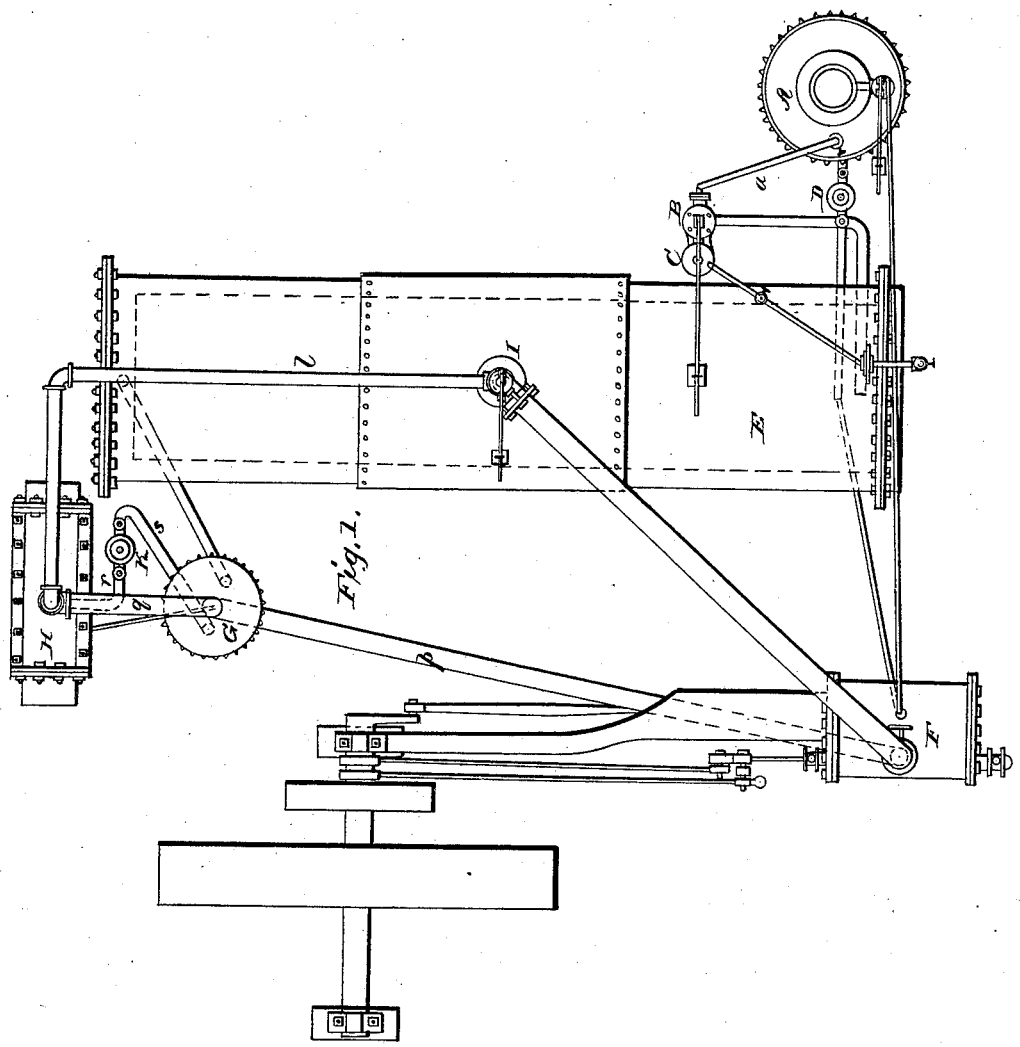
(No Model.) 3 Sheets—Sheet 1.

W. S. COLWELL.

UTILIZATION OF LATENT HEAT FOR GENERATING A MOTOR.

No. 266,952. Patented Oct. 31, 1882.



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(No Model.) 3 Sheets—Sheet 2.

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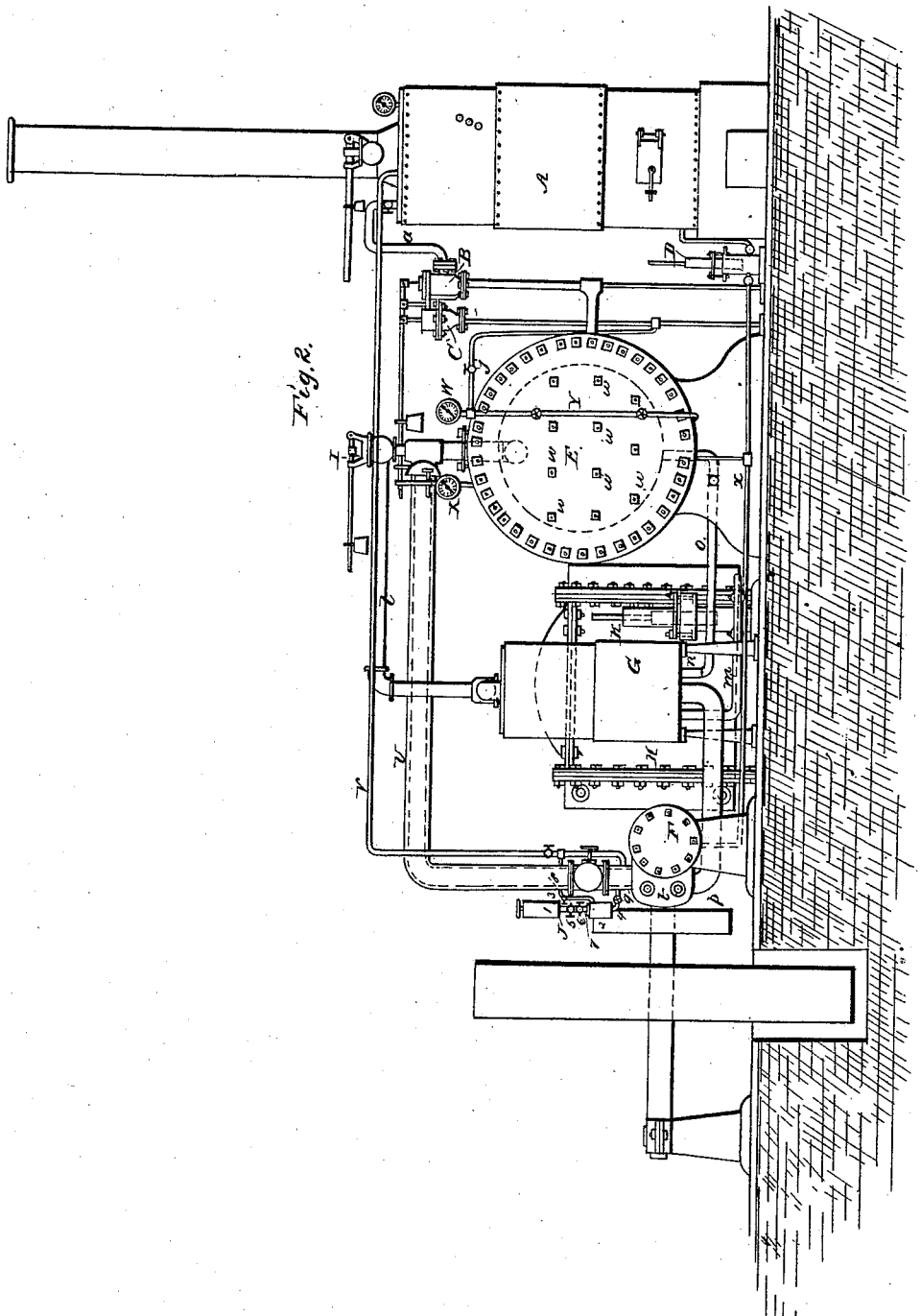

Fig. 2.

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Fig. 3.

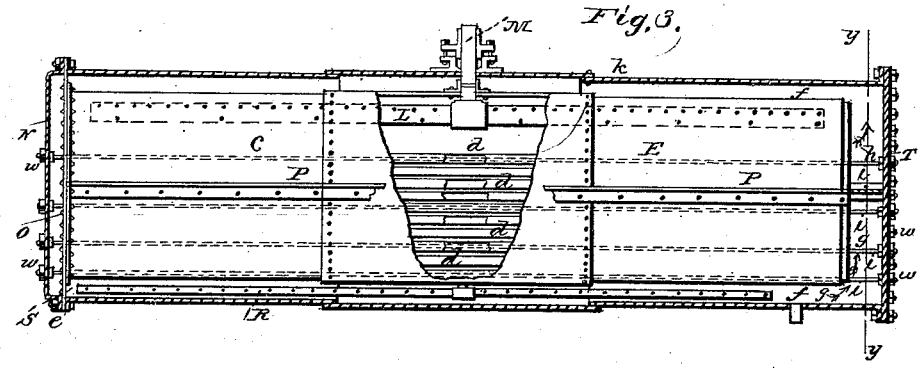


Fig. 4.

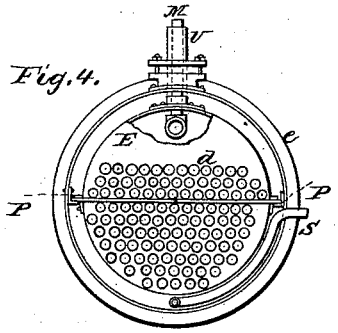


Fig. 5.

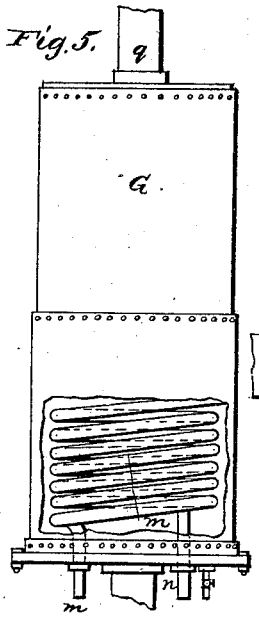


Fig. 7.

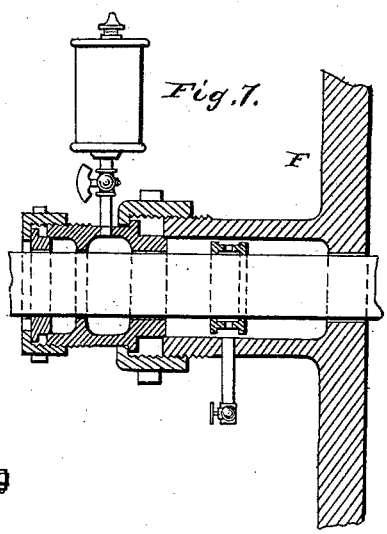
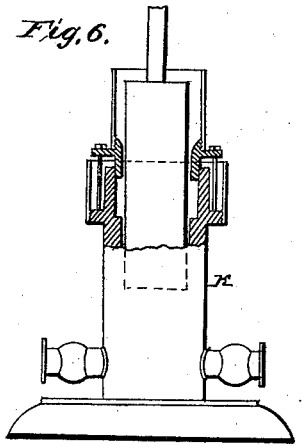


Fig. 6.



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WILLIAM S. COLWELL, OF PITTSBURG, PENNSYLVANIA.

UTILIZATION OF LATENT HEAT FOR GENERATING A MOTOR.

SPECIFICATION forming part of Letters Patent No. 266,952, dated October 31, 1882.

Application filed August 30, 1882. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM S. COLWELL, of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Utilization of Latent Heat for Generating a Motor; and I do hereby declare that the following is a full and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

My invention relates to an improvement in motors; and it consists of a vapor evolved from bisulphide of carbon through the medium of the latent elements of static and specific heats transmitted to the bisulphide of carbon through the medium of steam generated from water, and applying said vapor of bisulphide of carbon to the piston of an engine for the purpose of operating it, as will hereinafter more fully and at large appear, my present invention being an improvement upon the inventions described in Letters Patent granted to me September 16, 1879, No. 219,622, October 7, 1879, No. 220,220, and March 23, 1880, No. 225,689.

In order that the nature of my present invention may be properly understood, I will state briefly some facts connected with water and bisulphide of carbon, which are the two liquids I employ for producing a motor by the utilization of the latent heat of steam. The boiling-point of water is 212° Fahrenheit, and the latent heat of its steam 966° Fahrenheit, and its specific heat is greater than that of any other liquid, and its tension and expansive force is increased with every degree of heat added, and said tension and force diminished with every degree of heat taken from it. The boiling-point of bisulphide of carbon is 118° Fahrenheit, and the latent heat of its vapor is 156° Fahrenheit, and its specific heat is less than one-third of that of water, while its tension and expansive force are like that of water, depending directly upon the temperature applied to it. To illustrate the difference between the action of heat upon the two liquids named: To raise one pound of water from 50° Fahrenheit to 230° Fahrenheit and evaporate it at that point, eleven hundred and thirty-two thermal units (or degrees of heat) will be required. To raise one pound of bisulphide of carbon from 50° Fahrenheit to 230° Fahrenheit and evaporate it at that point, it will require two hundred and sixteen thermal units, (or degrees of heat.) Therefore water and bisulphide of carbon are to each other as eleven hundred and thirty-two is to two hundred and sixteen at the temperature named. It is a fact known to scientists that the tension or force of all vapors is the same at an equal distance above or below their respective boiling-points. Now, eleven hundred and thirty-two thermal units (or degrees of heat) applied to water will give a pressure of twenty-one pounds to the square inch, or will show six pounds pressure on the pressure-gage of the steam-generator, while two hundred and sixteen thermal units (or degrees of heat) applied to bisulphide of carbon will give a pressure of eighty-three pounds to the square inch, and will show a pressure of sixty-eight pounds on the pressure-gage of the bisulphide-of-carbon boiler.

The object of my invention is to utilize this latent heat for evolving liquid bisulphide of carbon into a vapor for a motor by the process and means hereinafter described.

To enable others skilled in the art with which my invention is most nearly connected to make and use it, I will proceed to describe its construction and operation.

In the accompanying drawings, which form part of my specification, Figure 1 is a top view of the engine, steam-generator, bisulphide-of-carbon boiler, condenser, heater, pump, and the several connecting-pipes, showing their relative arrangement with relation to each other. Fig. 2 is a front elevation of the same. Fig. 3 is a vertical and longitudinal section of the case that surrounds the bisulphide-of-carbon boiler, representing a portion of the shell of the bisulphide-of-carbon boiler broken away for the purpose of showing the internal arrangement of its pipes and tubes. Fig. 4 is a vertical transverse section of the bisulphide-of-carbon boiler at line *y y* of Fig. 3. Fig. 5 is a side elevation of the heater for heating the bisulphide of carbon after being exhausted from the engine and condensed by the condenser and prior to being forced into the bisulphide-of-carbon boiler by the pump. Fig. 6 is a side elevation of the pump employed for forcing the bisulphide of carbon into its boiler,

representing the upper portion, which surrounds the piston, in section. Fig. 7 represents a section of the cylinder-head and the arrangement of the parts connected therewith employed for the purpose of packing the piston-rod.

Figs. 6 and 7 represent devices which are of great advantage to the apparatus or engine hereinafter described, but are adapted to other uses. Therefore I disclaim them in this application, reserving the right, however, to make them the subject-matter of other applications for Letters Patent of the United States.

Reference being had to the accompanying drawings, A represents an ordinary vertical boiler or steam-generator, provided with the usual appendages. The steam-conduit *a* is connected with a regulating-valve, B, which acts in conjunction with a valve, *c*, used for the purpose of regulating the flow of steam into case *k*, for generating heat in the bisulphide-of-carbon boiler E, the construction of which valves and their operation are fully described in Letters Patent Nos. 220,220 and 225,689, heretofore cited, and therefore need not be further described in this application. The bisulphide-of-carbon boiler E is of peculiar construction and operation, and is different from that described in the before-mentioned patents. I will therefore proceed to describe said boiler in all its details.

Reference being had to Figs. 3 and 4, *k* represents the casing which surrounds the shell *c* of the boiler E, which is furnished with a large number of tubes, *d*, extending longitudinally through the boiler and secured in the ends thereof in the usual way.

The head *e* of one end of the boiler extends beyond the diameter of the shell *c* sufficient to form a suitable bearing or flange for attaching it to the flange of the case *k*, to which is also attached the flange of the part N, which forms a distributing or circulating chamber, O.

On one end and each side of the outer wall of the shell *c* of the boiler E are secured flanges P, which are attached to and rest upon similar flanges on the inner side walls and one end of the case *k*, which flanges are so attached to each other as to form a steam-tight joint.

In the boiler E, above its tubes *d*, is arranged a perforated pipe, L, extending longitudinally from end to end of said boiler, and communicates with a pipe, M, which pipe passes through the shell *c* and through the case *k*, which surrounds said boiler. In the upper side of the pipe L are a large number of perforations and in the lower side a less number, the latter perforations being employed for draining said pipe in case of condensation of the steam. The pipe L is used for the purpose of drawing off the vapor evenly and uniformly from all parts of the boiler.

On the under side of the boiler E, in the space *f* formed by the case *k*, is arranged a perforated pipe, R, which communicates with a steam-pipe, S, and is employed for the distribution of steam around the lower half of the shell *c* of the boiler E, the steam being confined around the lower half of said boiler through the medium of the flanges P, and caused to flow through the tubes *d* into the circulating or distributing chamber O, from which it flows back through the tubes *d* above the flanges P, and surrounds the upper half of the boiler, as indicated by the arrows *g* and *h*.

The part N and the end T are stayed through the medium of stay-rods *i*, which pass through the tubes *d* and through said end and part N, and are secured thereto by screw-nuts *w*. The pipe M communicates with the steam chest and cylinder of the engine F, and is surrounded with a casing or pipe, U, which communicates with the steam-space *f* around the upper half of the boiler E, and with the casing that surrounds the steam chest and cylinder of the engine F, which engine is of ordinary construction and operation. By this construction and arrangement of the boiler E, case *k*, chamber O, and pipes L and R the steam is distributed thoroughly over the entire surface of the shell *c*, and caused to travel through the tubes *d* in one direction in the lower half of the boiler E and in an opposite direction through the tubes *d*, located above the flanges P, the steam acting first on the lower half of the shell *c* of the boiler E, heating it, then heating the tubes *d* in that part, and then passing into chamber O, and from it entering the tubes *d* above the flanges P, heating them, and, passing from them, enters the upper half of the steam-space *f*, spreading over the upper surface of the shell *c*, heating it, and passes into the case U and the casing which surrounds the steam chest and cylinder of the engine F, so that the bisulphide-of-carbon vapor evolved in the boiler E is continuously heated by the steam, transmitting its latent heat to said vapor until it has performed its office upon the piston of the engine F.

The bisulphide-of-carbon boiler is provided with pressure-gages W X and sight-gage Y. The gage W is for showing the pressure in the boiler E and the gage X for indicating the steam-pressure in the casing *k*, and the sight-gage for indicating the liquid bisulphide of carbon in the boiler E.

The pipe M, which communicates with the interior of the boiler E, is provided with a safety-valve, I, which communicates through the medium of pipe *l* with an ordinary surface condenser, H, whereby, in case of undue pressure in the boiler E, the surplus of vapor is allowed to flow off through pipe *l* to said condenser, and from it passes to the pump K.

The heater G is what is known as a "surface heater," and is employed for the purpose of heating the bisulphide of carbon prior to entering the boiler E, and is provided with a coiled pipe, *m*, which is arranged in a spiral form in said heater, traveling up and then down through it, terminating at *n*, and is connected with the pipe *o*, which communicates

with the interior of the bisulphide-of-carbon boiler E, said coiled pipe *m* communicating with the pump K. The exhaust-pipe *p* (shown in Figs. 1 and 2) communicates with the lower end of the heater G, and it with the condenser H by means of pipe *q*, the condenser communicating with the pump K through the medium of a pipe, *r*. By this construction of the heater G and its arrangement and connections with the parts stated the liquid bisulphide of carbon, in passing from the condenser through pipe *r* to the pump K, and from it, through pipe S, passing up through and down the spiral coil *m* and through pipe O, enters the boiler E in a highly-heated condition, which heat is imparted to it by the vapor exhausted from the engine.

Another and very important advantage is obtained by this arrangement of the heater G and its connections—to wit, the liquid bisulphide of carbon, in its passage from the condenser to the boiler, as stated, is heated to the vaporizing-point, which vapor in a saturated condition is forced into the boiler by a volume of the liquid bisulphide of carbon acting against said conditioned vapor in the pipe *m*, which volume of liquid bisulphide of carbon is always between the pump K and some point in the pipe *m* of the heater G, thus securing a result not heretofore obtained in the operation of an engine—viz., forcing the vapor of bisulphide of carbon into the vaporizing-generator or bisulphide-of-carbon boiler.

The advantage of the heater G in connection with the bisulphide-of-carbon engine consists in avoiding the introduction into the evolving-chamber of cold liquid bisulphide of carbon, which is always attended with bad results, by subjecting the generator or boiler to undue strain, caused by the sudden condensation of the vapor in it, and then rapidly expanding the cold liquid into vapor. This sudden alternate condensation and rapid expansion subjects the material of which the generator or boiler is constructed to such frequently-repeated contractions, expansions, and strains as to cause crystallization, and therefore weakening said material, and thereby rendering the generator or boiler unfit for use and liable to accident. The forcing or injecting into the generator or boiler of cold liquid bisulphide of carbon causes a hammering, thumping, and jarring action in it, which is transmitted to all parts connected therewith.

All of these stated disadvantages are overcome or avoided by the use of the heater G for heating the bisulphide of carbon prior to being forced into the generator or boiler by the pump in the manner hereinbefore described, and at the same time regains the sensible heat of the bisulphide of carbon lost by the condensation of its vapor exhausted from the engine.

The casing of the steam chest and cylinder of the engine F and the casing *k* of the bisulphide-of-carbon boiler E communicate with the water-pump D by means of pipe *x*, which should be provided with an ordinary steam-trap, so that said casings will retain the steam in them, and only the product of condensation be carried to the pump D. The cylinder, valves, valve-seats, piston, and rods connected therewith are lubricated with pulverized plumbago by introducing it into the steam-chest of the cylinder by means of the lubricating apparatus J, which consists of a capped hopper, 1, and receiving and distributing chamber 2, said parts communicating with each other by a pipe, 7, in two parts, furnished with valves 5 and 6, the point of separation being between said valves.

The upper part of the receiving and distributing chamber 2 communicates with the steam pipe or conduit M by means of a pipe, 3, provided with a valve, 8, and the lower end of said chamber communicates with the steam-chest by means of a pipe, 4, provided with a valve, 9.

The operation of the lubricating apparatus J is as follows: The plumbago is charged into the hopper 1 and the valves 5 and 6 of pipe 7 opened, which will allow the pulverized plumbago to flow into the receiving and distributing chamber 2. The valves 5 and 6 are then closed and the valves 8 and 9 of the pipes 3 and 4 opened very little. The vapor flowing through pipe 3 from the pipe M into the upper part of the chamber 2 will cause a fine stream of the pulverized plumbago to flow through pipe 4 into the steam-chest *t*, from which it is carried into the cylinder of the engine, thereby lubricating the valves, valve-seats, cylinder, piston, and the rods connected therewith.

Lubricants consisting of a single ingredient are very numerous, among which may be mentioned the several known oils, tallow, glycerine, litharge, plumbago, black-lead, beeswax, and many other articles, and the ingredients or articles mentioned have been compounded in almost every conceivable way for forming lubricants, and I am aware that glycerine, litharge, petroleum-oil, oleaginous matter, and other things have been used for the purpose of lubricating bisulphide-of-carbon engines, and that they have failed to meet the end desired as a lubricant for such engines. This is due to the fact that as soon as the lubricant comes in contact with the heated vapor of bisulphide of carbon the latter takes up the oleaginous matter and deposits a part of its sulphur, and the vapor carries over to the condenser that part of the lubricant which it has taken up, so that no element having any lubricating qualities comes in contact with the working-surfaces of the engine which require lubrication, and said vapor, taking up the oily matter and depositing part of its sulphur, will in a short time destroy or render the bisulphide of carbon inefficient for the purposes of a motor.

In the Letters Patent herein cited are set forth fully the effects produced upon the working-surfaces of the engine by the heated vapors of bisulphide of carbon and the disadvantages which follow said effects.

In Letters Patent No. 225,689 I describe and claim a lubricant consisting of petroleum-oil, black-lead, or plumbago which I found to be the best lubricant known at the date of said patent for bisulphide-of-carbon engines; but in the use of said lubricant I discovered that pure plumbago alone formed a most excellent lubricant for such engines.

When the plumbago is applied in the manner hereinbefore described it is deposited evenly upon all parts of the engine which require to be lubricated, filling up the pores of the working-surfaces of the valves, valve-seats, piston, cylinder, and the rods connected therewith, causing said working-surfaces to become coated with a thin smooth coating of enamel, which is impervious to damp and atmospheric influences.

For the purpose of securing the best result as a lubricant for bisulphide-of-carbon engines the plumbago must be pure, with thin flexible laminæ. When the plumbago is of this character a very small quantity will be sufficient for lubricating the working parts of the engine herein mentioned, not requiring more than eight ounces of said plumbago daily for an engine of fifty horse-power, and therefore forms a very cheap lubricant for the purpose stated, not costing over three cents per day for an engine of the power stated. I have discovered by experience that parts of bisulphide-of-carbon engines which had been frequently lubricated while in use, and afterward exposed to damp and atmospheric influence for a period of ten months were found to be entirely free from the least sign of oxidation. This is due to some cause unexplained, and in the present state of knowledge of chemistry is unexplainable. I therefore can only state the facts and results discovered, which are of the greatest importance in the art of operating bisulphide-of-carbon engines; but that some inexplicable union or combination of the heated vapors of the bisulphide of carbon and the plumbago is formed is certain, and that such union or combination and that of the heated surfaces of the metal previously subjected to the action of said vapors have an affinity for each other is also certain; otherwise the result above stated could not be obtained.

Having thus described the apparatus or engine for carrying out my process for utilizing the latent heat of steam for evolving vapor from bisulphide of carbon, I will proceed to describe its operation, which is as follows:

By the process and apparatus hereinbefore described the two liquids employed and the vapors evolved therefrom are at all times and under all conditions kept separate from each other. The desired quantity of the liquid of bisulphide of carbon is charged into the boiler E and steam generated in the steam-generator A until the desired pressure is obtained, which is then allowed to flow through regulating-valves B C into the case *k*, surrounding the boiler E, the heat of which steam will evolve a vapor from the liquid bisulphide of carbon in said boiler, and when the desired pressure is obtained by the heat acting upon said boiler in the manner herein described the operator or engineer opens the throttle of the engine, which will allow the vapor of the bisulphide of carbon to act upon the piston, the engine receiving and exhausting said vapor in all respects the same as the ordinary steam-engine. The exhausted vapor from the cylinder of the engine F passes through pipe *p* into the heater G, and from it, through pipe *q*, to the condenser H, where it is condensed into a liquid, which flows through pipe *r* to the pump K, which forces it through pipe S into the coiled pipe *m*, where it is heated by the exhaust-vapor and forced into the bisulphide-of-carbon boiler, in the manner and in the condition hereinbefore described.

It will be observed that in this operation of evolving the bisulphide of carbon and utilizing its vapors as a motor by means of steam generated in the boiler A the latent heat of the steam is utilized, so that there is only a loss of one hundred and fifty-six thermal units (or degrees of heat) occasioned by the condensation of the exhausted vapor of the bisulphide of carbon, for the water formed by the condensation of the steam that takes place in the case *k* is returned to the boiler A through the medium of the pump D at its boiling-point, or 212° Fahrenheit, thus saving and utilizing 966° of latent heat of the steam less one hundred and fifty-six thermal units (or degrees of heat) lost in the condensation of the vapor exhausted from the engine.

The steam yields up its latent heat by transmitting it to the bisulphide of carbon in the boiler E, and said latent heat, and it alone, evolves the bisulphide of carbon into a vapor for a motor, for the water at all times retains all of its sensible heat, and therefore can in the process described only surrender the latent heat of its steam.

Having thus described my improvement, what I claim as of my invention is—

1. In a bisulphide-of-carbon engine, the process hereinbefore described—viz., evolving steam from water and utilizing the latent heat thereof by causing said steam to travel circuitously over the exterior and through the tubes in the interior of the boiler charged with liquid bisulphide of carbon, and thereby transmit said latent heat to said bisulphide of carbon for evolving a vapor therefrom for a motor.

2. In a bisulphide-of-carbon engine, the process hereinbefore described—viz., evolving steam from water and utilizing the latent heat thereof by causing said steam to travel circuitously over the exterior and through the tubes in the interior of the boiler charged with liquid bisulphide of carbon, and thereby transmit said latent heat to said bisulphide of carbon for evolving a vapor therefrom for a motor, and continuously heating said vapor in its passage from said boiler and until it has performed its

office upon the piston of the engine, as and for the purpose set forth.

3. In a bisulphide-of-carbon engine, the process hereinbefore described—viz., evolving steam from water and utilizing the latent heat thereof by causing said steam to travel circuitously over the exterior and through the tubes in the interior of the boiler charged with liquid bisulphide of carbon, and thereby transmit said latent heat to said bisulphide of carbon for evolving a vapor therefrom for a motor, and continuously heating said vapor in its passage from said boiler and until it has performed its office upon the piston of the engine, and condensing said vapor after being exhausted from said engine, and subsequently heating the product thereof by vapor exhausted from said engine, as and for the purpose set forth.

4. In a bisulphide-of-carbon engine, the process hereinbefore described—viz., evolving steam from water and utilizing the latent heat thereof by causing said steam to travel circuitously over the exterior and through the tubes in the interior of the boiler charged with liquid bisulphide of carbon, and thereby transmit said latent heat to said bisulphide of carbon for evolving a vapor therefrom for a motor, and continuously heating said vapor in its passage from said boiler and until it has performed its office upon the piston of the engine, and condensing said vapor after being exhausted from said engine, and subsequently heating the product thereof by vapor exhausted from said engine, and forcing saturated vapor evolved from said condensed product into said boiler through the medium of a pump and a volume of heated liquid bisulphide of carbon, for the purpose set forth.

5. In a bisulphide-of-carbon engine, the combination of a heater for heating a liquid product obtained from the vapor exhausted from the engine, a pump, and vapor-generator, substantially as herein described, and for the purpose set forth.

6. In a bisulphide-of-carbon engine, the combination of a boiler or steam-generator, a boiler for evolving the bisulphide of carbon, a heater, condenser, and a pump whereby the vapor exhausted from the engine may be returned to said boiler or generator, substantially as herein described, and for the purpose set forth.

7. In a bisulphide-of-carbon engine, a boiler or generator for evolving liquid bisulphide of carbon into a vapor, said boiler or generator surrounded with a case divided into two compartments, *f*, communicating with each other through the medium of tubes passing through said boiler, and communicating with the circulating-chamber O, substantially as herein described, and for the purpose set forth.

8. In a bisulphide-of-carbon engine, a boiler or generator for evolving liquid bisulphide of carbon into a vapor, said boiler or generator surrounded with a case divided into two compartments communicating with each other through the medium of tubes passing through said boiler, a receiving and circulating chamber, and a perforated pipe, R, substantially as herein described, and for the purpose set forth.

9. In a bisulphide-of-carbon engine, an apparatus for lubricating with plumbago the valves, valve-seats, cylinder, piston, and rods connected therewith by the pressure of vapor of bisulphide of carbon being applied to the upper surface of the plumbago for forcing it into the valve chamber or chambers and cylinder of the engine, substantially as herein described, and for the purpose set forth.

10. In a bisulphide-of-carbon engine, an apparatus for lubricating with plumbago the valves, valve-seats, cylinder, piston, and rods connected therewith, said apparatus consisting of a hopper communicating with a receiving and distributing chamber, which communicates with the vapor-generator and the valve chamber or chambers and the cylinder of the engine, substantially as and for the purpose set forth.

11. In a bisulphide-of-carbon engine, the apparatus J for lubricating with plumbago the valves, valve-seats, cylinder, piston, and rods connected therewith, said apparatus consisting of hopper 1, receiving and distributing chamber 2, and pipes 3, 4, and 7, furnished with valves, substantially as for the purpose set forth.

12. In a bisulphide-of-carbon engine, the union or combination of plumbago and vapor of bisulphide of carbon for a lubricant for the valves, valve-seats, cylinder, piston, and the rods connected therewith, substantially as and for the purpose set forth.

WILLIAM S. COLWELL.

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JAMES J. JOHNSTON.