R. M. MARCHANT.

Pump and Condenser for Motive Power Engines, &c.

No. 201,542. Patented March 19, 1878.

Fig. 2.

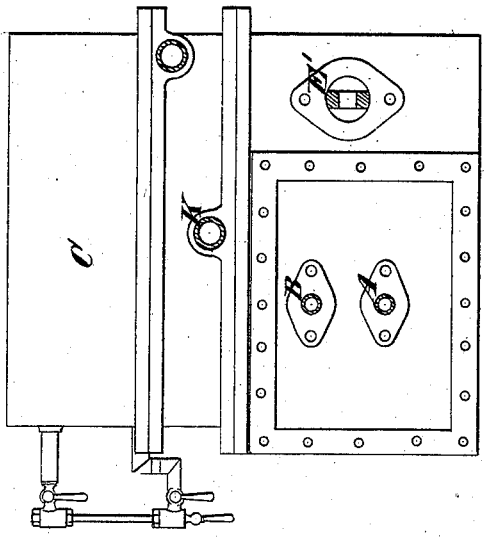


Fig. 4.

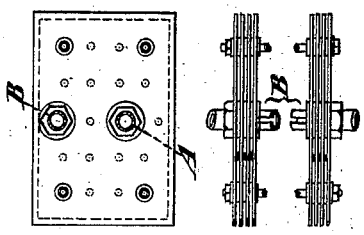


Fig. 1.

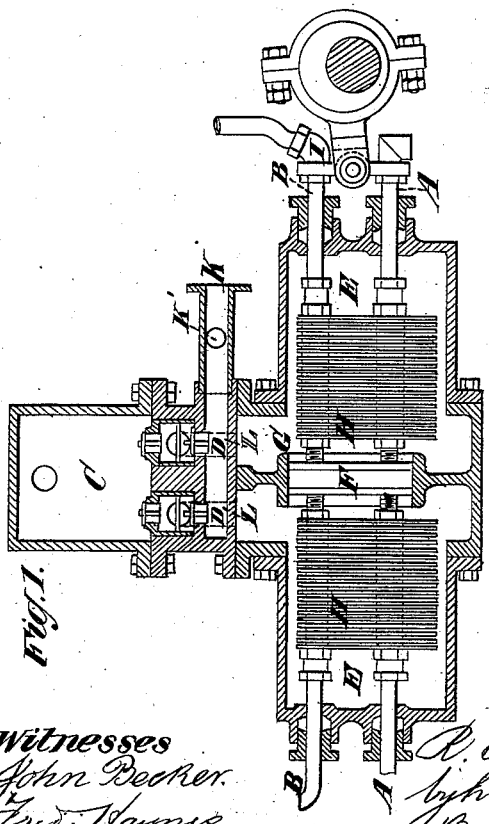
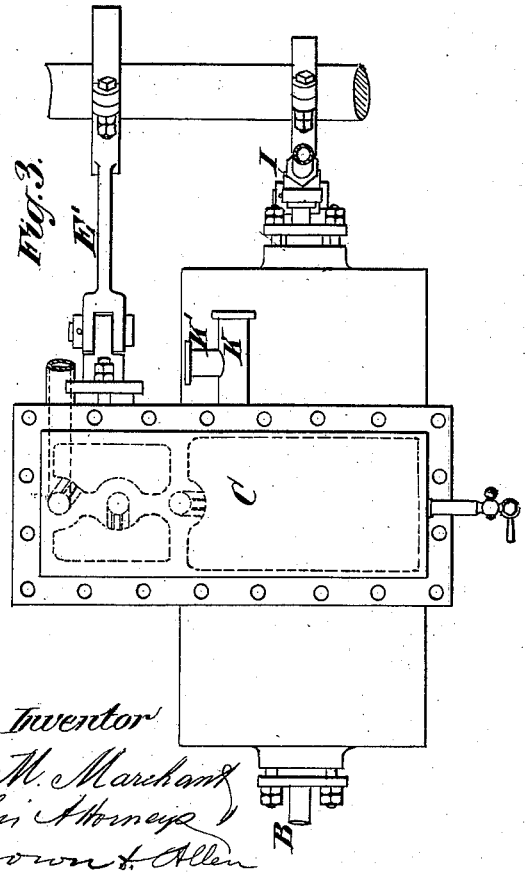


Fig. 3.



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ROBERT M. MARCHANT, OF LONDON, ENGLAND.

IMPROVEMENT IN PUMPS AND CONDENSERS FOR MOTIVE-POWER ENGINES, &c.

Specification forming part of Letters Patent No. **201,542**, dated March 19, 1878; application filed December 15, 1877; patented in England November 21, 1876.

To all whom it may concern:

Be it known that I, ROBERT MUDGE MARCHANT, of London, England, have invented certain new and useful improvements in compressing and condensing steam, a mixture of steam and air, or other gases, for motive-power engines and other purposes; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, forming part of this specification.

Figure 1 is a vertical section, Fig. 2 a front elevation, and Fig. 3 a plan view, of a pump and condenser constructed in accordance with my invention.

My invention relates to an improved method and means of applying that production or expression of heat which is due to the compression of steam or other vapor or gas from the saturating water or liquid supplied to such steam, vapor, or gas when under compression, and partly to means for the production and application of a new gaseous fluid for motive-power purposes.

Such improved methods and means are based partly on my discovery of the law that any vapor or gas can be compressed without any thermometrical production or expression of the increased temperature due to its compression, if, during such compression, it be so saturated with a liquid that all the heat evolved by its compression shall be taken up by the liquid and expressed in vapor out of such saturating-liquid; and that such process can be effected without destroying the elasticity of the steam or vapor.

In carrying out my invention, by the introduction of air into the apparatus by which I apply the aforesaid law, I produce the aforesaid gaseous fluid for motive purposes, as hereinafter described.

According to my method of effecting the first-named result, the whole operation is confined within the pumps, which are constructed for the purpose, and which compress steam (or other vapor or gas) under water or liquid saturation, and supply, for example, the boiler of an engine with saturated steam.

To effect the second result—that is to say, the production of a new gaseous fluid for motive purposes—I only need an ordinary forcing-pump, to introduce air in the proper quantity into the aforesaid compression-pumps.

I construct the compression-pump, or the first of my series of compression-pumps, of such capacity of pumping-power as shall deliver the proportion of exhaust-steam which is to be compressed as steam with every revolution of the engine; and I make the pump rod or rods of this pump of tubes, working through glands, in the ordinary manner. I slot these tubes in such manner as to connect them with thin copper or other compartments, which are perforated or bored to receive the pipes, and in such manner as to put the interior of each compartment in communication with the interior of the tube. I then thread these compartments on the tubes, making the joints between them and at the ends by means of rubber washers, which close up the slot in the tube where it is not in connection with a compartment. When all the compartments are threaded on with alternate washers the whole is screwed up tight by means of a back nut or other suitable contrivance at each end for the purpose; or the compartments may be built up in one structure by means of brazing a center ring of metal onto a compartment, (in the place described as occupied by the rubber,) the second compartment being brazed again onto this ring; then a center ring is brazed onto the other side of this second compartment, and so on for the whole series. There would, in such case, only remain the end joints to be made, and the compartments could be tested for tightness in one operation.

I keep the ends of the tubes forming the pump-rods open to the atmosphere, and by means of these tubes I convey into the copper compartments external air, saturated in its passage by water from the open end of one of these tubes.

By such means I can regulate the condensation by giving a greater or less supply of water to the air, so as to make either a good or inferior condensing medium, and I obtain an enormous condensing-surface in a small space. I then deliver the steam-charge for compression on the top of the water in the pump, and the

steam that I require to be condensed into water (for the purpose of saturating such steam-charge when under compression) below the top of the water in the pump; and in this water the copper compartments, full of saturated air, and open by means of the tubes to the external atmosphere, are given a corresponding motion with the stroke of the pump, and the water for saturation is manufactured in the required proportion of the exhaust-steam in the pump itself, and without necessity for an external condenser or other pumping arrangements. By such arrangement, therefore, the whole of the exhaust-steam is delivered into the pump. The proportion to be compressed as steam is delivered forward with the stroke of the pump, and the proportion that has to be condensed for the purpose of saturating the former charge is condensed in the pump itself, and the law hereinbefore named by which such process is effected is applied in a complete and economical manner.

To the pumps employed in carrying out my invention, I add chambers for the reception of the aforesaid saturated air-condenser. I provide, by an arrangement of valves, for the compression of the charge of air, steam, or other gas to be delivered over the water or other required liquid in the pumps for the purpose of effecting such compression of the charge; and I provide for the maintenance of such water or other liquid in the pumps by delivering the remainder of the steam or gas charge below such liquid, so that it shall pass upward by the action of gravity through the liquid in which the condenser works with the fullest attainable convenience for coming in contact with the condenser itself, by which process such proportion of the steam or other gas supply will be condensed, and will, by such process of condensation, maintain the quantity of saturating-water or other liquid intact, the whole operation becoming one of continuous circuit, and the only addition required being that for the purpose of supplying gland, cock, or other leakage.

Referring to the drawing, E and E are two chambers, one on each side of a pump-piston, F, which has a very short stroke in the barrel G, the requisite capacity being obtained by a great diameter of the pump-chambers. A B are two pipes, which act as pump-rods, and on these pipes are a number of condenser-compartments, H H, the pipes being slotted to allow of communication with the interior of such compartments. Between the compartments are rubber washers, which close the slots in the parts of the pipes A B which are between the compartments. The lower pipe A is open at both ends, so that the external air, entering at both ends, may circulate through the compartments H H, and pass into the upper pipe B. This pipe is formed at one end with a bell mouth or funnel, I, over which is a cock, from which cold water can be percolated for the saturation of the air in its passage through the compartments; and I prefer to slot the portion of the pipe B for the first set of compartments only at its top, while the portion for the second set, as well as both portions of the lower pipe A, are slotted both at top and bottom. The other end of the pipe B works in a gland (not shown) or other contrivance attached to a fixed pipe, the other end of which is over the furnace, so that the air may be sucked through and delivered in its heated state over the fire.

If special velocity of circulation be required, it can be increased by percolating a little coal-oil into the fixed pipe through which such heated air is led from the condenser.

It is evident that such circulation of the air is determined by the character of the vacuum into which the hot air rushes, so that when, by the application of a minimum of oil, there is flame at the outlet of the pipe in the furnace, such vacuum is nearly perfect, and the rush will be under the pressure of the external air into the vacuum at the end of the pipe, whatever such vacuum may be.

Such application of hot air to the furnace is also one by which smoke will be consumed in the furnace itself without that check to its evaporating power which arises from the admission of cold air for such purpose.

C is a storage-chamber, which, when the pumps are in action, is filled with vapor. The steam introduced by the pipe K is delivered, at its already attained compression, to the pump-chambers E E alternately above the water therein through the valves D D and passage L L, and the compressed charge, saturated with water, is delivered from the said chambers through the passage L and through similar valves into the storage-chamber C. Further, steam which is required to be condensed is admitted to the chambers E E below the water (by preference at the bottom of these chambers) through suitable valves. (Not shown.) The steam thus condensed supplies the place of the water taken up by the compressed steam.

Fig. 4 shows one of the condenser-compartments, H H, and one manner of attaching these to the slotted pipes A B.

These compartments can be constructed in various ways—the one shown, by riveting and distance-pieces. Another way would be by indentations, which should meet each other, and fulfill the duties of the distance-pieces; and when these compartments become an article of commerce this latter system will be preferable, and the plates will be stamped, so as to be indented where rivets are shown, and round the edges, so that they can be brazed together in pairs, the indentations answering the purpose of the distance-pieces.

It will be observed that all pressure is external to the condenser-compartments, and that the object of the distance-pieces or inden-

tations is to maintain any determined separation of the two sides of any condenser-compartment.

Although I have described my pumps and condensers as applied to steam or motive-power engines, they are applicable to other gases for the same purpose, or to other purposes where it is required to compress and condense steam or other vapor or gas—in ether or other gas machines used in the manufacture of ice, for example; or condensers, constructed as described, can be used to condense steam or other vapor or gas admitted to a chamber containing the condenser, and without compression; and, instead of the condenser being constructed in the manner described, the pumps may contain condensers of any other form which will afford sufficient surface to carry out the condensation of the steam or vapor, for the purpose explained.

In working engines in which a portion of the exhaust-steam is utilized in its condensed state—that is to say, as boiling water—to saturate the rest of the exhaust in the state of vapor while being forced to the engine-boiler, as hereinbefore described, I have employed a series of pumps worked in stages of compression, or what is now known as the "stage process"—that is to say, the exhaust-steam and the saturating-water have been compressed in the first pump of a series of pumps. The compressed mixture has then been passed onto a second pump, where it has been further compressed, and so on through the whole series of pumps, in each of which it receives a further compression, together with the increased temperature due to such further compression, and from the last pump of the series the steam saturated with water has been passed forward to the boiler at the full pressure due to the last stage of compression.

But I have, in practice, found difficulty in getting up the required pressures because steam mixes with water of its own temperature and the pump-piston plays in such mixture as it does in steam alone.

By repeated experiments I have, however, found that, by pumping a permanent gas or a mixture of permanent gases, such as air, into the steam, any determined pressure can be obtained in the air and steam, when saturated with water to any desired extent, without the production of those temperatures which are in other cases produced by steam according to its pressure.

Steam can thus be made use of, so that its latent heat may be applied for any continuous action—for example, the exhaust-steam from an engine can be pumped, together with air and hot water at any determined pressure and temperature, into the boiler from which such engine is supplied.

A part of my invention consists in the combination, with one or more compression-pumps provided with condensers, as hereinbefore specified, of a pipe, port, or passage for the introduction of air into the compression-chambers of said compression-pumps, to mingle with the steam during the compression of the same, as aforesaid.

I do not confine myself to any particular kind of air-pump, or to any precise location of the passage for the air from said air-pump into said compression pump or pumps.

In the drawing, K′ represents such a pipe, port, or passage, through which air, taken from the external atmosphere, is forced from any suitable air-pump into the compression-chambers, passing, in this instance, first through the pipe K, whence, after undergoing one stage of compression with the intermixed steam, the mixture may be, if desired, delivered to other pumps for further compression, or to the pump E′ for final delivery into the boiler.

The amount of air necessary to enable the required pressures and temperatures of steam to be attained is comparatively small—for instance, for an engine of five hundred indicated horse-power the dimensions of the air-pump required would not exceed a cylinder of four inches bore, having a stroke of twelve inches.

The final temperature of the mixture depends upon the proportion of water and air supplied to the steam; but in no case is it below the temperature of the steam-supply.

It will be seen that the production of the gaseous mixture of saturated steam and air may be obtained in any compression-pump without the condensers H H, by supplying the said pump with hot water through a separate pipe or passage, to saturate the steam when the said mixture of steam and air is compressed.

I claim—

1. The combination, with a compression-pump, of one or more surface-condensers placed within said pump, the interior or interiors of which condenser or condensers receive cold air, or a mixture of cold air and water, that circulates through said condensers, substantially as and for the purpose set forth.

2. The combination, with the pump-chambers E E and pump-piston F, of one or more tubular piston-rods, A B, with attached condenser-compartments, the interiors of which communicate with the interiors of said rods through the slots in said rods, substantially as and for the purpose specified.

3. The combination of one or more slotted pipes, A B, and one or more condenser-compartments, H, the interiors of which communicate with the interiors of said pipes through the slots in the said pipes, substantially as described.

4. The combination, with a pump or pumps for compressing a gaseous mixture of air and saturated steam, and a pump for forcing said mixture into a steam-boiler, of a pipe, port, or

passage for the introduction of air into said compression-pumps, substantially as and for the purpose set forth.

5. The production of a gaseous mixture of air, steam, and water, by pumping air first into a compression-pump supplied with hot water and steam, and then pumping the said mixture forward for motive-power purposes, or back into the steam boiler or generator, substantially as and for the purpose set forth.

In witness whereof I, the said ROBERT MUDGE MARCHANT, have hereunto set my hand this 5th day of October, 1877.

R. M. MARCHANT.

Witnesses:
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Both of 169 *Fleet Street, London.*