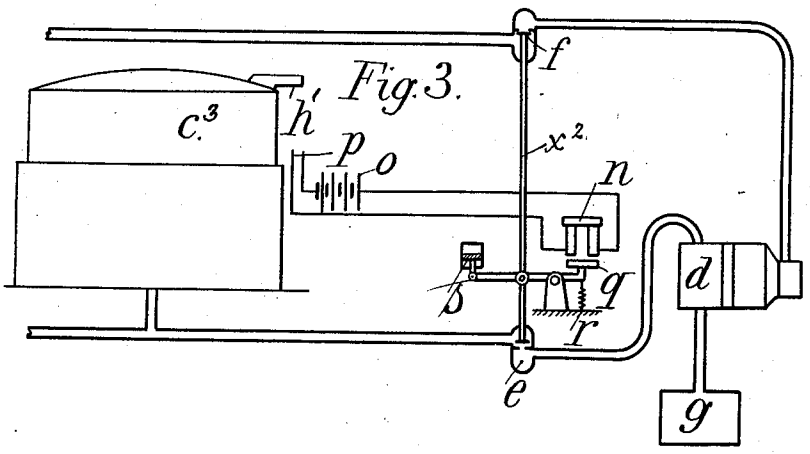


Fig. 3.



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2 SHEETS—SHEET 2.

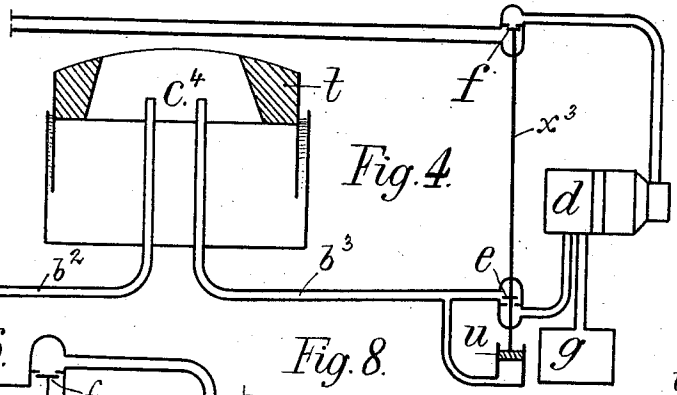


Fig. 4.

Fig. 6.

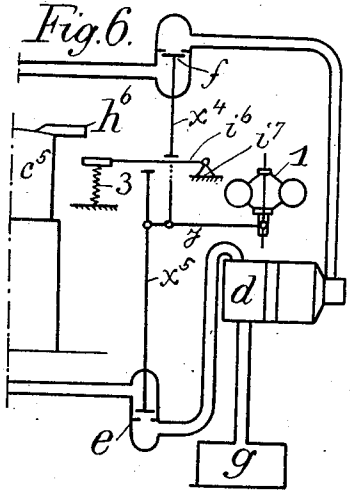


Fig. 8.

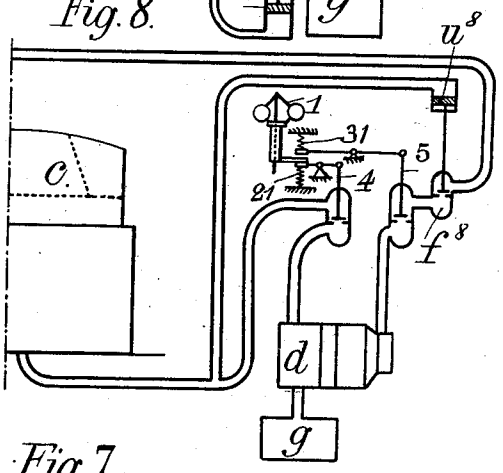
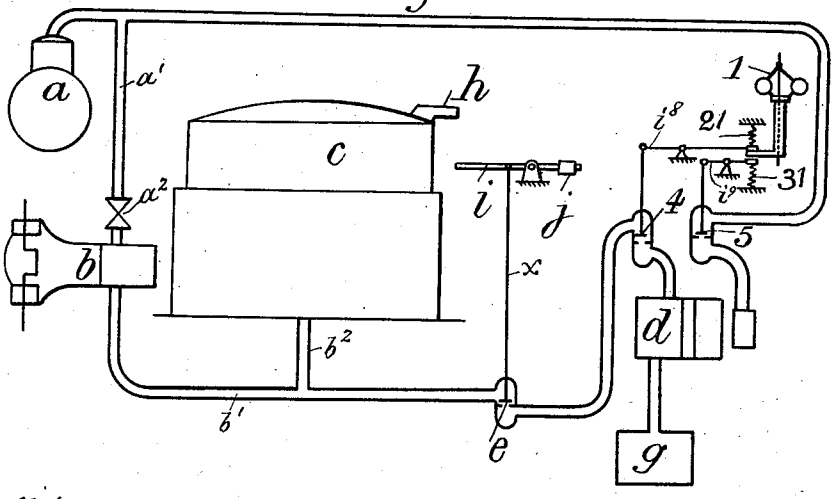


Fig. 7.



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UNITED STATES PATENT OFFICE.

EMILE HARLÉ, OF PARIS, FRANCE, ASSIGNOR TO SOCIÉTÉ HARLÉ & CIE., OF PARIS, FRANCE, A CORPORATION OF FRANCE.

REGULATOR FOR STEAM-ACCUMULATORS.

1,023,376. Specification of Letters Patent. Patented Apr. 16, 1912.

Application filed September 30, 1910. Serial No. 584,739.

To all whom it may concern:

Be it known that I, EMILE HARLÉ, of 26, Avenue de Suffren, Paris, France, engineer, have invented a new and useful Improvement in Regulators for Steam-Accumulators, which improvement is fully set forth in the following specification.

This invention relates to improvements in regulators for steam accumulators.

It has been proposed heretofore to provide a steam plant comprising a source of steam, a primary engine taking live steam from said source, a secondary engine arranged to take either live steam from said source or exhaust steam from the primary engine, according to whether the primary engine is idle or operating, in combination with a steam accumulator interposed between the exhaust of the primary engine and the exhaust steam inlet of the secondary engine, said accumulator serving to store any surplus exhaust steam from the primary engine and in turn supply it to the secondary engine, thus allowing the latter to receive a fairly constant supply of exhaust steam notwithstanding the intermittent discharge of exhaust steam from the said primary engine.

It is the object of my invention to provide a plant of this kind in which the accumulator has a capacity of variable volume and at constant pressure, in combination with regulating means controlled by this accumulator for supplying live steam to the secondary engine when the exhaust steam fails, one modification of the invention providing a governor control of the steam to the secondary engine.

With this general object in view my invention consists in the features, details of construction and combination of parts which will first be described in connection with the accompanying drawings and then particularly pointed out in the claims.

In the drawings,—Figure 1 is a diagrammatic view of one embodiment of my invention; Figs. 2 to 8 inclusive are detail diagrammatic views of other modifications to be described hereinafter.

Referring to Fig. 1, a is a source of steam, for example, a boiler, b is a primary steam engine, c a steam accumulator of variable volume and constant pressure, this accumulator being a tank in which is mounted a rising and falling bell c'. At d is indicated a secondary steam engine, connected to a condenser g.

The primary engine b takes live steam from the boiler a through a suitable conduit a', controlled by a valve as indicated at a^2, and said engine discharge exhausts steam through an exhaust pipe b' to the exhaust steam inlet of the secondary engine d, said exhaust pipe b' having a branch b^2 extending into the accumulator c in a well known manner. The secondary engine d may be operated by live steam taken direct from the boiler a by a live steam pipe a^3.

In the exhaust pipe b' between the accumulator and the secondary engine d is placed a valve e and in the live steam pipe a^3 is placed a valve f, these valves being united so as to operate simultaneously but in an opposite sense, the valve e closing when the valve f opens, and vice versa. In the present example, the two valves are shown as connected by a valve rod x.

Suitable means is provided whereby the accumulator c may control the valves e and f. In the example shown in Fig. 1 the control of the said valves e and f depends upon the volume of steam in the accumulator, that is to say, upon the rise and fall of the bell c. In the example of the invention shown in said Fig. 1, the bell c' is provided with an arm h and a lever i is arranged with one end in the path of the arm h, this lever being fulcrumed at i' and connected to the rod x so that as the lever i is moved it will move the said valve rod x. The lever i is provided with a suitable counterbalancing device, as for example, a weight j which tends to move the valve rod in such a direction as to close the valve f and open the valve e.

The operation of the apparatus thus far described is as follows: When the primary engine is in operation, it receives live steam from the boiler a and discharges exhaust steam to the accumulator thereby raising the bell c', which removes the arm h from contact with the lever i, thus allowing the counterbalance j to lift the valve rod x and open the valve e while at the same time closing the valve f. Thereupon the live steam supply is cut-off from the secondary engine d and the exhaust steam is permitted to flow to the same. When the primary engine is stopped, the bell c' will fall and by operating on the lever i, will move the valve rod x to open the valve f thereby admitting live

steam to the secondary engine d and simultaneously closing the valve e.

In Fig. 2 is shown a modification of the device in which a bell crank lever l fulcrumed at l' is pivotally connected to the rod x' and is arranged to have one of its arms in the path of an inclined detent k carried by the bell c^2. The other arm of the bell crank l is acted upon by a spring m tending to lift the rod x'.

In Fig. 3 is shown a still further modification whereby the bell may control the valves e and f. In this form of the invention an electromagnet n is arranged to pull upward on a lever provided with an armature q, the lever being pivoted to the valve rod x^2 and being acted on at its other end by a dash-pot s. A spring r normally tends to draw the lever to close the valve f and open the valve e. The electromagnet n is included in an electric circuit energized by a suitable source of electricity, as for example, the battery o, said circuit including two contacts or terminals as indicated at p arranged to be closed by the arm h' carried by the bell c^3 when the bell falls. It will be noted that when the bell is raised the spring r closes the valve f and when the bell falls the arm h' closes the circuit through the terminals p, thereby energizing the electromagnet n which attracts its armature q and pulls the rod x^2 downward to open the valve f and close the valve e.

In Fig. 4 is illustrated a modification in which the valve rod x^3 is operated by steam pressure. In this arrangement the exhaust pipe b^2 from the primary engine does not extend direct to the secondary engine but terminates in the accumulator. A second pipe b^3 leads from the accumulator to the secondary engine. The bell c^4 of the accumulator is provided with a float t whereby as the bell descends and the float enters the liquid in the bottom of the accumulator a part of the weight of the bell is taken off the steam, thereby resulting in a variation of pressure on the exhaust steam in the accumulator. To the end of the valve rod x^3 is attached a piston and cylinder device as indicated at u, the bottom of the cylinder being in communication with the exhaust steam pipe b^3 as will be clear from the drawing. In this construction when the bell c^4 is down the exhaust steam coming into the accumulator through the pipe b^2 initially raises the said bell at a low pressure but as the bell is lifted and the float t emerges from the water of condensation in the bottom of the accumulator a relatively larger proportion of the weight of the bell must be overcome by the steam so that the pressure of the steam in the accumulator gradually increases. When the steam pressure has reached the proper point the piston u is lifted and opens the valve e while closing the valve f. Thereafter the secondary engine operates with the exhaust steam. As soon as the primary engine stops, the pressure in the accumulator falls and the piston u by its own weight coupled with the weight of the rod x^3 moves downward, thereby closing the valve e and opening the valve f so as to supply live steam to the secondary engine. Instead of using the form of valve shown in Fig. 4 the conical valve illustrated at e', Fig. 5, may be used, whereby the variations in pressure in the accumulator, which will cause slight movements of the piston u and rod x^3, may throttle the supply of exhaust steam to the secondary engine d and thereby control the speed of the same.

In the modification of the invention shown in Fig. 6, the bell indicated at c^5 is arranged in connection with a governor so that when exhaust steam is being used through the valve e the governor 1 may control said steam in order to control the speed of the secondary engine d and when the said engine is being supplied with live steam through the valve f the governor 1 may control said valve f in order to regulate the speed of the said engine d. In order to accomplish this result the following means are employed.

A lever i^6 fulcrumed at i^7 is acted upon by a spring 3 normally tending to push the free end of the lever upward. The said end of the lever i^6 is arranged in the path of an arm h^6 secured to the bell. Instead of a continuous valve rod connecting the valves e and f, two valve rods x^4 and x^5 are employed. These rods are both pivotally connected to a lever y one end of which is arranged to be acted upon by a suitable governing device, for example, the ordinary fly ball governor indicated at 1. The valve rod x^4 is provided with an abutment arranged in the path of the lever i^6, this abutment being just above the lever i^6 when the latter is in an intermediate position. The rod x^5 is extended above its connection with the lever y and also carries an abutment in the path of the lever i^6 and just below the same. When the bell c^5 is in its raised position the spring 3 forces the lever i^6 upward whereby it contacts with the abutment of the rod x^4 and closes the valve f to shut off the supply of live steam to the secondary engine d. The valve rod x^4 being thus firmly held by the spring 3, its pivotal connection with the lever y becomes a fulcrum for said lever so that as the governor moves the lever y the valve rod x^5 will be moved up and down to control the supply of exhaust steam through the valve e and thus control the speed of the secondary engine d. On the other hand when the bell c^5 falls owing to the stopping of the primary engine the arm x^6 contacts with the end of the lever i^6 and compresses the spring 3, the said lever coming in contact

with the abutment on the valve rod x^5 and forcing said rod downward to close the valve e while at the same time the lever i^6 is freed from the abutment on the rod x^4 and the valve f is free to open. In this condition the connection of the valve rod x^5 with the lever y becomes the fulcrum for said lever and the governor, by moving the lever y, may control the valve f to control the supply of live steam to the secondary engine.

In Fig. 7 a construction is shown in which the accumulator directly controls the valve e only, while the live steam supplied in the secondary engine is under the sole control of the governor. The governor also is arranged to control the flow of exhaust steam to the secondary engine d after it has passed the valve e. In this arrangement the governor spindle is provided with an arm playing between the ends of the two levers i^8 and i^9 fulcrumed as shown in the drawing and connected to the valves 4 and 5 respectively, the former being located in the exhaust steam supply while the other is located in the live steam supply to the secondary engine. The ends of the levers i^8 and i^9 are pressed toward each other and toward the arm of the governor spindle by means of springs 21 and 31 respectively. The operation of this modification of the invention is as follows:

When the primary engine is operating the bell is raised as in the construction shown in Fig. 1 and the lever i opens the valve e, thus maintaining a supply of exhaust steam under uniform pressure to the secondary engine d. The governor spindle rises and lifts the end of the lever i^8 according to the speed of the engine, thereby tending to throttle the exhaust steam supply at the valve 4 as may be required. If the engine slows down the spring 21 moves the lever i^8 to open the valve 4. If the source of exhaust steam fails owing to the stopping of the engine b the bell falls and closes the valve e while the valve 4 is opened by the falling of the governor and the action of the spring 21. The continued movement of the governor spindle downward compresses the spring 31, moving the lever i^9 to open the valve 5 and thereby supply live steam to the secondary engine. Variations in the speed of the engine will cause movements of the governor spindle and its attached arm thus moving the lever i^9 to adjust the valve 5 as may be required to control the speed of the said secondary engine. It will be noted that if at any time while the secondary engine is running with the live steam supply the primary engine is started, the arm h of the bell will free the lever i and allow the counterweight j to open the valve e. Since the valve 4 is standing open, the exhaust steam may pass to the secondary engine and speed up the same whereby the governor spindle will lift and coöperate with the lever i^8 to control the valve 4 for the exhaust steam inlet, while the spring 31 will be free to move the lever i^9 so as to close the valve 5 and shut off the live steam from the said secondary engine.

In Fig. 8 the arrangement of the governor and the valves 4 and 5 with their levers and springs is similar to the construction shown in Fig. 7, but in this case the valve e for the exhaust steam pipe is omitted and the accumulator pressure is used to control a valve f^8 located in the live steam pipe leading to the secondary engine. In this arrangement the accumulator is of the kind shown in Fig. 4 and described in connection therewith and the valve f^8 has its stem connected to a piston u^8 acted upon by the exhaust steam coming from the accumulator. In this construction as the bell rises and falls the pressure of the exhaust steam varies and the piston u^8 is forced downward to close the valve f^8 whenever a sufficient pressure of exhaust steam exists in the accumulator. The governor controls the valves 4 and 5 in the same manner as described in connection with the corresponding elements in Fig. 7. When the exhaust steam supply fails the piston u^8 is raised by any suitable means, not shown, to open the valve f^8 and admit live steam to the secondary engine.

While I have herein shown and described in illustration of my generic claims the forms of apparatus represented in Figs. 7 and 8, in which the governor controls separate governor valves for live steam and exhaust steam supply, respectively, while the accumulator controls one separate valve in one only of the sources of steam-supply, I do not herein specifically claim these forms of apparatus, since they are thus specifically claimed in my application Serial No. 669856 filed January 6, 1912, which is a division of this application.

Having thus fully described my invention, what I claim is:

1. The combination, with a primary engine and a secondary engine, of a boiler, connections between the boiler and the primary engine whereby live steam may be supplied to the latter, connections between the boiler and the secondary engine, for supplying live steam to said secondary engine, means for supplying exhaust steam from the primary engine to the secondary engine, a volumetric steam accumulator arranged to be acted upon by said exhaust steam, valves in the respective live steam and exhaust steam inlets of the secondary engine, and means controlled by the steam accumulator for actuating said valves.

2. The combination, with a primary engine, of a volumetric steam accumulator, comprising a moving member arranged to

be acted on by the exhaust steam from the primary engine, a secondary engine supplied with steam from both the accumulator and from another source, and means controlled by the moving member of said accumulator for regulating the delivery of steam to the secondary engine.

3. The combination, with a primary engine, and a volumetric steam accumulator arranged to be acted upon by exhaust steam by said primary engine, of a secondary engine, connections for supplying said secondary engine with the exhaust steam from the primary engine, connections for supplying said secondary engine with live steam, a throttle valve for throttling the exhaust steam supply to the secondary engine, and means controlled by the steam accumulator for adjusting said throttle valve.

4. The combination, with a primary engine, and a secondary engine arranged to receive the exhaust steam from the primary engine, of means for supplying live steam to said secondary engine, a valve for controlling said live steam supply, a valve for controlling the exhaust steam supply to the secondary engine, connections between said valves for moving them in opposite senses, substantially as described, a steam accumulator having a moving part acted upon by the exhaust steam from the primary engine, and means controlled by said moving part for operating the said valves.

5. The combination, with a primary engine, a secondary engine, arranged to receive the exhaust steam from the primary engine, and means for supplying live steam to the secondary engine, of valves for controlling the live steam and exhaust steam supply respectively, of the secondary engine, a steam accumulator having a moving part arranged to be acted upon by said exhaust steam, a governor actuated by the secondary engine, and means controlled by the moving part of the steam accumulator for putting the governor mechanism in operative relation with either the live steam supply valve or the exhaust steam supply valve.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

EMILE HARLÉ.

Witnesses:
DEAN B. MASON,
FRÉDÉRIC HARLÉ.