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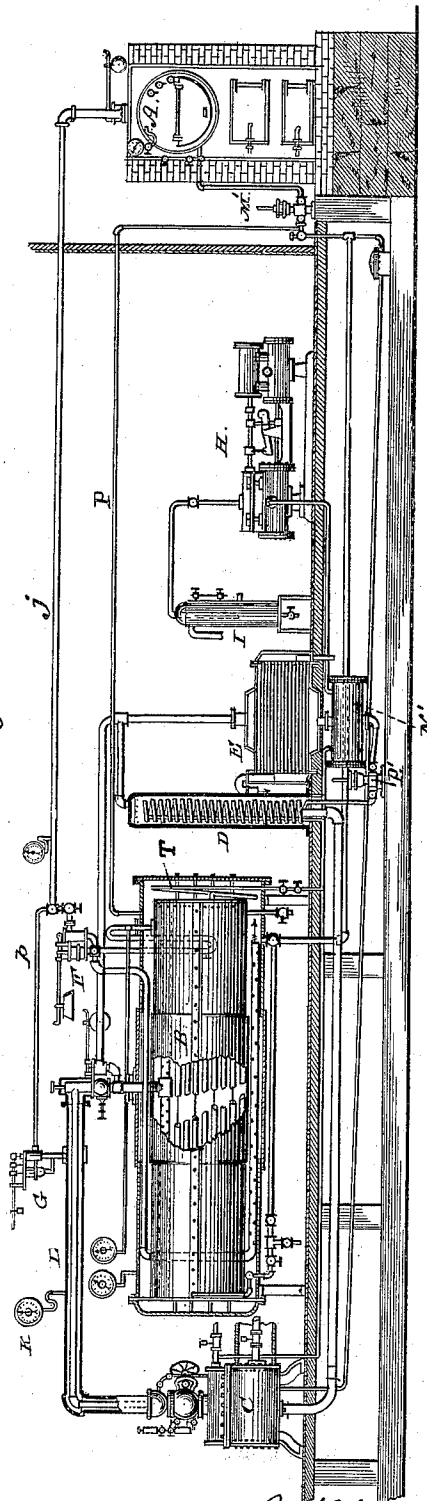
3 Sheets—Sheet 1.

W. S. COLWELL.
TRIPLE THERMIC MOTOR.

No. 313,178.

Patented Mar. 3, 1885.

Fig. 1.



WITNESSES:

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(No Model.)

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Fig. 2.

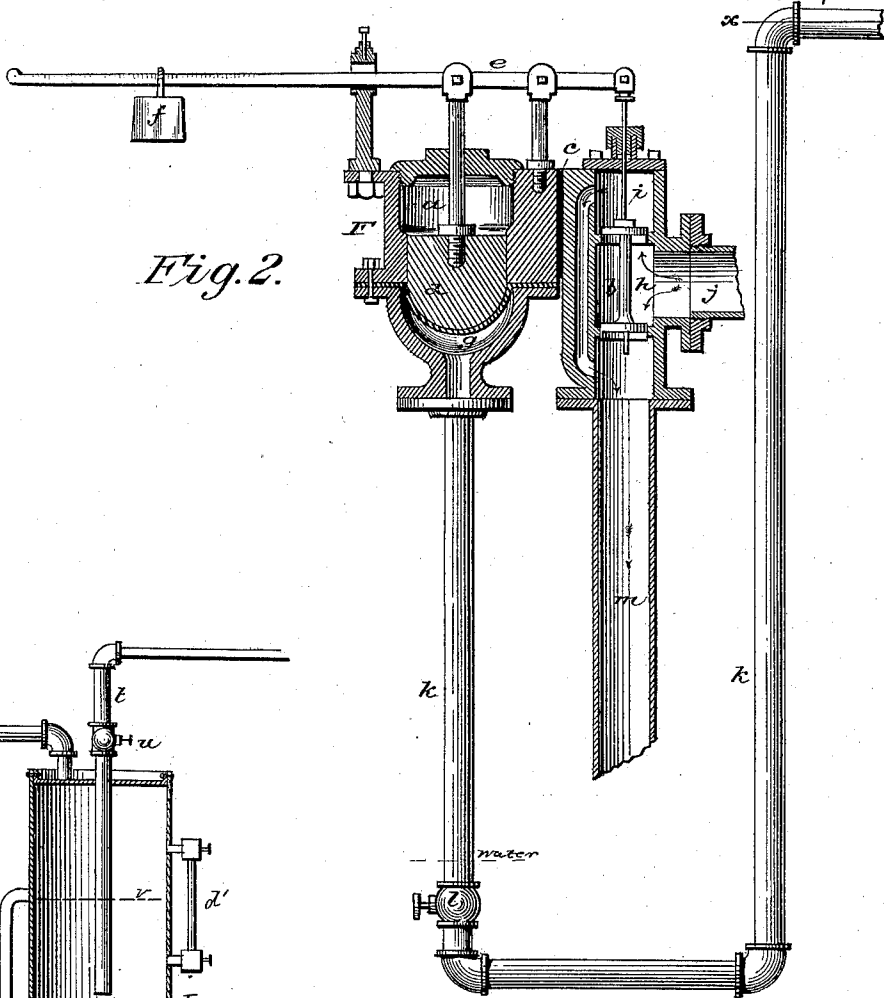
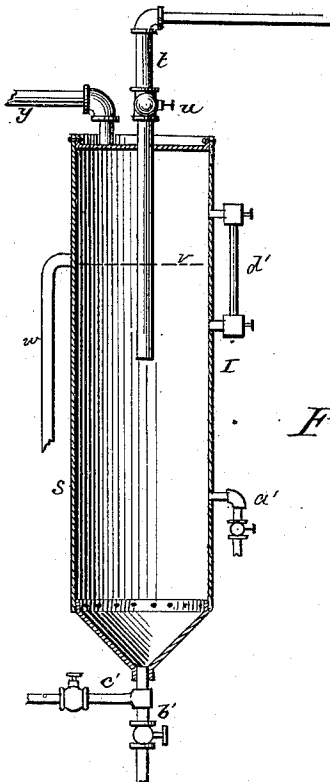


Fig. 4.



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(No Model.)

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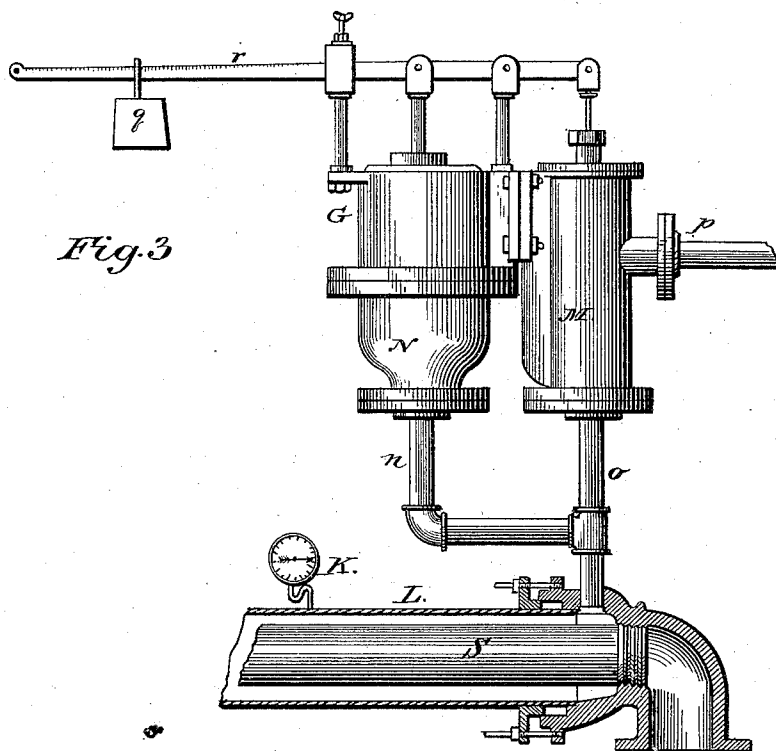
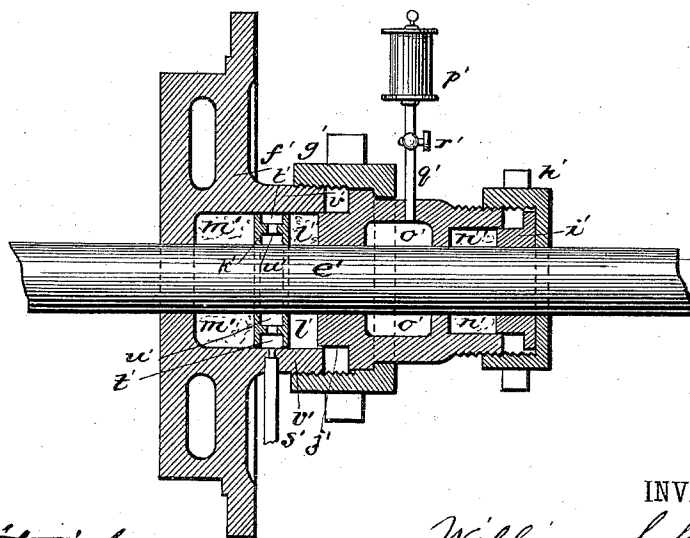


Fig. 5.



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UNITED STATES PATENT OFFICE.

WILLIAM S. COLWELL, OF PITTSBURG, PENNSYLVANIA, ASSIGNOR TO THE
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TRIPLE THERMIC MOTOR.

SPECIFICATION forming part of Letters Patent No. 313,178, dated March 3, 1885.

Application filed July 26, 1884. (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 certain new and useful Improvement in Triple Thermic Motors; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

My present invention relates to certain new and useful improvements on the inventions described in Letters Patent of the United States No. 225,689 and No. 266,952, granted me.

The nature of my present invention consists in the methods hereinafter described for operating a bisulphide-of-carbon engine, which said invention I call "triple thermic motor," in view of the fact that I utilize the three heats in steam evolved from water—to wit, the specific, latent, and sensible heats thereof.

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 this specification, Figure 1 is a side elevation of my improvement in triple thermic motors. Fig. 2 is a vertical section of the regulating-valve employed for controlling the admission of steam to and through the boiler for evolving the liquid bisulphide of carbon into a vapor. Fig. 3 is a side elevation of the valve employed for controlling the quantity of heat fixed upon for heating the vapor after it leaves the boiler. Fig. 4 is a vertical section of a washer used in combination with the condenser and vacuum-pump. Fig. 5 is a vertical section of a section of the cylinder-head of the engine, representing the means employed for packing the piston-rod and valve-rods.

My invention has for its object the utilization of the specific, latent, and sensible heat of steam, and through the medium thereof apply a low degree of heat to liquid bisulphide of carbon for evolving a vapor therefrom, and then expanding said vapor under an increased temperature, which is maintained until its power has been applied to the engine.

My invention has also for its object the automatic control of said heats of low and high temperature in their applications to said liquid bisulphide of carbon and to the vapor evolved therefrom, and also automatically controlling the vapor evolved by a low degree of heat and expanded by a higher degree of heat, and also automatically controlling the supply of said vapor to the engine as to quantity and temperature, and conducting the exhaust of the engine by gravity to a condenser, and finally returning the liquid bisulphide of carbon and the water resulting from the condensation of steam back to the respective generator of each at about their boiling-points, all of which is accomplished substantially by the methods hereinafter described and specifically claimed.

The steam-boiler A, bisulphide-boiler B, engine C, heater D, condenser E, and the pipes, valves, pressure-gages, and other appendages connected with said parts are all constructed and operate substantially as shown and described in the cited Letters Patent No. 225,689 and No. 266,952, excepting certain additions and changes, which additions are as follows: vacuum-pump H, washer I, regulating-valve G, gage K, and well N. The changes are in the regulating-valve F and in the pump M, the construction of which additions and changes I will now proceed to describe.

The regulating-valve E (see Fig. 2) consists of two chambers, *a* *b*, secured together with a non-conducting packing, *c*, placed between them—such as asbestos—for preventing the heat from chamber *b* being transmitted to chamber *a*, and thereby heating the water in chamber *a*. The chamber *a* is provided with a plunger, *d*, connected to a pivoted lever, *e*, having an adjustable weight, *f*. The lower end of the plunger *d* is of the form of a section of a sphere, which form will prevent the plunger from cutting or otherwise injuring the elastic diaphragm *g*, which divides the chamber *a* into two compartments. The chamber *b* is furnished with a balance-valve, *h*, and suitable seats for said valve. The stem *i* of this valve is connected to the lever *e*.

To the chamber *b* is attached a pipe, *j*, which communicates with the steam-boiler A.

To the chamber *a* is connected a pipe, *k*, which communicates with the vapor-space of the bisulphide-of-carbon boiler B, and is provided with a valve, *l*, above which said pipe is filled with water. The weight *f* being adjusted on the lever *e* for securing the desired pressure of bisulphide-of-carbon vapor in the boiler B and the desired admission of steam to and through said boiler for evolving said vapor, steam flowing through pipe *j* from boiler A enters the chamber *b* of the regulating-valve F, and passes therefrom through pipe *m* to and through the boiler B. The vapor of bisulphide of carbon passes from the boiler B, filling the pipe *k*, in which it condenses until it fills the U-shaped bend in said pipe to about the dotted line *x*. The valve *l* now being opened, the bisulphide-of-carbon vapor will press against the liquid bisulphide of carbon, which, pressing against the water, which, pressing against the elastic diaphragm *g*, and it against the plunger *d*, which, in combination with the lever *e* and weight *f*, will open and close the valve *h* in accordance with the pressure in the bisulphide-of-carbon boiler B, closing said valve when the pressure is greater than that fixed upon, and opening it when it is less, thereby diminishing the flow of steam through pipe *m* when the pressure of bisulphide-of-carbon vapor is greater than that determined upon, and increasing said flow when it is less, thereby increasing and diminishing the heat around and through the bisulphide-of-carbon boiler B, whereby the desired working pressure of the vapor is always maintained.

The supply and regulating valve G is constructed in every respect the same as the regulating-valve F, excepting the pipes *n* *o*, the latter of which communicates with the casing L, which surrounds the pipe S, which conducts the vapor of the bisulphide of carbon to the cylinder of the engine C.

The operation of the valve G is the same as that of the valve F, excepting that the steam which enters it also controls the movements of its valve and plunger for controlling the admission of steam into the case L. The pipe *p*, attached to the valve G, communicates with the steam-boiler A. Now, by adjusting the weight *q* on the lever *r* for obtaining the desired pressure of steam in the case L, (which pressure may be indicated by pressure-gage, as at K,) the operation will be as follows: The steam flowing from the steam-boiler A through pipe *p* enters the chamber M, and from it through pipe *o* enters the case L, which communicates with the casing which surrounds the cylinder of the engine C, so that the same pressure of steam which is in case L will also be in the casing of the cylinder of the engine C. In the event of the pressure in the boiler A increasing beyond that determined upon for the case L the pressure of steam will act against the diaphragm *g*, which, acting against the plunger *d*, will thereby, through the me-

dium of the lever *r* and weight *q*, so operate the valve *h* as to cut off, or partly cut off, the supply of steam to case L till the desired pressure is attained in said case L. If the pressure in said casings should become less than that fixed upon, then the weight *q*, through the medium of the lever *r*, will open the valve *h*, so as to admit more steam, and will hold the valve open till the desired pressure is attained. It will be observed that by this arrangement of the supply and regulating valve G with relation to the casing L, and its communicating with the casing of the cylinder of the engine C, uniform pressure may be maintained in said casings notwithstanding any variation of pressure that may occur in the boiler A, and that the heat, and consequently pressure in said casings, is greater than that in the casing of the bisulphide-boiler B, and that the vapor in the pipe S and in the cylinder of the engine is subjected to an increased heat, which increases the tension, after it leaves the boiler B until it performs its office upon the piston of the engine C.

In the operation of the steam-engine from the moment the steam leaves the boiler and its furnace or superheater until it reaches the piston of the engine there is a continuous loss of its heat, and therefore a corresponding loss of power; and when working said steam expansively there is a further loss of heat and power due to the steam coming in contact with the walls of the cylinder, which are of less temperature than said steam; but in working the vapor of bisulphide of carbon, as herein described, the vapor is superheated from the time it leaves the generating boiler B until the end of the stroke of the piston, the vapor being subjected after leaving the boiler to a greater temperature in the pipes and cylinder than that at which it was evolved in the boiler B. It therefore follows that in working it expansively it can be cut off at an earlier point in the stroke of the piston, and in view of these facts economy of fuel, heat, and a full utilization of the power generated in the boiler must follow.

For the purpose of showing the gain secured by this arrangement for subjecting the vapor to a greater heat than that at which it was evolved in the boiler B, I give the following example: When the pressure of steam in the boiler A is about fifty (50) pounds per square inch of boiler-surface, and the circulating-pressure of steam around and through the boiler B is six (6) pounds per square inch of the boiler-surface working-pressure, the bisulphide of carbon in the boiler B will be subjected to 230° of heat, Fahrenheit, which will evolve the bisulphide of carbon into a vapor having a working-pressure of sixty-eight (68) pounds per square inch of boiler-surface. Now, with forty-three (43) pounds working-pressure in the casing L and in the casing of the cylinder of the engine C, the bisulphide-of-carbon vapor after leaving the boiler B will be

subjected to an increased heat of sixty-three (63) degrees more than it was in the boiler B, therefore requiring a less quantity of vapor to be withdrawn from the boiler B for the purpose of working the engine C.

When it is desired to work the vapor expansively, the engine is provided with any known cut-off mechanism.

The vacuum-pump H communicates with the condenser E and with the washer I, which latter device I will proceed to describe. (See Fig. 4.) It consists of a shell, *s*, with a pipe, *t*, having a valve, *u*, said pipe communicating with the vacuum-pump and projecting down into the shell below the water-line, (indicated by the dotted line *v*,) at which is a waste-pipe, *w*. To the upper end of the shell *s* is attached a pipe, *y*, for carrying off the washed air and incondensable and unabsorbed gases. The shell *s* is also provided with a pipe, *a'*, for supplying it with water, and also drain-pipes *b' c'*, and with a "sight-gage," *d'*, for ascertaining the height of the water in the shell *s*.

The piston-rod of the engine C is packed in the following manner, (see Fig. 5): *e'* is the piston-rod, *f'* the cylinder-head having packing-caps *g' h'*, packing-glands *i j*, and packing-ring *k'*, having recesses *t' u'*, which communicate with each other by a series of openings. In the projection *v'* of the cylinder-head *f'* is a cavity, in which is placed "plumbago packing" *m'*, then the ring *k'*, then plumbago packing *l'*, which is followed by the gland *j'*, which is provided with a cavity, *o'*, for oil, which surrounds the rod *e*, and a recess for packing, *n'*, which is followed by the packing-gland, *i'*, which, with the packing-gland *j'*, is forced against the plumbago packing by means of the screw-caps *g' h'*. The oil-cup *p'* communicates with the cavity *o'* in the gland *j'* by means of a pipe, *q'*, having a valve, *r'*. The projection *v'* of the cylinder-head *f'* is provided with a pipe, *s'*, which communicates with the well N, which communicates with the condenser E. The pipe *s'*, through the medium of the vacuum-pump, forms a vacuum in the recesses *t' u'* of the ring *k'*, through which vacuum the piston and valve-rods move, and thereby prevent the possibility of the vapor of bisulphide of carbon leaking out into the engine-room, the tendency of the atmosphere being toward filling said vacuum formed in the recesses *t' u'* in the ring *k'*. The hot-water pump M', which supplies the boiler A with hot water, the product of the condensed steam, which product is conveyed to the pump through the medium of pipes communicating with the several compartments supplied with steam from the boiler A, is the same as that described in cited Letters Patent No. 266,952. It was discovered that in the working of the pump (marked D) described in said Letters Patent the said pump did not at all times work perfectly in pumping the hot water when it was at or about the boiling-point. To remedy this defect, a pipe, P, is employed, so as to communicate between the casing of

the boiler B and the pump M', to convey steam therefrom, which simple means causes said pump to do its work successfully at all times. I state this fact, which has been fully demonstrated by an experience of several months' use of said arrangement, without attempting to describe its theory of operation.

The operation of my improvement, briefly stated, is substantially as follows: Steam is generated in the boiler A, which, by means of a pipe provided with a reducing-valve, communicates with the boiler B, and by the heat of the steam at a low degree of pressure the bisulphide of carbon is evolved into a vapor, which is conveyed by pipe S to the cylinder of the engine, the vapor being superheated in said pipe by steam from the boiler at a higher pressure, and consequently a higher degree of temperature. After the vapor has performed its office in the engine-cylinder it is exhausted and conducted to the condenser E by gravity, assisted by the vacuum in the condenser. Passing through the heater on its way to the condenser the exhaust-vapors impart their heat to the liquid, being returned from the well N through heaters D and T into the boiler B by the pump P'. The vacuum-pump H forms a vacuum in the condenser E and well N by withdrawing air and gases from them and forcing said air and gases through pipe *t* down into the water in the washer I, thereby washing said air and condensing the condensable gases, the washed air and incondensable gases passing off through the pipe *y*, and any bisulphide of carbon which may be collected in the washer I can be drawn off by means of the pipe *b'*, and thereby be saved.

The mechanism hereinbefore described I do not herein claim, but have made it the subject of other applications for Letters Patent, (marked Division B and Division C,) Serial Nos. 141,109 and 140,111.

Having thus described the construction and operation of my present improvements, what I claim is—

1. The method of operating a bisulphide-of-carbon engine, which consists in evolving vapor from liquid bisulphide of carbon, by applying heat thereto, and superheating the vapor under an increased temperature, which is maintained until the power thereof has been applied to the engine, substantially as described.

2. The method of operating a bisulphide-of-carbon engine, which consists in evolving vapor from liquid bisulphide of carbon by the application thereto of a low degree of heat, and then superheating the vapor by the application of a higher degree of heat, applied thereto before it is admitted to the engine, and continuing the same throughout the power-stroke of the piston, substantially as described.

3. The method of operating a bisulphide-of-carbon engine, which consists in evolving a vapor from liquid bisulphide of carbon by applying thereto a low degree of heat, and auto-

matically controlling the supply of heat at a higher degree of temperature to superheat the vapor, substantially as described.

4. The method of operating a bisulphide-of-carbon engine, which consists in evolving vapor from liquid bisulphide of carbon by the application of a low degree of heat thereto, controlling the supply of vapor from the generator to the conduit leading to the engine, and applying a higher degree of heat to the vapor contained in said conduit for superheating the same, substantially as described.

5. The method of operating a bisulphide-of-carbon engine, which consists in evolving vapor from liquid bisulphide of carbon by the application thereto of heat at a low degree of temperature, regulating the supply of vapor from the generator to the conduit leading to the engine, and automatically controlling the supply of heat at a higher temperature to the vapor contained in said conduit, substantially as described.

6. The method of operating a bisulphide-of-carbon engine, which consists in evolving vapor from liquid bisulphide of carbon by applying thereto heat at a low temperature, controlling the supply of vapor from the generator to the conduit leading to the engine, superheating the vapor under a higher temperature before it is admitted to the engine, and continuing the expansion throughout the stroke of the piston, and automatically controlling the supply of said vapor to the engine, substantially as described.

7. The method of operating a bisulphide-of-carbon engine, which consists in evolving a vapor from liquid bisulphide of carbon by applying thereto heat at a low temperature, regulating the supply of vapor from the generator to a conduit leading to the engine, and automatically controlling the supply of heat at a higher temperature to the vapor contained in said conduit and the supply of vapor to the engine-cylinder, substantially as described.

8. The method of operating a bisulphide-of-carbon engine, which consists in evolving vapor from liquid bisulphide of carbon by applying heat thereto at a low temperature, superheating the vapor under a higher temperature, automatically controlling the supply of vapor to the engine-cylinder, and maintaining the vapor under a degree of expansion greater than its initial expansion until the piston has completed its power-stroke, substantially as described.

9. In a bisulphide-of-carbon engine, the method of controlling the supply of heat to the vapor-evolving chamber, which consists in automatically operating or controlling a valve which regulates the supply of heat to said evolving-chamber by the pressure of the vapor contained in the generator operating upon one end of a column of water and the gravity of a suspended weight upon the opposite end of said column, substantially as described.

10. In a bisulphide-of-carbon engine, the method of controlling the supply of heat to the

vapor-superheating chamber, which consists in operating the valve which controls said supply by the pressure of the heated fluid in said expanding-chamber moving the valve in one direction and the gravity of a weight in the opposite direction, substantially as described.

11. The method of operating a bisulphide-of-carbon engine, which consists in evolving vapor from liquid bisulphide of carbon under a low temperature, controlling the supply to a conduit, where the vapor is superheated under a higher temperature, and conducting the excess of vapor to the condenser, substantially as described.

12. The method of operating a bisulphide-of-carbon engine, which consists in evolving vapor from liquid bisulphide of carbon by applying thereto heat at a low temperature, superheating the vapor under a higher temperature, applying the power of said vapor in an engine, condensing the vapor after it leaves the engine, and finally returning the condensed liquid to the generator, substantially as described.

13. The method of operating a bisulphide-of-carbon engine, which consists in evolving a vapor from liquid bisulphide of carbon by applying heat thereto at a low temperature, superheating the vapor under a higher temperature, applying the energy or power thereof in an engine, condensing the exhaust-vapor, returning the condensed liquid to the generator, and the air which may be in the condenser charged with vapor to a vessel containing water, substantially as described.

14. The method of operating a bisulphide-of-carbon engine, which consists in evolving vapor from liquid bisulphide of carbon by applying heat thereto, superheating the vapor under a higher temperature, which is maintained until it reaches the engine, applying the power thereof in an engine, condensing the exhaust-vapor, and reheating and returning the liquid to the generator at nearly the temperature at which it was evolved into vapor, substantially as described.

15. The method of operating a bisulphide-of-carbon engine, which consists in evolving vapor from liquid bisulphide of carbon under a low temperature, expanding the vapor under an increased temperature, applying the power thereof to an engine, conducting the exhaust-vapor by gravity to a condenser, and finally returning the liquid to the generator, substantially as described.

16. The method of operating a bisulphide-of-carbon engine, which consists in evolving vapor from liquid bisulphide of carbon under a low temperature, expanding the vapor under an increased temperature, conducting it to an engine, where the power is applied, and the exhaust to a condenser, reheating the liquid, and finally returning the liquid to the generator under pressure and at a temperature nearly at the boiling-point, substantially as described.

17. The method of operating a bisulphide-of-

carbon engine, which consists in evolving vapor from liquid bisulphide of carbon under a low temperature, expanding the vapor under an increased temperature maintained until its energy or power has been applied as a motor, condensing the exhaust-vapor in a chamber *in vacuo*, reheating the liquid, and finally returning it to the generator, substantially as described.

18. The method of operating a bisulphide-of-carbon engine, which consists in generating steam in a suitable generator, conducting a portion thereof at a reduced pressure to a chamber surrounding a vessel containing liquid bisulphide of carbon for evolving vapor, and then expanding the vapor by the heat of steam under a higher pressure applied directly from the generator to the vapor, substantially as described.

19. The method of operating a bisulphide-of-carbon engine, which consists in generating steam in a suitable generator, conducting a portion thereof at a reduced pressure to a chamber surrounding a vessel containing liquid bisulphide of carbon for evolving vapor, and then expanding the vapor by the heat of steam under a higher pressure applied directly from the generator to the vapor in automatically-regulated quantities, substantially as described.

20. The method of operating a bisulphide-of-carbon engine, which consists in generating steam in a suitable generator, conducting a portion thereof at a reduced pressure to a chamber surrounding a vessel containing liquid bisulphide of carbon for evolving vapor, and then expanding the vapor by the heat of steam under a higher pressure applied directly from the generator to the vapor in automatically-regulated quantities before it is admitted to the engine-cylinder, substantially as described.

21. The method of operating a bisulphide-of-carbon engine, which consists in generating steam in a suitable generator, conducting a portion thereof at a reduced pressure to a chamber surrounding a vessel containing liquid bisulphide of carbon for evolving vapor, superheating the vapor by the heat of steam under a higher pressure applied directly from the generator to the vapor in automatically-regulated quantities before it is admitted to the engine-cylinder, and continued until the piston has completed its power-stroke, substantially as described.

22. The method of operating a bisulphide-of-carbon engine, which consists in generating steam in a suitable generator, conducting a portion thereof under a reduced pressure to a chamber surrounding a vessel containing liquid bisulphide of carbon for evolving vapor,

and then superheating the vapor by the heat of steam under higher pressure drawn directly from the generator, conducting the vapor to the engine, and automatically controlling the supply of steam for evolving the vapor as variations in the work performed by the engine require, substantially as described.

23. The method of operating a bisulphide-of-carbon engine, which consists in generating steam in a suitable generator, applying the heat thereof to evolve vapor from liquid bisulphide of carbon and to expand the same, utilizing the energy of the vapor in an engine, and returning the water of condensation to the steam-generator with a volume of steam from the chamber which surrounds the vapor-generator, substantially as described.

24. The method of operating a bisulphide-of-carbon engine, which consists in generating steam in a suitable generator, applying the heat thereof to evolve vapor from liquid bisulphide of carbon and to expand the same, utilizing the energy of the vapor in an engine, and returning the water of condensation from the chamber surrounding the vapor-generator, the supply-conduit, and the engine-cylinder, to the steam-generator with a volume of steam from the chamber which surrounds the vapor-generator, substantially as described.

25. In a bisulphide-of-carbon engine, the method of condensing the exhaust-vapor, which consists in conducting it to a chamber in which the major portion is liquefied and the air charged with the uncondensed vapor to a secondary vessel, in which the escape vapor from the primary vessel is condensed and the liquid bisulphide precipitated, substantially as described.

26. In a bisulphide-of-carbon engine, the method of condensing the exhaust-vapor, which consists in conducting it from the engine to a chamber in which the major portion is liquefied and the air charged with uncondensed vapor to a secondary vessel containing water, through which the escape vapors from the primary vessel pass, the liquid bisulphide precipitated, and withdrawn therefrom, substantially as described.

27. In a bisulphide-of-carbon engine, the method of relieving the air which may be contained in the condenser of the noxious odors of the vapor, which consists in conducting said air charged with vapor from the condenser through a body of water contained in a vessel, precipitating the liquid bisulphide, and discharging the air into the open atmosphere, substantially as described.

W. S. COLWELL.

Witnesses:

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