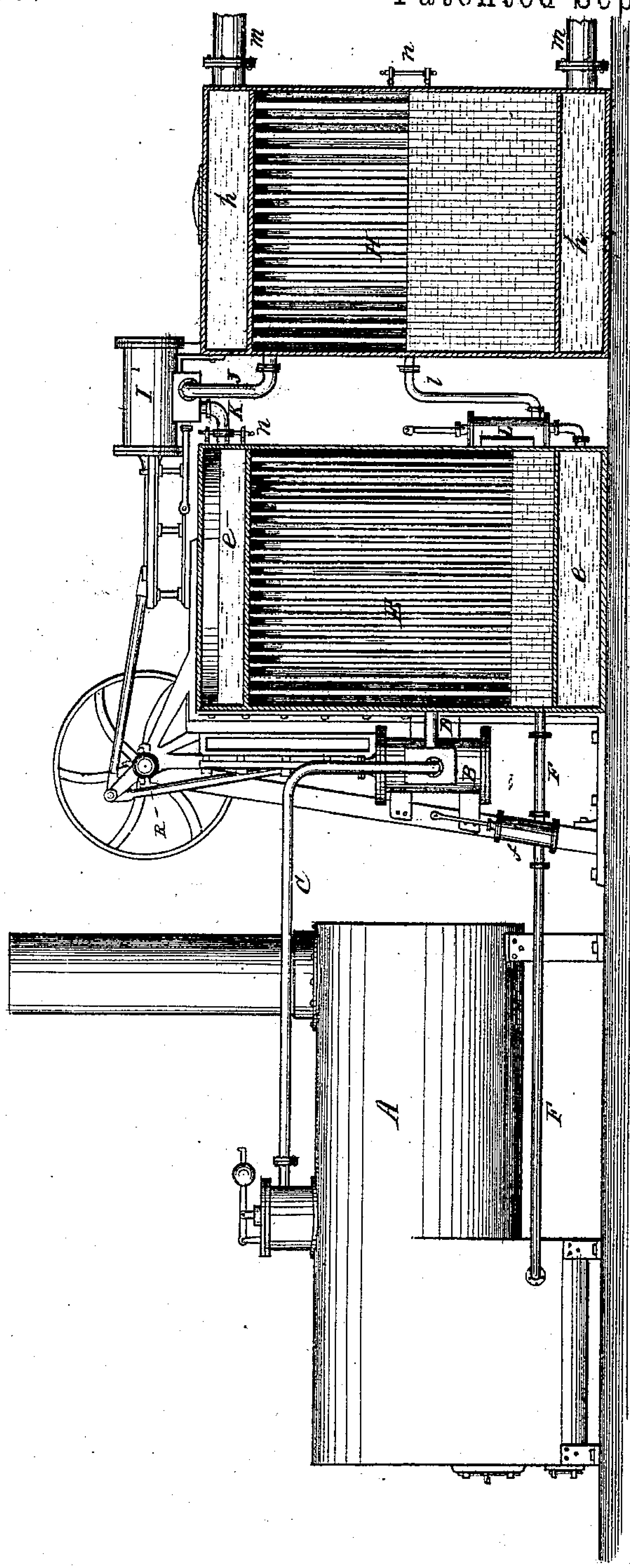
2 Sheets—Sheet 1.

F. A. MORLEY.

STEAM AND VAPOR ENGINE.

No. 107,206. Patented Sept. 6, 1870.



WITNESSES

Wm J Dodge

Wm A. Burnham

INVENTOR.

F. A. Morley

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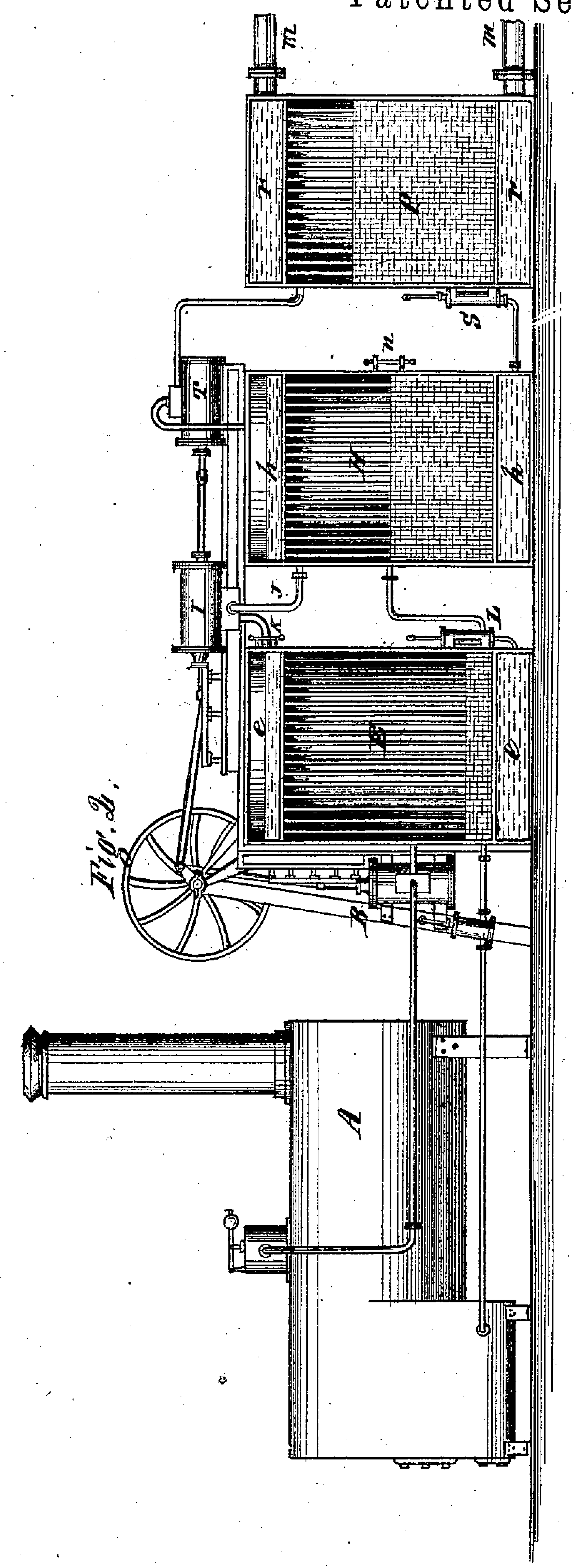

Fig. 2.

Witnesses.

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UNITED STATES PATENT OFFICE.

FRANKLIN A. MORLEY, OF SYRACUSE, NEW YORK.

IMPROVEMENT IN STEAM AND VAPOR ENGINES.

Specification forming part of Letters Patent No. **107,206**, dated September 6, 1870.

To all whom it may concern:

Be it known that I, FRANKLIN A. MORLEY, of Syracuse, in the county of Onondaga and State of New York, have invented a new and useful Improvement in Steam and Vapor Engines; and I do hereby declare that the following is a full, clear, and exact description thereof, which will enable those skilled in the art to make and use the same, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a sectional view of my invention, showing the use of two condensers; and Fig. 2 is a like view, showing the use of a third condenser.

Similar letters of reference indicate like parts in the several figures.

In the accompanying drawings, A is an ordinary steam-boiler, and B is the steam-engine. C is the steam-pipe, and D the exhaust. The engine B exhausts into a surface-condenser, E, and the steam being condensed on its flues falls to the bottom of the chamber E, and is returned to the boiler A by the feed-water pipe and pump F *f*, the pump *f* being worked by an eccentric on the main shaft, or by other suitable device.

The chambers *e e* of the condenser connect with each other by the flues E. Instead of supplying these flues and chambers *e e* with cold water, they are filled with aqua-ammonia, so that the upper chamber, *e*, is nearly full, as shown. This aqueous solution of ammonia is heated by the exhaust-steam to a temperature of 176° Fahrenheit, and gives a pressure of seventy-five pounds to the square inch of ammoniacal gas. This gas is worked through the second engine, I, and discharged into the chamber H of the second condenser, and is there condensed on the flues H by a current of cold water kept passing through the flues and chambers *h h* by means of cold-water pipes *m m*.

The aqueous solution is kept at a temperature of 176°, or thereabout, by its vapor being withdrawn from *e* by the engine I, and this temperature condenses the steam from the engine B, and the feed-water for the boiler A is returned to it at the boiling-point from chamber E.

The circulation of cold water through the second condenser lowers the temperature of the aqueous solution of ammonia in H to 122°, and this brings the expansibility of the solution to that of atmospheric pressure, and thus a working pressure of seventy-five pounds to the inch is obtained between the condensers E an H for driving the engine I.

The action of the water and ammonia in solution with relation to each other when undergoing change of temperature is as follows: The solution in *e e* being heated to 176°, the tendency for the ammonical gas to be expelled from the water is equal to a pressure of seventy-five pounds to the inch, and this pressure is wholly neutralized by bringing the temperature of the solution down to 122°, as is done in the condenser H; but the ammonia and water must accompany each other back and forth from one condenser to the other to get the best effect. If the ammoniacal gas should be worked through the engine I and the water be left behind in *e*, there would soon be more ammonia in H than would enter into solution with the water in said chamber H, and this would increase the pressure in H and make a wasteful resistance in this condenser, and the elasticity of the solution in *e* would soon be impaired and the engine I would be working at a great loss of power. This is obviated by working the water and ammonia both through the engine and discharging them into the condenser H.

The valve-chest and ports of the engine I are made more roomy, and are turned underneath, and water and ammonia are admitted through the pipe K into the engine, a small quantity of the liquids giving ammoniacal gas enough for a stroke of the engine. The gas leaves the water, and after the stroke is made both are expelled and by the pipe J conducted into the condenser H, and as the water and gas in H become cooled the ammonia is again absorbed by the water, and in a liquid form they are returned to *e e* by the pump L.

The height of the solution in *e e* and in H is regulated by the pipes K *l*. If the solution should get a little too low in *e*, then the engine works through more gas, the pipe K being at the regulated height; and if the liquid should be too high, then more of it is worked through the engine, and the pump L, with its pipe *l*, entering H at the upper surface of the liquid, also regulates the height of the liquid in H by pumping more gas or liquid into *e*, as the case may require. When the condensers have been furnished with the proper quantity of the solution these heights regulate themselves, as described, and fluctuate little or none.

If a leak should occur, by which some of the solution should be lost, water can be added temporarily to restore the height, if no aqua-ammonia is at hand. Each condenser is provided with a glass gage-tube, *n*, so that the height of the fluids can be seen at a glance.

The engine I can be inclosed in an accessible box or compartment, and provision made for keeping a small waste-pipe for water in operation within the box, so that the gas would enter into solution with this water and be carried away, and any smell of gas avoided in case the engine should get to leaking; or, in place of this, the room containing the engine I and the condensers can be sufficiently ventilated to carry off any gas occasioned by a leak.

If A B is an engine that utilizes the heat from the furnace in the most economical manner, but eleven per cent. of all the heat that is passed into the boiler A to make steam is utilized, and consequently eighty-nine per cent. of this heat is still left in the exhaust-steam to be applied to the aqua-ammonia in *e e*. If the steam-engine A B is burning two and one-half pounds of coal per horse-power per hour, and each pound of coal evaporates from the boiling-point twelve pounds of water, then the amount of heat that passes into the boiler A for a horse-power per hour is that necessary to evaporate thirty pounds of water or twenty-nine thousand and ten units of heat; and as two thousand five hundred and sixty-five units of heat converted into work are the equivalent of a horse-power of work per hour, then but eleven per cent. of the heat that is passed into the steam-boiler A is really utilized or converted into work by the steam-engine B when such engine and boiler are of the best kind, and consequently eighty-nine per cent. of the heat that has been used in the steam-engine B is yet ready and available for evaporating the liquid in the condensers H *e e*; and by these means the effectiveness of the engine is nearly doubled without any increase of fuel.

By adding a third condenser, P *r r*, Fig. 2, and using in this condenser liquid ammonia, the useful effect of the fuel can be still further increased eighty-one per cent. In this case the liquid ammonia would cool the condenser H in place of water, and the current of water would be employed to cool the third condenser, P, containing the pure or liquid ammonia. The pure ammonia gives a working pressure of seventy-five pounds to the inch for the third engine, T, with a temperature of 80° in the condenser P and 110° in the condenser *h h*, or with only 30° of differential temperature.

To give a greater range or difference of temperature between the several condensers or liquids, the steam-engine can exhaust into its condenser at a temperature as high as 230° without loss of power, as its feed-water will be returned to the boiler A at 230° and fully compensate for the back-pressure of seven pounds.

With these attachments to the steam-engine eighty-nine per cent. of the heat that passed into the boiler A to make steam is available after passing through the engine B to work the engine I, and eighty-one per cent. is still left to reach the engine T after passing through both of the engines B and I.

Valves for the engine I, similar to the valves of the "Corliss engine," are preferable to a slide-valve; but for the third engine, that is actuated by pure ammonia, any kind of valve that is used for steam can be used.

The engines can be constructed to act independently, or be connected in action, as desired.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is—

1. In combination with the engine A B and condenser E, the second multitubular condenser, H *h h*, substantially as and for the purpose specified.

2. The third multitubular condenser, P *r r*, substantially as and for the purpose specified.

3. The method herein described of regulating the height of the liquid in *e* and H—namely, inserting the pipes K *l* at such point that they will receive more gas or liquid as the surfaces of the liquid fluctuate in height, for the purpose specified.

4. The method of preventing back-pressure in the aqua-ammonia engine I by causing the water of the solution to accompany the ammonia to the cooling-vessel or condenser H.

The above specification of my invention signed by me this 19th day of May, 1870.

F. A. MORLEY.

Witnesses:

Wm. J. Dodge,

W. A. Burnham.