R. CREUZBAUER.

Method of Utilizing Bisulphide of Carbon as a Motive Power.

No. 210,840. **Patented Dec. 17, 1878.**

Fig. 1

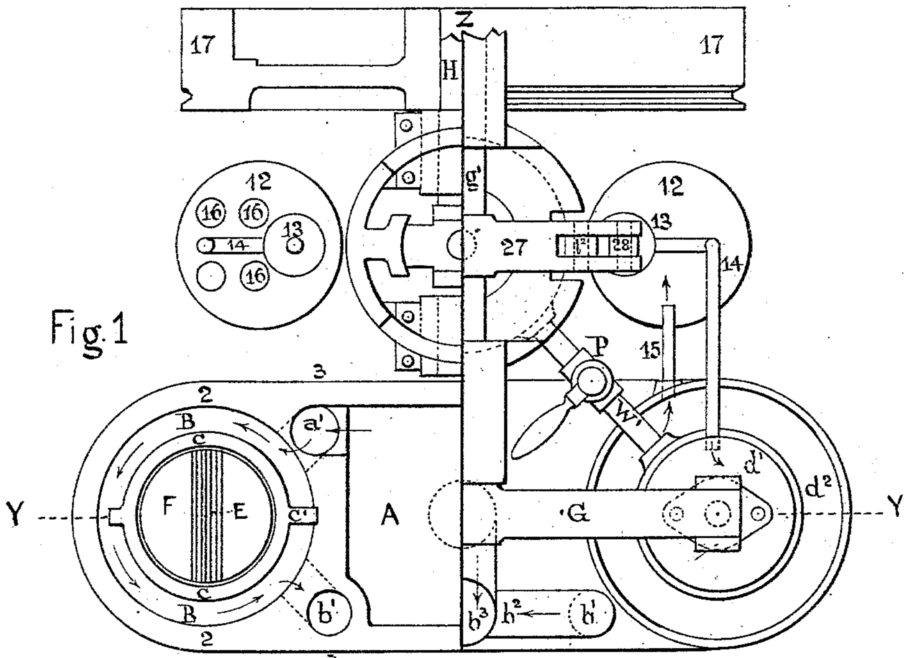

Fig. 2

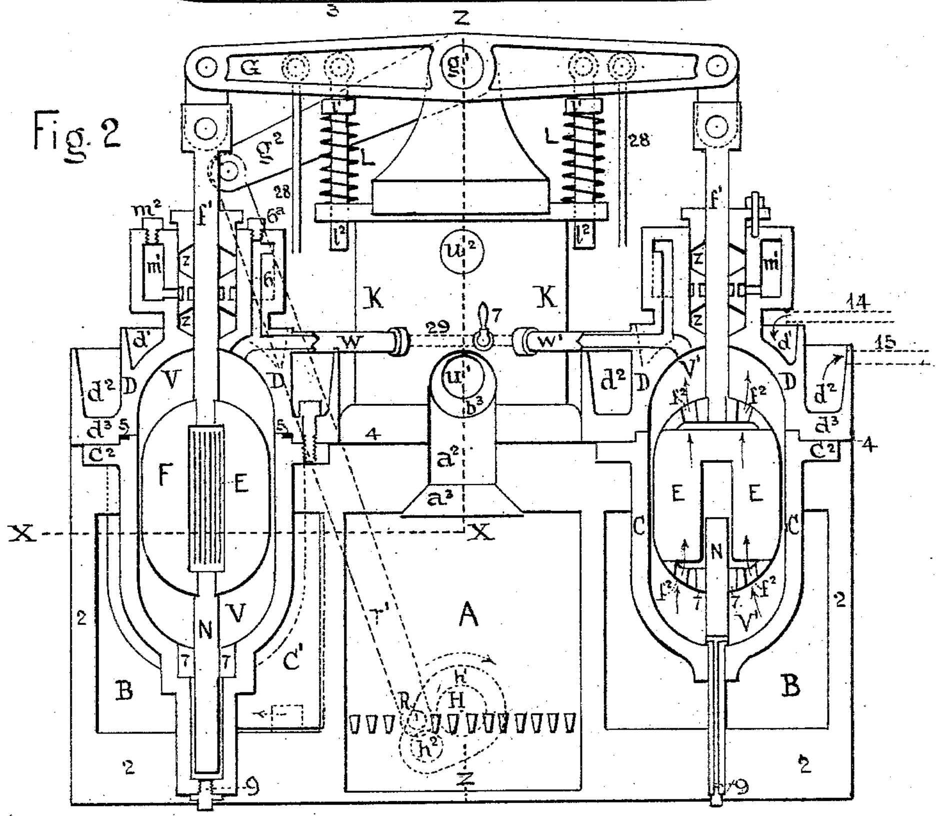

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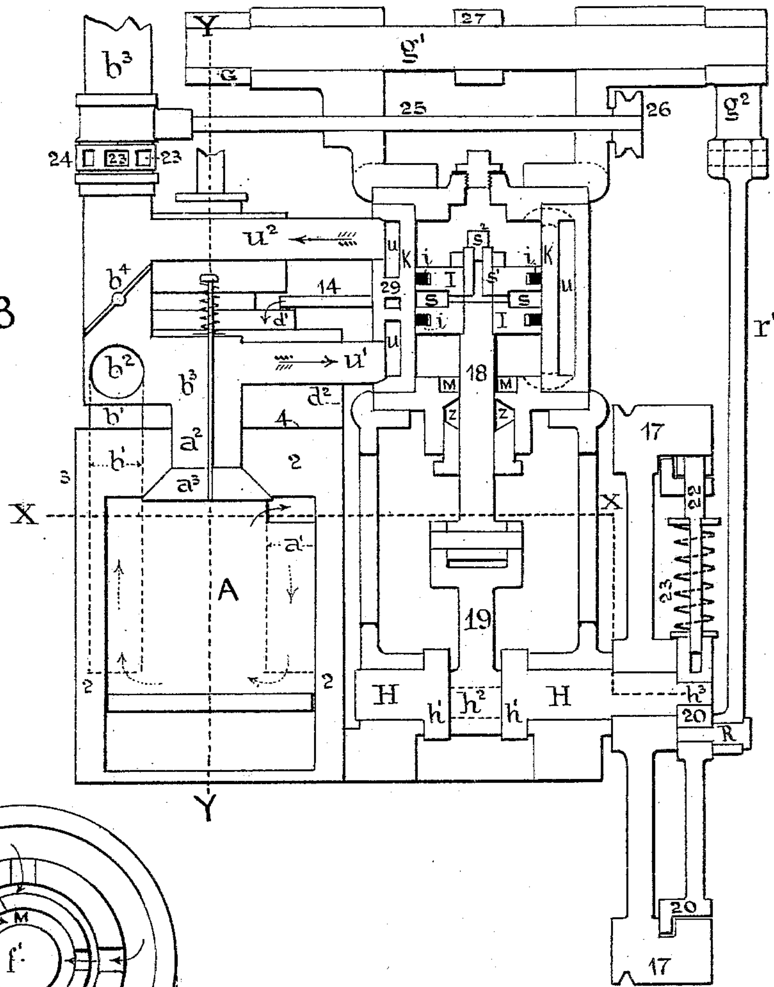
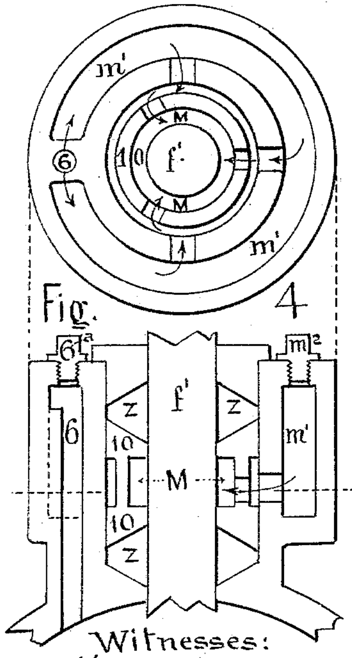
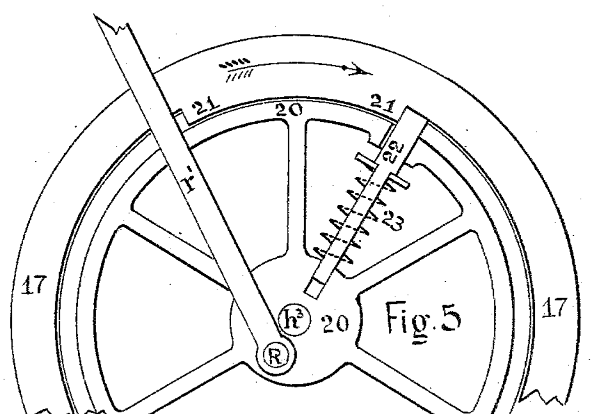
Fig.3







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UNITED STATES PATENT OFFICE.

ROBERT CREUZBAUR, OF BROOKLYN, E. D., NEW YORK.

IMPROVEMENT IN METHODS OF UTILIZING BISULPHIDE OF CARBON AS A MOTIVE POWER.

Specification forming part of Letters Patent No. **210,840**, dated December 17, 1878; application filed April 27, 1878.

To all whom it may concern:

Be it known that I, ROBERT CREUZBAUR, of the city of Brooklyn, E. D., county of Kings, and State of New York, have invented a new Method of Utilizing Bisulphide of Carbon as a Motive Power, of which the following is a specification:

1. Hitherto the attempts to obtain motive power from this source have been confined to a method similar to that applied for producing steam-power by means of a condensing-engine, in which a surface-condenser is used, to wit: The bisulphide of carbon was evaporated in various ways, and the vapor so obtained was caused to propel a piston in an engine in the manner usually applied in steam-engines. After having thus performed its work, the vapor was condensed in a surface-condenser, and the resulting liquid—bisulphide of carbon—was then pumped back into the evaporating-vessel, to be again evaporated, and so on.

2. It is a well-established fact that the evaporation of bisulphide of carbon, as well as of all other liquids, requires a far greater amount of heat than the expansion of its vapor in producing an equal amount of power.

3. In my method of utilizing bisulphide of carbon and compounds thereof as a motive power, I confine myself, after the vapor of such carbon is once produced at the commencement of work, to the expansion of and increase of tension in such vapor by the addition of heat thereto, and to the contraction of and decrease of tension therein by the abstraction of heat therefrom.

4. To enable me to utilize this method of obtaining work from the expansion and contraction of vapor of bisulphide of carbon and compounds thereof, without condensing the same during the performance of work thereby, I employ a modification of the mechanism incorporated in the Sterling high-pressure air-engine, in which the air is alternately heated and cooled in each of two separate chambers, or sets of chambers, connected, one to one end of a usual working cylinder in which a piston reciprocates, and the other to the opposite end thereof. Each of these two chambers, or sets of chambers, consists of a comparatively cold end and a hot end, the air being changed from one end to the other by a reciprocating plunger or displacer, one in each chamber, so that while the air is in the hot end in one chamber with elevated pressure, the air is in the cold end in the other chamber with decreased pressure, the piston in the cylinder being propelled accordingly. To obtain any considerable power it is necessary to use a condensing-pump, by which the air is brought to, and maintained at, a high pressure, generally ten atmospheres at the cold end.

5. The leading differences in the method of producing power by the Sterling high-pressure air-engine and in my method of producing power by the expansion and contraction of the vapor of bisulphide of carbon are these: In said air-engine the high tension of the air is produced by a compressing-pump. By my method the desired high tension in the vessels is obtained, without a compressing-pump, by the evaporation through heat of a corresponding quantity of the liquid of bisulphide of carbon and compounds thereof.

When air and other pure gases are applied as the medium for producing power, it requires an increase in their temperature of about 490° Fahrenheit to double their tension or volume, whereas, with the vapor of bisulphide of carbon, aside of its lower capacity for heat, such an increase in its temperature doubles its tension or volume several times. This quality of the vapor of bisulphide of carbon of requiring only a comparatively low degree of heat to increase its tension does away with the necessity of heating the vessels to an injurious degree. With air as the medium for producing any considerable amount of power, the high heat to which the heating-vessels have to be subjected causes their destruction.

The comparatively large amount of heat which has to be imparted to and abstracted from the air in the Sterling air-motor, as compared to the small amount of heat required to be imparted to and abstracted from the vapor of bisulphide of carbon during each revolution of the engine, gives to the latter a correspondingly small furnace and a small consumption of fuel, with a proportionate small requirement of heat-abstracting medium, resulting, together with the absence of the compressing-pump, in largely-reduced bulk, cost, and maintenance.

6. The mechanism which I employ for the utilization of bisulphide of carbon for motive

power in the manner named is described as follows, and is illustrated in the accompanying drawings, of which—

Figure 1 is a horizontal section of the left half of the machine along the line X X, Figs. 2 and 3, the right-hand portion being a plan or top view of the same. Fig. 2 is a vertical section along the line Y Y, Figs. 1 and 3, and a view of parts to the right of line Y Y, Fig. 3. Fig. 3 is a vertical section along the line Z Z, Figs. 1 and 2. Figs. 4 and 5 represent details referred to in the following description.

A is a usual furnace for the combustion of coal, wood, oil, or any other source of heat, a lamp serving the purpose for producing the heat required for small motors. B B are heating-chambers, in which the heating-vessels C C are placed, as shown in Figs. 1 and 2. The combustion-chamber A and heating-chambers B B may together form one chamber, particularly so when a lamp only is used.

The portions of the mechanism to the right of the furnace A, Figs. 1 and 2, being counterparts of those to the left of the furnace A, the following description of one side of the two applies to both:

7. From the combustion-chamber A the heat passes from the top and rear thereof down a channel, a^1, Figs. 1 and 3, into the lowest portion of heating-chamber B, from where it rises and passes around outwardly, as indicated by the arrows, Fig. 1, being prevented from passing around the other way by the rib C′, formed upon the vessel C. The unappropriated heat and fire products finally pass from the lowest portion of chamber B, Figs. 1 and 3, into channel b^1, leading into the branch smoke-pipe b^2, emptying into the main pipe b^3, as shown. Thus the hottest gases come first in contact with the part of the vessel C farthest removed from the cooling-vessel D. This may be accomplished in various ways. A spiral flange may be cast around vessel C, serving the double purpose of increasing the vessel's fire-surface and of preventing the gases from ascending directly, forcing them to follow the spirals around, they finally entering the smoke-pipe b^2 or b^3 from the top of chamber B; or the flanges may run around vessel C horizontally, having upward passages in them on alternate sides. All such flanges or projections cast upon the vessel C serve, as does the rib C′, for increased fire-surface, as well as a means for controlling the course of the fire products. By thus bringing the hottest fire products in contact with the parts of vessel C farthest removed from the cooling-vessel D, and by bringing the coolest fire products in contact with the parts of the vessel C nearest to the vessel D, the injurious tendencies of unequal expansion are neutralized, and the heat of the fire products is more fully utilized.

8. The combustion and heating chambers A B are surrounded with fire-brick 2 2, or other non-conducting material, in any usual manner, inclosed by the sheet-metal shell 3 3 and top plate A, upon which the vessels C D rest, as shown in Fig. 2. To facilitate the starting of the fire in the furnace A, and to prevent the overheating of the vessels C C, a direct passage, a^2, is provided from the top of the combustion chamber or furnace A into the smoke-pipe b^3, which passage a^2 is usually closed by a cover, a^3.

9. The cooling-vessel D is bolted upon the vessel C, as shown in Fig. 2, their respective flanges d^3 and c^2 being tightly fitted to each other. In large machines leakage between these flanges may be totally prevented by forming a groove, 5, between them, (shown in Fig. 2,) which is kept full of glycerine or other suitable packing material, through a filling-tube. (Not shown.) A packing of asbestus or other suitable material may be placed between these flanges c^2 d^3, to cut off the transmission of heat from one to the other.

10. The vessel D may be cooled by a current of air when the required power is light; otherwise water is used. To carry out the above-mentioned method of keeping the extremes of temperatures farthest from each other, the hottest part of vessel D is kept nearest to the heating-vessel C. This is accomplished by forming a series of basins around vessel D, as d^1 and d^2, Fig. 2, in such manner that the water first introduced into the uppermost basin, d^1, overflows, after taking up heat from that part of the vessel D, into the next chamber, d^2, and so on, if there are any more such chambers. The result is a saving of water and the nearest practicable approximation of the temperatures of the portions of vessels C and D nearest to each other. Furthermore, the formation of these chambers d^1 d^2 in one piece with vessel D increases this vessel's water and cooling-surface accordingly. These cooling-vessels d^1 d^2 are supplied with a current of water from a reservoir, 12, Fig. 1, in which a common submerged circulating-pump, 13, delivers water through pipe 14, Figs. 1 and 3, into the upper basin, d^1. From that basin d^1 the water overflows into the next lower basin, d^2, and from this basin d^2 the water is returned, through pipe 15, into the reservoir 12, or is carried off without being reused. When the saving of the water is of importance, and to increase the cooling-surface of the reservoir 12, cooling-tubes 16 16, Fig. 1, are formed through the same, open at both ends, through which the air passes and abstracts heat from the water, these tubes being best placed vertically or obliquely. The circulation and the cooling of the water must be so regulated that the vessel D is not cooled sufficiently to cause condensation of the vapor within it.

11. The bisulphide of carbon is introduced into the chamber V, formed of the two vessels C D, in a liquid form, through the stuffing-box channel 6, Fig. 4, referred to below, and closed by plug 6^a. When sufficient heat is applied to the vessel C, the vapor is formed, which produces the power, by being alternately heat-

ed and cooled, as aforesaid, so as to produce alternating comparatively high and low tensions in said space V.

12. To accomplish this, the vapor is alternately driven from the hot end to the cold end in space V, and vice versa, by means of the plunger or displacer F, Figs. 1 and 2, which is reciprocated through rocking beam G, from one end of the chamber V to the other end. This displacer F may be fitted accurately, so as to form its own guide, and so as to leave no dead space between it and the shell C D. But to attain cheap manufacture, and to prevent friction between the displacer F and the shell C D, a slight space is left between them, the displacer F being guided in the stuffing-box by its rod f^1, and at the other end by a guide-rod, N. This rod N is either fastened to the displacer F, so as to slide through the graphite-lined bearing 7 into the sleeve 8, as shown on the left side in Fig. 2, or the guide-rod N is fastened in the bottom of the vessel C, so as to slide through the bearing 7, fastened in the lower end of displacer F, as shown on the right in Fig. 2. In either case there is an opening, 9, in the lowest portion of vessel C, through which the contents of the chamber V may be drawn off.

13. To prevent leakage of the vapor through the stuffing-boxes, the respective rod, before it leaves the stuffing medium Z, Figs. 3 and 4, is made to pass through an annular chamber, M, filled with glycerine or other suitable material, which is forced against the rod by the pressure in the vessel to which the stuffing-box is attached. With a downward stuffing-box, as that of the working-cylinder K, Fig. 3, it is only necessary to provide a well, M, which forms the annular chamber M, and in which the fluid packing material collects, its escape being prevented by the usual stuffing medium Z. When the stuffing-box is upward, as in Fig. 2, and as shown on a larger scale in Fig. 4, the stuffing material Z Z is separated by the annular piece 10, which is perforated and reduced in the center, so as to form such an annular chamber, M, next to the rod f^1, as shown in Figs. 2 and 4, this chamber M being filled with the glycerine through a reservoir, m^1, as shown by the arrows. The pressure within the vessel D is brought to act upon the fluid in the reservoir m^1 and annular chamber M through the pipe or channel 6. The liquid packing in reservoir m^1 is replenished through the opening covered by the plug m^2.

14. When the displacer F is being moved, the vapor which it displaces passes through the ports f^2 f^2 and through the central part of the displacer, traversing the regenerator E. This regenerator may be located around the chamber V. In placing it into the central part of the displacer F it is more effective and easier of construction. It may be formed of a series of thin metal plates, as is usual, or it may be formed of rods placed transversely above each other, so as to break joints, or otherwise. The hot vapors traversing the regenerator E, from the vessel C to the vessel D, transmit most of their heat to the regenerator, leaving but a fraction of their initial heat to be extracted by the cooling-chamber D. In passing the other way, from the cooling-chamber D downward, the vapor reabsorbs the heat left by it in the regenerator in its upward passage, so that only a comparatively small quantity of heat has to be imparted to the vapor by the heating-vessel C to give to the vapor the density required.

15. K K is the working cylinder, in which the piston I is reciprocated by the difference of pressure in the two vapor-spaces V V′, the pressure in vapor-space V acting upon the top of the piston through pipe W, and that in vapor-space V′ upon the under side of the piston through pipe W′, or vice versa. To lubricate the piston, as well as to prevent the escape of vapor from one side of the piston to the other, which might result in average unequal pressures on its opposite sides, an annular space, S, is formed in the piston, which is filled with glycerine or other suitable material through the channel S^1, closed by cap S^2. This packing and lubricating material is confined by packing-rings i i, which prevent its ready escape out of the piston-chamber S. The leakage downward collects in the well M, where it prevents the escape of vapor through the stuffing-box. The surplus leakage overflowing the well M is drawn off by a channel. (Not shown.) To serve as lubricating material only, graphite and similar substances may be used in said piston-chamber S and otherwise. When such inequality of the average pressure in spaces V V′ has taken place, it is equalized by opening the two-way cock 7, Fig. 2, which controls the small channel 29, connecting the two cylinder-port channels fed by pipes W W′. This is done after the machine has stood a little while with the piston I at half-stroke, and the displacers F F also exactly at half-stroke; or, if a due overpressure is desired on one side of the piston—for instance, to balance the weight of the piston and other vertically-moving unbalanced parts—an extra quantity of liquid of bisulphide of carbon is introduced, as named, into the side where the overpressure is to exist.

16. To be able to heat the cylinder K at the commencement of work, so that the vapor entering it may not be condensed, and so as to evaporate the bisulphide of carbon condensed in it after the machine ceases to work, a smoke-jacket, u, is provided, through which, by more or less closing the damper b^4, the fire products are made to traverse, passing through pipe u^1 into jacket u, and returning through pipe u^2 into the smoke-pipe b^3, or passing out independently of pipe b^3. After the cylinder has been heated sufficiently to prevent the condensation of the vapor in it the passage of the fire products through jacket u is stopped, as no increase of power would be attained by

heating the cylinder to a higher temperature, and because a low temperature is best for the working parts.

17. Motion is given to the crank-shaft H and fly-wheel 17 in the usual way through piston-rod 18 and a connecting-rod, 19. Motion is given to the rock-shaft g^1 either through an eccentric upon the crank-shaft or by a crank-pin, R, or other equivalent, the motion being transmitted to the rock-shaft g through connecting-rod r' and arm g^2. The crank-pin R, in its path of rotation, leads the main crank-pin h^2, as dotted in Fig. 2. This lead is necessary, because, for instance, when the piston is placed midway of its stroke, and the displacers are simultaneously midway of their stroke, the pressures upon both sides of the piston would be equal; but when in that position of the piston the displacers F F have passed their midway position, the vapor, in one space, V, is mostly in the heating-vessel C with increased pressure, while the vapor in the other space, V′, is mostly in the cooling-vessel D with decreased pressure, or vice versa, the piston being acted upon accordingly. When the machine is designed to run in one direction only such crank-pin R is permanently fastened in this case upon the fly-wheel 17. When the machine is to run both ways the following arrangement is used:

18. The crank-pin R, Figs. 3 and 5, is fastened upon the wheel 20, turning loosely upon the crank-shaft end h^3, and carried by the fly-wheel projection 21. This projection bears upon the bolt 22, sliding radially through the rim of the wheel 20, and kept in position by spring 23. The driving projection 21 is twice the length of the intended lead of displacers F F, measured by the angle of the corresponding lead of their driving crank-pin R. To reverse the motion of the machine the latch or bolt 22 is forced back against the spring 23, so as to allow the wheel 20 to be moved backward from its preceding course, so that the bolt will spring in at the other end of its driving projection 21. For the purpose of starting the engine it is of advantage to be able to move the latch 22, with its wheel 20, ahead of its driving projection 21, so as to obtain, through the momentary greater lead of the displacers F F, an excess of power. The contrary result, however, is obtained when this is done just before the piston I has passed one of its dead points. As a convenient method of retaining the wheel 20 endwise, the projection 21 on the fly-wheel is duplicated on the opposite side, and the rim of the wheel 20 is shaped to enter behind these projections, as shown in Figs. 3 and 5.

19. The connection of the rod r' to arm g^2 may be made movable radially to shaft g^1, for the purpose of regulating and changing the stroke of the displacers F F, the power being reduced in proportion as the displacers displace the vapor (more or less) partially from the ends of vapor-spaces V V′. The speed of the machine may be thus governed; but I prefer to regulate it thus: Upon one or both of the pipes W W′, connecting the vapor-spaces V V′ with the interior of the working cylinder K, a throttle, P, is placed, Fig. 1, of any usual construction, its stuffing-box being turned downward, and provided with a fluid-packing well, M, as represented in the cylinder stuffing-box, Fig. 3. By thus throttling the passage of the vapor into and from the cylinder K the speed of the engine may be controlled, and its motion may be entirely stopped. Manufacturing motors would have this throttle P controlled by the governor driven from shaft 25.

20. Another means for controlling the speed of the machine consists in the usual mode of controlling the intensity of the furnace-heat by a damper controlling the quantity of air feeding the fire. In place of such a damper, or in addition thereto, gridiron air-passages 23 into the smoke-pipe b^3 are applied, as represented in Fig. 3, its revolving cover 24 being adjusted by hand, or through a governor or pressure-gage. When necessary, a blower is applied above the register-valve 23, a screw-fan, placed directly into the smoke-pipe, being generally preferred, to which motion is imparted by the shaft 25, driven through a band passing over the fly-wheel 17 and the pulley 26.

21. The momentum of the displacers F F, in their downward movement, is stored in the springs L L, which return it to the displacers by starting and aiding them in their upward movement. The resistance of the springs L L is regulated by the movable nuts l^1 upon rods l^2, these rods l^2 being pivoted to the central rocking beam 27, keyed upon rock-shaft g^1. By means of rods 28 28 this rocking beam 27 also drives the pumps 13 13, which circulate the water through the cooling-vessels d^1 d^2, as above named. The springs L L may be applied to these pump-driving rods 28 28 instead of using extra rods l^2 l^2.

22. Although bisulphide of carbon seems to be the best material for the within-stated purpose, there are other substances known to chemistry possessing properties which adapt them to be introduced into the mechanism in a liquid form, or as non-gaseous ingredients, which form the required vapor by the application of heat or by admixture—for example, liquefied ammonia-gas, also aqua ammonia, which enlarges the range of high and low tension of the gas it surrenders upon being heated, by alternately absorbing and surrendering a portion of that gas by its change of temperature during each revolution of the engine; also, carbonic acid may be employed, either in a liquefied form or by being generated in the usual manner, by placing marble-dust in chamber m', and bringing a proper acid in contact with it, the acid being introduced through a suitable cup, the same as oil is introduced into a steam-chest under pressure; also, alcohol, ether, and other substances may be substituted, the suitableness of any such substances depending upon their

greater or less specific heat, boiling-point, opacity to radiating heat, degree of expansion within certain limits of temperature, effect upon the material of the mechanism, inflammability, poisonous qualities when inhaled, and cost.

The furnace and the heating-vessels may be placed above the cooling-vessels, or they may be placed side and side. Motion may be given to the displacers F F from below and by various devices. The displacers may rotate continuously in one direction, serving as a fly-wheel, with correspondingly-formed vapor spaces V V′. The heating and cooling vessels may be formed in nests and multiplied according to the amount of power required.

In small motors the furnace A may be omitted, and a lamp placed directly under the heaters C C. The two cooling-vessels D D may be cast in one piece, with the water-basins d^1 d^2 respectively connected, and various other modifications in the arrangement can be made.

I do not, therefore, confine myself to the particular arrangement of the mechanism shown and described; but

I claim as my invention—

1. The herein-described method of utilizing the expansion and contraction of the vapor of bisulphide of carbon and of compounds thereof as a motive power—to wit, by adding heat to and extracting heat from such vapor at each revolution of the engine, substantially as described.

2. The herein-described method of utilizing bisulphide of carbon and compounds thereof as a motive power—to wit, by alternately increasing and decreasing the tension of the vapor thereof by the addition of heat thereto and the abstraction of heat therefrom without condensing the said power-producing vapor to a liquid during the operation of the motor.

3. The furnace A, heating-chambers B B, vapor-chambers V V′, displacers F F, in combination with a working cylinder, K, the whole connected and operating substantially as described, with an initial pressure in chambers V V′ of over fifteen pounds per inch, produced without a compressing-pump.

4. The furnace A, heating-chambers B B, vapor-chambers V V′, displacers F F, in combination with regenerators E E and a working cylinder, K, the whole connected and operating substantially as described, with an initial pressure in chambers V V′ of over fifteen pounds per inch, produced without a compressing-pump.

5. The method herein described of producing motive power by the expansion and contraction, during each revolution of the engine, of vapors and gases produced within the mechanism employed from liquids and non-gaseous ingredients.

6. The combination, with a cooling-vessel, D, forming part of a vapor-chamber, V, of water-basins d^1 d^2, formed in one piece with said cooling-vessel D, as described.

7. The combination, with a cooling-vessel, D, and a heating-vessel, C, forming a vapor-space, V, of fire-gas directing flanges C′, cast upon such vessel C, and forming part of its heating-surface, substantially as described.

8. The combination, with vapor-spaces V V′, of springs L L, which store the momentum of the continuously-moving displacers F F and of rocking-beam G, with other reciprocating attachments, substantially as described.

9. The combination, with a vapor-space, V, and a working cylinder, K, of the stuffing-box fluid-packing chamber M, connected with the interior of the vessel to which the stuffing-box is attached, so as to submit chamber M to the pressure existing in such vessel, in order to prevent leakage into chamber M, substantially as described.

10. The combination, with a vapor-space, V, and a displacer, F, with a free space between the displacer F and the walls of said space V, of a guide-rod, N.

11. The combination, with vapor-spaces V V′, displacers F F, guide-rods N N, and working cylinder K, of the regenerators E E, when incorporated in said displacers F F, substantially as described.

12. The combination, with a motor in which power is produced by vapors or gases produced within the mechanism, which are alternately contracted and expanded during each revolution of the engine, of a velocity-controlling valve, P, through which, when open, the gases pass alternately both ways during each revolution of the engine.

13. The combination, with the vapor-spaces V V′, displacers F F, regenerators E E, and working cylinder K, of rock-shaft g^1, driving-pin R upon loose wheel 20, bolt 22, and fly-wheel lug 21, for reversing the engine.

14. The combination, with vapor-spaces V V′, displacers F F, and working cylinder K, of the piston I, constructed with a packing and lubricating chamber, S, between the packing-rings *i i*.

15. The combination, with the vapor-spaces V V′, displacers F F, and working cylinder K, of the annular static fluid-packing chamber 5 between vessels C D.

16. The combination, with vapor-spaces V V′ and displacers F F, of smoke-jacket *u*, around the working cylinder K, with independent smoke-passages u^1 u^2 and damper b^4.

17. The combination, with vapor-spaces V V′, displacers F F, and working-cylinder K, of the cock 7 and equalizing-channel 29, connecting the two vapor-channels leading to opposite ends of the cylinder K.

18. The combination, with vapor-spaces V V′, displacers F F, and working cylinder K, of the water-cistern 12, provided with cooling-tubes 16 16, for the purpose named.

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