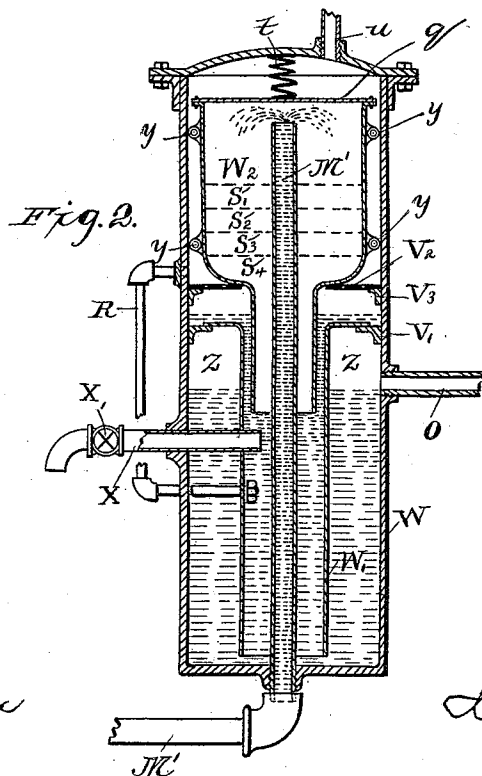


J. H. CAMPBELL.
AQUA AMMONIA ENGINE.

Patented May 6, 1890.



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UNITED STATES PATENT OFFICE.

JOSEPH H. CAMPBELL, OF NEW YORK, N. Y.

AQUA-AMMONIA ENGINE.

SPECIFICATION forming part of Letters Patent No. 427,401, dated May 6, 1890.

Application filed January 2, 1890. Serial No. 335,631. (No model.)

To all whom it may concern:

Be it known that I, JOSEPH H. CAMPBELL, a citizen of the United States, and a resident of the city of New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Aqua-Ammonia Engines, of which the following is a specification.

My invention relates and is applicable to that class of engines known as "aqua-ammonia" engines.

The object of my invention is to prevent the violent agitation of the aqua-ammonia in a well communicating with the atmosphere, or in that part of the well from which the feed-pump takes its supply for the generator, and thus avoid a loss of ammonia-vapor, whether the agitation is produced by the forcible entry of the combined exhaust-vapor and absorbing-liquid, or by air that has been drawn into the engine and has been carried over to the well.

A further object is the purging of the aqua-ammonia in the apparatus of air or incondensable gases, automatically or otherwise.

A further object is preventing oil or other foreign substances that have been carried into the well from being forced into the generator by the feed-pump.

My invention consists in combining with a pipe conveying the liquid from the exhaust-pipe of the engine to the feed-well a suitable resistance sufficient to overcome upon the entrance of the combined absorbing-liquid and exhaust-vapor into such well any force imparted to the said liquid and vapor in excess of that required for their discharge into the receiving-well, and afterward carrying the combined exhaust-vapor and absorbing-liquid through the main body of liquid within such well, thus preventing agitation of the contents of the feed-well.

My invention consists, further, in providing suitable passages for the escape of the air drawn into the exhaust-pipe of the engine, so as to discharge such air from the apparatus before it reaches the main body of the liquid in the feed-well.

My invention consists, further, in placing in the path of the combined exhaust-vapor and absorbing-liquid between the absorbing apparatus and the generator a chamber supplied with a strainer, and so constructed that

it may contain an absorbent of deleterious or injurious substances, or a purifying agent or a mechanical separator, and said chamber being so constructed that the weight of the liquid on the outside will prevent the oil or any lighter substance than the liquid from reaching that part of the well from which the feed-liquid is drawn—that is, the well is divided into two compartments, an inner and outer compartment, the liquid passing from the inner to the outer through the bottom of the inner compartment.

In the accompanying drawings, Figure 1 represents a side elevation, partly in section, of an aqua-ammonia engine constructed according to my invention; and Fig. 2, a vertical section, on an enlarged scale, of the receiving-well provided with my improvements.

Like letters in both figures refer to like parts.

A is an aqua-ammonia boiler or generator, having tubes *a a*, through which steam is made to circulate. *b* is the inlet-pipe for such steam. Said pipe is provided with a valve *b*², and is made to communicate with steam-tubes *a a* within the generator, while *b*³ is a pipe for withdrawing the condensed steam from said generator. Said pipe is also provided with a suitable valve *b*⁴.

C is the main vapor-pipe for conveying the ammonia-vapor expelled from the aqua-ammonia within the generator by heat to the cylinder D, C' being the main valve for controlling the passage of such ammonia-gas from said generator into pipe C, and C² being the throttle-valve of the engine.

E is a pipe for conveying weak solution from the lower part of generator A to the exhaust-pipe of engine D. Said pipe E is made to pass in the form of a coil through a casing G, wherein the liquid in pipe E is cooled by cooling-water entering such casing through pipe *g*¹, and leaving it through pipe *g*².

e is a cock in pipe E for regulating the amount of cooled weak solution discharged through jet J into exhaust-pipe F of engine-cylinder D.

Owing to the strong tendency of cool water or weak solution to take up and absorb ammonia-gas, the liquid discharged from jet J downward, and preferably in the form of a spray, will withdraw vapor from that side of

the engine-cylinder which at that time temporarily communicates with the exhaust-pipe, thus creating a partial vacuum in such part of the cylinder. Upon such meeting of vapor and liquid, heat, called "heat of absorption" is developed, which has a tendency to defeat or retard further absorption and to again set free gas previously absorbed, thereby interfering with the vacuum and possibly producing back-pressure on the engine. To dispose of such heat of absorption I employ two absorbers I and K, which in their general construction resemble surface condensers employed in connection with steam-engines. Absorber I has in its central section tubes $i' i'$, $i^2 i^2$, and $i^3 i^3$, through which cooling-water circulates. The combined absorbing-liquid and exhaust-vapor enter absorber I at its top and pass to the right along tubes $i' i'$, then downward and to the left along tubes $i^2 i^2$, and again downward and to the right along tubes $i^3 i^3$ until they leave such absorber through pipe L.

$i^4 i^5$ are division-plates attached in each case to one end of the central section of absorber I, as shown, leaving a space between the same and the opposite end of such central section, thus compelling the combined liquid and gas to take the course indicated above.

Pipe L enters the bottom of the central section of absorber K, liquid and gas being made to move upward around tubes $K^2 K^2$, through which cooling-water is made to pass, and leaving the absorber at its top through pipe M.

K' and K^3 are chambers at the ends of absorber K, and $I' I^2 I^3 I^4$ are chambers at the ends of absorber I, while $n' n^2 n^3$ are water-pipes. The cooling-water employed is made to pass through pipe n' , chamber K' , pipes $K^2 K^2$, chamber K^3 , pipe n^2 , chamber I' , tubes $i^3 i^3$, chamber I^2 , tubes $i^2 i^2$, chamber I^3 , tubes $i' i'$, chamber I^4 , leaving the absorber through pipe n^3 .

P is a vacuum-pump, of which M acts as suction-pipe, and M' is the discharge-pipe of such pump, leading through the bottom of well W upward sufficiently so as to discharge its contents above the strainers $S' S^2 S^3 S^4$ into the well.

O is the suction-pipe, through which feed-pump P' withdraws liquid from the well for the purpose of forcing it through pipe O' back into generator A. The well W is cylindrical in form, having within it a cylindrical casing W', provided at its upper end with a rim extending outward sufficiently so as to rest upon and be attached to a ring V', attached to the inner side of the walls of well W, the ring and the rim forming an air-tight joint. Said casing W' is open at its top and bottom and reaches downward nearly to the bottom of the well W, leaving, however, a space sufficient for the free passage of liquid from the interior of casing W' to the part of well W surrounding it.

W² is a casing having the general outlines of a bottle so adjusted as to have its neck pointing downward, the pipe M passing upward through such neck to within a short distance of the detachable disk q, which closes the upper end of casing W². This casing rests on a perforated ring V², located above the upper rim of casing W' sufficiently high to leave a space between the rim of casing W' and perforated ring V² for receiving air and any liquid that may be forced up above casing W', as mentioned hereinafter.

$y y$ are rollers attached to casing W², and serving to guide said casing along said well.

V³ is a shoulder attached to the walls of well W, to which perforated ring V² is secured.

t is a spring secured between the top of casing W² and the detachable cover of well W.

S' S² S³ S⁴ are plates provided with fine perforations and extending across the whole section of the upper part of casing W².

u is a pipe for the escape of air from the upper part of well W, and x is a pipe provided with a suitable cock x', and extending through the walls of well W and inner casing W' to a point just below the lower edge of casing W².

In operation, the engine having been started, the exhaust ammonia-gas, air, and incondensable gases pass through the absorbers, are withdrawn by the vacuum-pump, and forced by the same into the well through pipe M'. The ammonia-gas having been absorbed by the accompanying liquid before it reaches the outlet of pipe M' or at that point, the force of the liquid and the pressure of the air and incondensable gases operate against the top of casing W², and their force is neutralized by the weight of said casing, and also by spring t, secured between the top of well W and disk q. The liquid discharged from pipe M' falls down to strainers S' S² S³ S⁴, passing down within the body of casing W² and out of its bottom into that part of casing W' surrounding the lower part of said casing W² without violently agitating the liquid in this part of the well. The liquid surrounding the casing W² is at all times higher than the liquid within such casing. This is due to the pressure of the air and incondensable gases within the same. When the engine remains standing for a considerable time, or the generator or engine has been opened, or if from any cause a large amount of air has been drawn into the apparatus, so as to reach the vacuum-pump after the engine has been started, this quantity of air will force the casing W² upward and the liquid in casing W' downward, and will thus make a free passage for the air to the atmosphere between the casings W' and W². Ordinarily the amount of air discharged into the well while the engine is running will not be sufficient to force casing W² upward, but will force the liquid in casing W' downward, and thus permit the air to escape through the same passage between the casings W' and W². Free

gas that may be forced through said passage will be absorbed by the liquid between casings W' and W^2 , and the air will be forced upward, passing through the perforations in ring V^2 and upward between the walls of well W and casing W^2 until it reaches and is discharged through air-pipe u . Any foreign matter that has been forced through pipe M' will be discharged by the same above the strainers S' S^2 S^3 S^4 , and will be deposited above or between the same, and oil and other impurities may be readily disposed of by a suitable chemical agent placed above or between said strainers; but if not here disposed of the same will pass downward through the strainers, and, being lighter than aqua-ammonia, will rest on the surface of the liquid in casing W' , from which place they may readily be withdrawn through pipe x after cock x' therein has been opened. The annular space $z z$ in well W around the upper part of casing W' and above the suction-pipe O of the feed-pump furnishes room for the liquid when forced in unusual quantity out of casing W' and before the same can be taken by the feed-pump. R is a vertical glass tube, its upper end being connected with the air-space surrounding casing W^2 in the well, and its lower end being connected by a suitable pipe with the inner casing W' at a point slightly lower than that where the drain-pipe x communicates with said casing W' . Thus whenever oil or similar substances fill the upper part of casing W' they will enter said glass tube R from its bottom, and their presence can in this manner be observed, and they may be removed by opening valve x .

It will be observed that with a slight modification casings W' and W^2 might be placed on the line of pipe M' before the same enters the well, and by properly connecting the same with the well would perform the same functions as specified above. They are simply shown within the well, as this offers a simple and convenient form of construction; and it is also evident that the well could be divided into two parts by a central partition, and one part might be made to receive the incoming liquid and to serve to separate the air from it, while the second part of such well might be made to supply the feed-pump; but the construction as shown is preferred, but not essential.

I claim as new and desire to secure by Letters Patent—

1. The method herein described of preventing agitation in the feed-well of an aqua-ammonia-engine apparatus, which consists in directing the combined exhaust-vapor and absorbing-liquid toward a resisting device, so as to reduce the momentum of the inflowing solution after its leaving the main supply-pipe and before its commingling with the main body of liquid within the receiving-well, substantially as set forth.

2. The method herein described of preventing

agitation in the feed-well of an aqua-ammonia-engine apparatus, which consists in conveying the combined exhaust-vapor and absorbing-liquid into the upper part of said well, causing the solution discharged there to impinge upon a resisting device, which overcomes the momentum of such solution and deflects it, so as to compel its passage through the main body of the liquid within said well, substantially as set forth.

3. The method herein described of preventing agitation in the feed-well of an aqua-ammonia-engine apparatus, which consists in conveying the combined exhaust-vapor and absorbing-liquid into the upper part of said well, causing the solution discharged there to impinge upon a resisting device, which overcomes the momentum of such solution and deflects the same, so as to direct it downward into the lower part of the well, from where it rises toward the suction-pipe of the feed-pump, substantially as set forth.

4. The method herein described of preventing agitation in the feed-well of an aqua-ammonia-engine apparatus, which consists in dividing the receiving-well into two parts, destroying or neutralizing the momentum of the inflowing solution in one of said parts, and afterward compelling the flow of such liquid by gravity into the other part of said well, substantially as set forth.

5. The method herein described of purging an aqua-ammonia-engine apparatus of air, which consists in separating the combined exhaust-vapor and absorbing-liquid from the air by gravity, storing or permitting the air to escape by suitable apertures, and causing the combined vapor and absorbing liquid to pass through the main body of liquid within the well, from which body the feed-liquid for the generator is supplied, substantially as set forth.

6. The method herein described of automatically purging an aqua-ammonia-engine apparatus of air, which consists in separating the combined exhaust-vapor and absorbing-liquid from the air by gravity, causing the air so separated to enter a movable air-chamber, and by its pressure to lift said air-chamber, so as to make its interior communicate with the atmosphere outside of the well, substantially as set forth.

7. The method herein described of automatically purging an aqua-ammonia-engine apparatus of air, which consists in separating the combined exhaust-vapor and absorbing-liquid from the air by gravity, causing the air so separated to enter a suitable air-chamber having a liquid seal, which the pressure of the air within said chamber removes or forces back, thereby opening communication between the interior of said air-chamber and the atmosphere outside of the well, substantially as set forth.

8. The method herein described of automatically purging an aqua-ammonia-engine apparatus of air, which consists in separating the combined exhaust-vapor and absorbing-

liquid from the air by gravity before their entering the main body of liquid in said well, causing the air so separated to enter an air-chamber, and utilizing the pressure of the air confined therein for opening a communication between the interior of said chamber and the atmosphere, substantially as set forth.

9. The method herein described of automatically purging an aqua-ammonia-engine apparatus of air, which consists in separating the combined exhaust-vapor and absorbing-liquid from the air by gravity, causing the air so separated to enter an air-chamber and to force the liquid therein into the main body of the well, and thereby opening communication between the interior of the air-chamber and the atmosphere, substantially as set forth.

10. The method herein described of enforcing absorption of free ammonia-gas within the receiving-well of an aqua-ammonia-engine apparatus, which consists in confining such gas under a movable casing and utilizing the weight of such casing for forcing said gas into the liquid contained in said well, substantially as set forth.

11. The method herein described of preventing air from being drawn into the feed-pump of an aqua-ammonia-engine apparatus, the feed being taken from a well having communication with the atmosphere, the same consisting in dividing the well into three parts so arranged that one of these parts located above the supply-pipe, by the pressure of the air on the liquid in the second part, opens a communication with the atmosphere, the air delivered in the first or upper part being prevented from reaching the main body of liquid in the third part, from which the feed-pump takes its supply, by a body of liquid in the second part of said well, substantially as set forth.

12. The method of preventing oil and other substances lighter than aqua-ammonia from being forced by the feed-pump of an aqua-ammonia-engine apparatus into the generator, the same consisting in dividing the feed-well into two compartments, the liquid being delivered into the first compartment and permitted to flow into the second compartment from the bottom of the first compartment by gravity, and removing the oil or other foreign substances collected on the surface of the liquid in the first compartment by a pipe leading into said first compartment, the feed-liquid being withdrawn from the second compartment at a higher elevation than that of the point where the aforesaid pipe connects with the first compartment, substantially as set forth.

13. The method of cleaning and purifying aqua-ammonia while passing from the absorber of an aqua-ammonia-engine apparatus to the generator, which consists in interposing a strainer and vessels charged with charcoal or other purifying substance in the upper part of the feed-well above the main body

of the feed-liquid, the discharge end of the pipe supplying the well being above such strainer, substantially as set forth.

14. The method herein described of operating an aqua-ammonia-engine apparatus, which consists in developing ammonia-gas by heating aqua-ammonia in a generator, conducting such gas to an engine-cylinder for propelling its piston, passing the exhaust of such engine through an absorbing apparatus constructed as a surface condenser, employing a vacuum-pump for withdrawing the contents of such absorbing apparatus and delivering the same into a well normally communicating with the atmosphere, and withdrawing the feed-liquid from said well by a feed-pump, which forces the same into the generator, while maintaining a body of feed-liquid between the suction-pipe of the feed-pump and the part of the well communicating with the atmosphere, substantially as set forth.

15. The method herein described of operating an aqua-ammonia-engine apparatus, which consists in developing ammonia-gas by heating aqua-ammonia in a generator, conducting such gas to an engine-cylinder for propelling its piston, passing the exhaust of such engine through an absorbing apparatus constructed as a surface condenser, discharging the contents of such absorbing apparatus into a well normally communicating with the atmosphere, and withdrawing the feed-liquid from said well by a feed-pump, which forces the same into the generator, while maintaining a body of liquid between the suction-pipe of the feed-pump and the part of the well communicating with the atmosphere, substantially as set forth.

16. The method herein described of operating an aqua-ammonia-engine apparatus, which consists in expelling ammonia-gas from aqua-ammonia in a generator by heat, conducting such gas to the engine-cylinder for propelling its piston, withdrawing weak solution from said generator, cooling it and conducting it to the absorbing apparatus of the engine, wherein the exhaust-vapor from the engine and such liquid are brought in contact with each other and cooled, employing a vacuum-pump for withdrawing the contents of such absorbing apparatus and for delivering the same into a well normally communicating with the atmosphere, and withdrawing the feed-liquid from said well by a feed-pump, which forces the same into the generator, while maintaining the body of liquid from which the feed is drawn between the suction-pipe of the feed-pump and the part of the well communicating with the atmosphere, substantially as set forth.

17. The method herein described of operating an aqua-ammonia-engine apparatus, which consists in expelling ammonia-gas from aqua-ammonia in a generator by heat, conducting such gas to the engine-cylinder for propelling its piston, withdrawing weak solu-

tion from said generator, cooling it and conducting it to the absorbing apparatus of the engine, wherein the exhaust-vapor from the engine and such liquid are brought in contact
5 with each other and cooled, withdrawing the contents of such absorbing apparatus and delivering the same into a well and withdrawing the feed-liquid from said well by a feed-pump, which forces the same into the gener-
10 ator, while maintaining the body of liquid from which the feed is drawn between the suction-pipe of the feed-pump and the part of the well communicating with the atmosphere, substantially as set forth.

15 18. The method herein described of operating an aqua-ammonia-engine apparatus, which consists in expelling ammonia-gas from aqua-ammonia in a generator by heat, conducting such gas to the engine-cylinder for
20 propelling its piston, withdrawing weak solution from said generator, cooling it and conducting it to the absorbing apparatus of the engine, wherein the exhaust-vapor from the engine and such liquid are brought in contact
25 with each other and cooled, employing a vacuum-pump for withdrawing the contents of such absorbing apparatus, and for delivering the same into a well normally communicating with the atmosphere, purging the combined
30 exhaust-vapor and absorbing-liquid of air

prior to mingling the same with the main body of liquid in said well, and finally forcing such liquid back into the generator, substantially as set forth.

19. The method herein described of oper- 35
ating an aqua-ammonia-engine apparatus, which consists in expelling ammonia-gas from aqua-ammonia in a generator by heat, conducting such gas to the engine-cylinder for
40 propelling its piston, withdrawing weak solution from said generator, cooling it and conducting it to the absorbing apparatus of the engine, wherein the exhaust-vapor from the engine and such liquid are brought in contact
45 with each other and cooled, withdrawing the contents of such absorbing apparatus by conducting the same into a well normally communicating with the atmosphere, purging the combined exhaust-vapor and absorbing-liquid
50 of air prior to mingling the same with the main body of liquid in said well, and finally forcing such liquid back into the generator, substantially as set forth.

Signed at New York, in the county of New York and State of New York, this 31st day 55
of December, A. D. 1889.

JOSEPH H. CAMPBELL.

Witnesses:

JAMES McLAIN,
B. SEAMAN.