

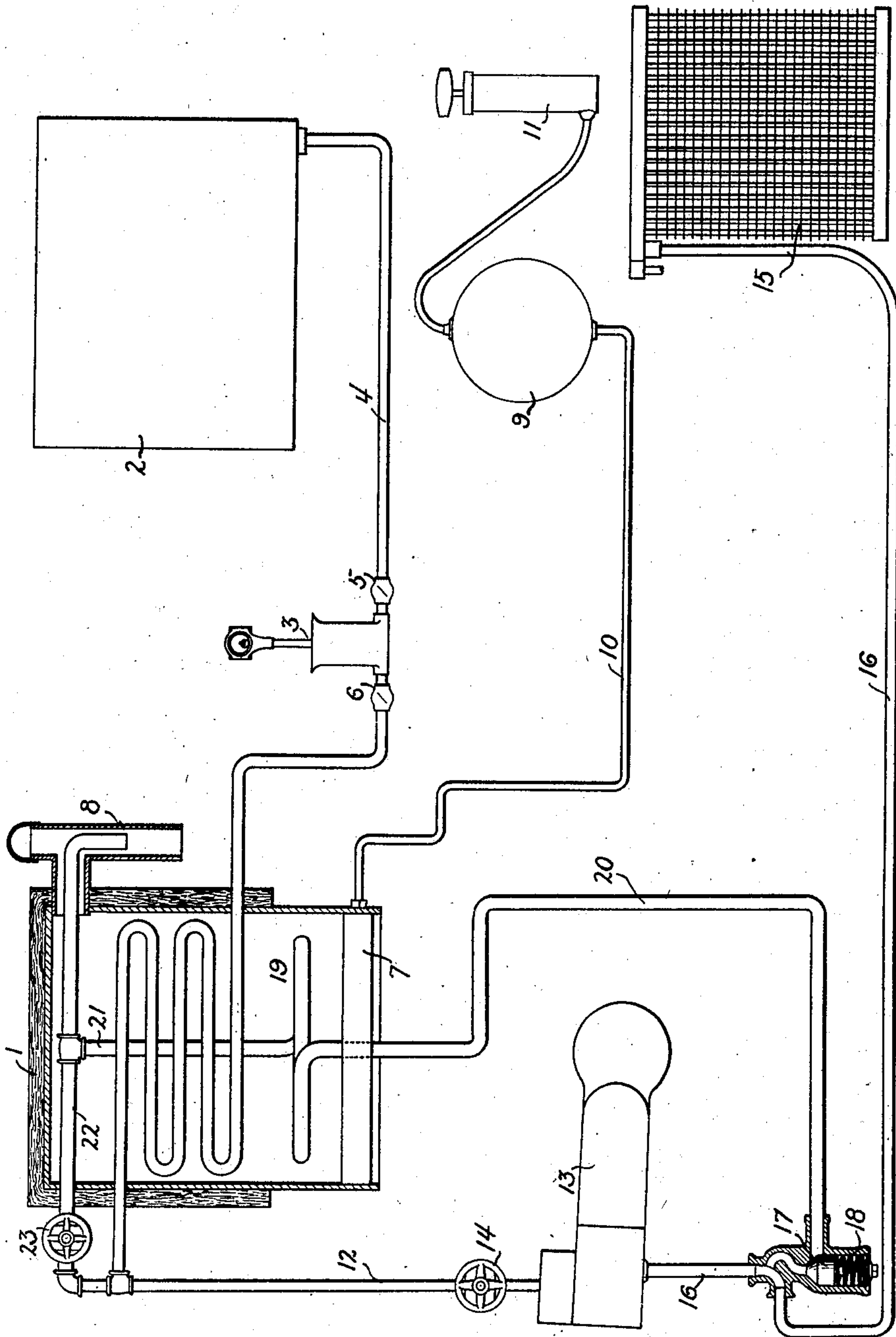
No. 747,927.

PATENTED DEC. 29, 1903.

A. A. BALL, JR.  
EXHAUST RELIEF FOR STEAM VEHICLES.

APPLICATION FILED JUNE 8, 1903.

NO MODEL.



Witnesses

*Harry N. Tilden.*

*Alex. F. Macdonald.*

Inventor

*Augustus A. Ball Jr.*

By *Allen H. Brown*

Att'y.



# UNITED STATES PATENT OFFICE.

AUGUSTUS A. BALL, JR., OF LYNN, MASSACHUSETTS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

## EXHAUST-RELIEF FOR STEAM-VEHICLES.

SPECIFICATION forming part of Letters Patent No. 747,927, dated December 29, 1903.

Application filed June 8, 1903. Serial No. 160,462. (No model.)

*To all whom it may concern:*

Be it known that I, AUGUSTUS A. BALL, Jr., a citizen of the United States, residing at Lynn, county of Essex, State of Massachusetts, have invented certain new and useful Improvements in Exhaust-Reliefs for Steam-Vehicles, of which the following is a specification.

This invention relates to a steam-power system particularly adapted for self-propelled vehicles in which a condenser is employed for recovering the water of condensation of the exhaust-steam from the engine.

The object of my invention is to provide means by which relief is afforded for excessive steam-exhaust delivered from the engine at heavy loads and whereupon such exhaust is introduced into the boiler-flue for inducing a forced draft. The exhaust is preferably reheated before entering the flue and issues therefrom into the air as an invisible gas at normal atmospheric conditions.

The condenser which I employ is of such capacity as to be sufficient to fulfil average conditions of operation or, in other words, to condense the full steam-exhaust of the engine at normal load. In view of this the condenser can be of minimum weight and size—important factors in automobile equipments. Under heavy loads, however—as, for instance, ascending steep grades or traveling over heavy roads—the exhaust of the engine is considerably increased, frequently to a point where it exceeds the normal capacity of the condenser. The pressure in the condenser under these conditions is accordingly augmented. Unless an outlet is provided for the excess steam the counter-pressure will materially affect the operation of the engine. In order to avert this, I provide an automatically-operated relief-valve in the exhaust-pipe, preferably adjacent the engine, whose function is to afford an outlet for the steam when the amount delivered exceeds the capacity of the condenser. This relief-valve operates automatically by the back pressure of the exhaust, and it may be set to act at any predetermined pressure. The outlet side of the relief-valve is preferably, although not

necessarily, in communication with a heating-coil in the boiler located adjacent to the burner. In this coil the steam is reheated and then passes through a pipe that leads into the down-flue of the boiler, where it exhausts with considerable pressure, so as to induce a forced draft. The heat of the flame in the boiler is thereby intensified, contributing a larger number of heat units to raise the temperature of the boiler and accelerate the generation of steam. It will be noted that this forced draft occurs only at times when the engine is under heavy loads, when a large demand is made upon the boiler. Thus the forced draft acts automatically to accelerate the generation of steam under abnormal conditions to meet the demands of the engine. Furthermore, the relief-exhaust by being reheated in the heating-coils of the boiler issues into the atmosphere in the state of an invisible gas.

In the accompanying drawing, which illustrates one embodiment of my invention, is shown diagrammatically an automobile steam system having my exhaust-relief applied thereto.

Referring to the drawing, 1 represents a boiler, preferably a steam-generator of the flasher type, wherein the water is gradually heated to the point of vaporization and the vapor afterward superheated.

2 is a source of water-supply from which water is forced under action of a plunger-pump 3 into the water-tubes of the boiler. The pump 3 is connected in the water-supply pipe 4 and is provided with the usual suction and delivery valves 5 and 6.

The boiler is provided with a hydrocarbon-burner 7 of approved form and with a double-draft flue 8. The burner is supplied with liquid fuel by a supply-tank 9, from which the fuel feeds through pipe 10. A pump 11 is provided in connection with the supply-tank 9 for establishing the necessary pressure. The burner operates under natural draft except when the volume of the exhaust is greater than the condenser can handle. At such times the burner works under a combination of natural and forced draft.



A steam-supply pipe 12, extending from the boiler, connects with an engine 13, a throttle 14 in said pipe serving to control the speed of the engine. A condenser 15, of any preferred construction, is connected with the exhaust side of the engine by the exhaust-pipe 16. This condenser preferably has a capacity equivalent to the normal exhaust of the steam. In other words, the capacity of the condenser is sufficient to condense the exhaust of the engine when the demand for steam is normal, as when running under average load work. The water of condensation may be drawn off from the condenser in any well-known manner and returned to the water-tank 2. Adjacent the engine a relief-valve 17 is arranged in the exhaust-pipe. This valve may operate at any desired pressure by adjusting the tension of its spring 18, and in practice it has been found to give satisfactory results by having the valve adjusted to be operative at a pressure from two to five pounds. I do not, however, limit myself to these or any other specific pressures.

The outlet or relief side of the relief-valve 17 is connected with a heating-coil 19 by means of a pipe 20. The coil 19 consists of several turns of pipe that are arranged in the boiler above the burner-flame, preferably circumscribing the same, so as to be beyond the intense heat to prevent the coil from burning out. The heating-coil continues in a riser 21, which terminates in the down-flue of the boiler. The relief-exhaust steam that enters the heating-coil is in a partially-condensed or wet state and upon being subjected again to the flame it becomes reheated. This raises its pressure and temperature and causes it to discharge into the down-flue with considerable force, creating thereby a strong draft, and consequently increasing the steam production of the boiler.

It has been previously stated that dependence is placed upon a natural draft on the burner for normal operation and a forced draft for abnormal operation, which arrangement I have found to operate satisfactorily. It may happen that for some reason the steaming capacity of the boiler is reduced. This may be due to a fault in the boiler or to the burner, or both, or the fuel may be poor. To provide for such contingencies, a steam-pipe 22 is provided, which is connected to the throttle side of the boiler and discharges vapor in a manner to create a forced draft on the burner. In the present embodiment of my invention the pipe 22 discharges into the downwardly-opening flue through the upper end of the riser 21; but obviously the same result can be obtained in other ways. In order to control the passage of vapor through the discharge-pipe, a manually-actuated valve 23 is provided, which is preferably located at a point where it can be conveniently reached by the operator.

When the engine is running under normal

load, the steam exhausts into the condenser in the usual manner. When, however, the load on the engine is increased by obvious causes, the exhaust-steam exceeds its normal volume, so that the condenser is unable to provide for this new condition. Thereupon the pressure in the condenser and exhaust-pipe increases until it is sufficient to overcome the tension of the relief-valve spring. This back pressure then opens the relief-valve and permits the excess of exhaust to escape therethrough. The relief-valve remains open so long as the engine is overloaded and the back pressure exists in the condenser. Thus at times of abnormal exhaust the usual volume of steam passes into the condenser, while that which is in excess of the condenser capacity passes through the relief-valve. Passing from the relief-valve the relief-exhaust steam enters the heating-coils to be reheated, thence passing into the down-flue of the boiler, wherein it creates a forced draft and issues into the atmosphere as an invisible gas.

It will be observed that the relief-valve acts automatically at such times when the engine is overloaded and creating an abnormal demand for steam. The forced draft occasioned by the relief-exhaust contributes simultaneously to accelerate the generation of steam in the boiler to approximate the demand of steam created by the engine. This tendency to accelerate the generation of steam by means of the forced draft varies in direct proportion to the excess of exhaust beyond the capacity of the condenser.

In accordance with the provisions of the Patent Statutes I have described the principle of operation of my invention, together with the apparatus which I now consider to be the best embodiment thereof; but I desire to have it understood that the apparatus shown is only illustrative and that the invention can be carried out by other means.

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. In combination, a boiler normally working under natural draft, a burner, an engine, a condenser arranged to receive the exhaust from the engine, a relief-valve in the condenser system which opens when the volume of steam delivered by the engine exceeds the capacity of the condenser, and a conduit which receives the exhaust from the relief-valve and discharges it in a manner to increase the draft on the burner.

2. In combination, a boiler normally working under natural draft, a burner, an engine, a condenser arranged to receive the exhaust from the engine, a relief-valve in the condenser system which opens when the volume of steam delivered by the engine exceeds the capacity of the condenser, a conduit which receives the exhaust from the relief-valve and discharges it in a manner to increase the draft on the burner, and a means acting in



conjunction with the exhaust for increasing the draft on the burner.

3. The combination of a boiler operating at normal capacity, an engine, a condenser having a maximum capacity equivalent to the normal exhaust of the engine, means for directly relieving the engine of the exhaust-steam in excess of the capacity of the condenser, and means for utilizing the excess exhaust-steam for accelerating the generation of steam in the boiler.

4. The combination of a boiler operating at normal capacity, an engine, a condenser having a maximum capacity equivalent to the normal exhaust of the engine, automatic means for exhausting directly from the engine the steam exceeding the capacity of the condenser, and means for utilizing the excessive exhaust-steam to increase the temperature of the boiler.

5. The combination of a boiler operating at normal capacity, an engine, a condenser having a maximum capacity equivalent to the normal exhaust of the engine, automatic means for exhausting directly from the engine the steam exceeding in volume the capacity of the condenser, and means for utilizing the excessive exhaust-steam to induce a forced draft in the boiler.

6. The combination of a boiler, a flue therefor, an engine, a condenser having a maximum capacity for condensing the normal exhaust of the engine, a relief device interposed between said engine and condenser, and a heat-

ing-coil connected with the relief device and terminating in the flue of the boiler for creating a forced draft.

7. In combination, a boiler having a flue-opening, a burner located within the boiler-casing, an engine, a condenser which is normally connected to the engine and disconnected from the boiler-casing, and automatic means acting when the volume of the exhaust is greater than the condenser can handle, for establishing communication between the flue and the condenser, while permitting the condenser to act in its normal manner.

8. The combination of a boiler, an engine, a condenser having a predetermined capacity, an automatic relief-valve operative at a pressure slightly exceeding the condenser-pressure, and a heating-coil in the boiler for reheating the excess exhaust from the relief-valve preliminary to issuing it into the atmosphere.

9. The combination of a boiler having a down-flue, an engine, a condenser, a relief-valve operated by the back pressure of the condenser during conditions of excess exhaust from the engine, and a heating-coil in the boiler connected with the relief-valve and terminating in the down-flue.

In witness whereof I hereunto set my hand this 4th day of June, 1903.

AUGUSTUS A. BALL, JR.

Witnesses:

DUGALD MCK. MCKILLOP,  
CHATTIE BRADWAY.