(No Model.) 2 Sheets—Sheet 1.

G. DAIMLER.

MOTOR ENGINE WORKED BY COMBUSTIBLE GASES OR PETROLEUM.

No. 334,109. Patented Jan. 12, 1886.

Fig. 1.

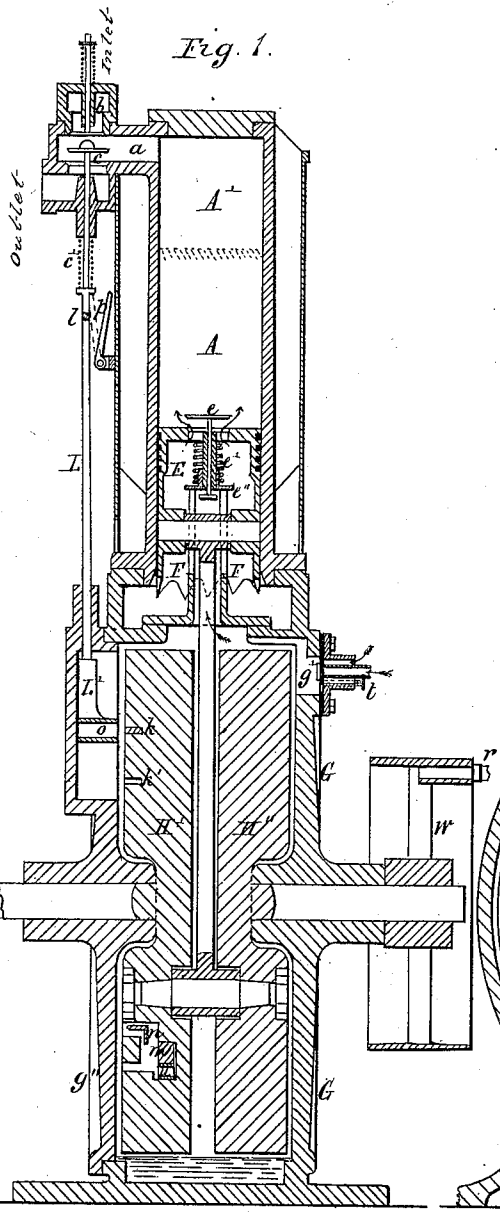
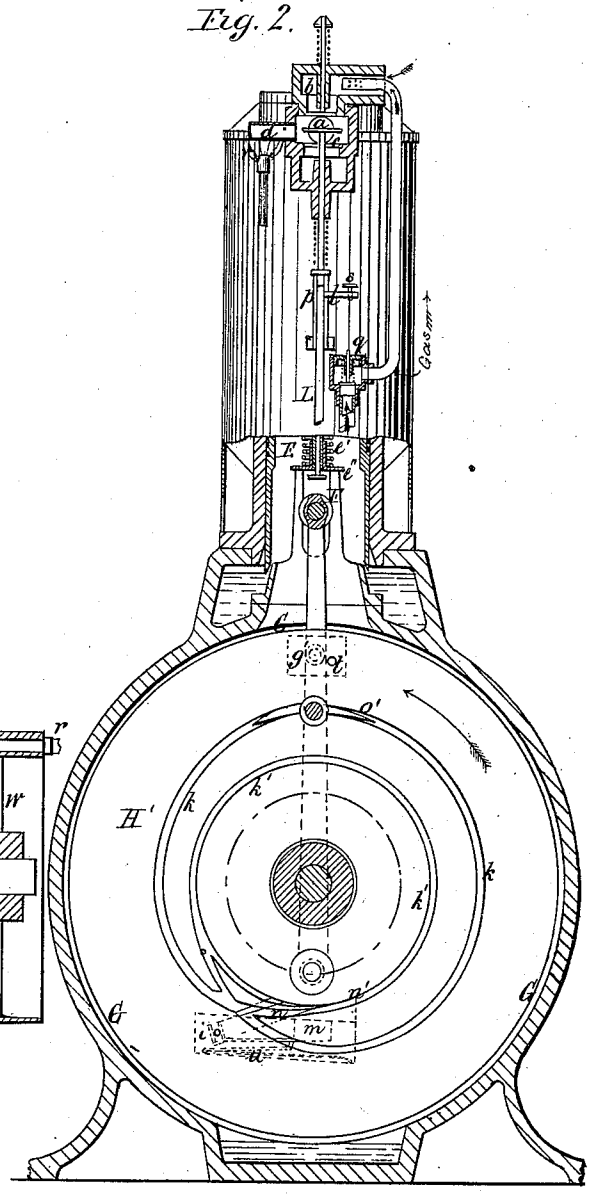


Fig. 2.



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(No Model.) 2 Sheets—Sheet 2.

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Fig. 3.

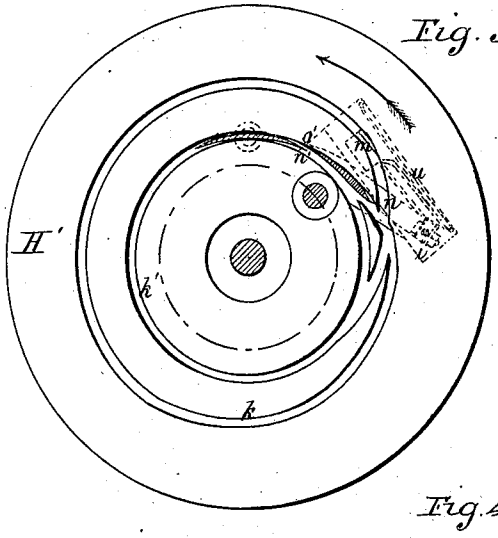


Fig. 4.

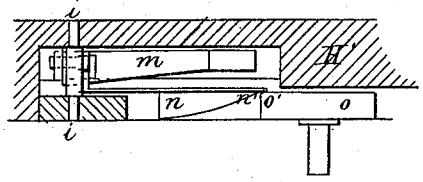


Fig. 6.

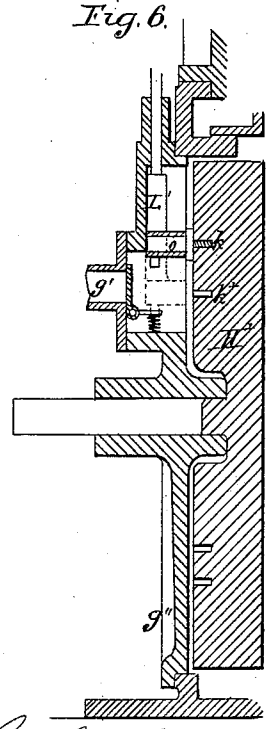
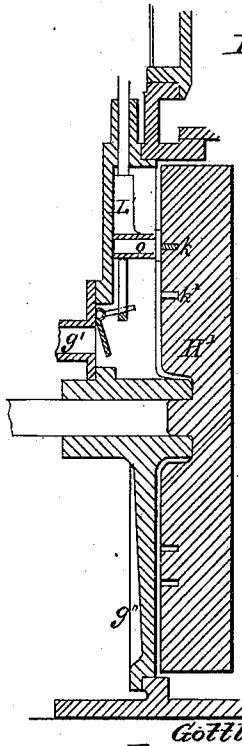


Fig. 5.



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UNITED STATES PATENT OFFICE.

GOTTLIEB DAIMLER, OF CANNSTADT, WÜRTEMBERG, GERMANY.

MOTOR-ENGINE WORKED BY COMBUSTIBLE GASES OR PETROLEUM.

SPECIFICATION forming part of Letters Patent No. 334,109, dated January 12, 1886.

Application filed September 21, 1885. Serial No. 177,713. (No model.) Patented in England April 7, 1885, No. 4,315; in Belgium April 30, 1885, No. 68,536; in Austria-Hungary July 10. 1885, No. 13,745 and No. 35,256; in Spain July 21, 1885, No. 5,021; in Italy August 27, 1885, No. 18,747, and in France September 16, 1885, No. 168,279.

To all whom it may concern:

Be it known that I, GOTTLIEB DAIMLER, a citizen of Würtemberg, residing at Cannstadt, in the Kingdom of Würtemberg and Empire of Germany, have invented new and useful Improvements in Motor-Engines Worked by Combustible Gases or Petroleum Vapor or Spray, of which the following is a specification.

My invention relates to an improved construction of that class of motor-engines worked by combustible gases or petroleum vapor or spray, wherein a combustible charge is only introduced at every alternate instroke of the piston, the improvements being such that the gaseous charges employed are of greater volume and are freer from products of combustion than those of engines heretofore constructed. This is effected by introducing into the cylinder, both before and after the admission of the main charge of gaseous mixture, additional charges of either combustible mixture or of air introduced at every stroke by means of a pump formed in the working-cylinder on the side of the piston opposite to that on which the charge works. By one of these additional charges the products of combustion are at the same time driven out of the cylinder.

For forming the pump, and at the same time to avoid the use of a stuffing-box for the piston-rod, and to render the construction of the engine more compact, the crank is inclosed in a chamber provided with a suction-valve for combustible mixture or air, the piston being provided with a valve that opens automatically when the piston is near the end of its instroke. The ignition of the charge is prevented from taking place until the crank is at the dead-center by causing an explosive mixture, poorer in gas than the cylinder-charge, to come in contact, when compressed, with a heated part of the admission-passage, the moment of ignition being regulated by varying the proportion of gas in the igniting-mixture.

A further improvement relates to the mode of regulating the speed of the engine, this being effected by bringing the valve-gear to a standstill when the normal speed is exceeded, the gaseous products of combustion being made to remain under pressure in the cylinder, so that no fresh charge is admitted.

A further improvement relates to the regulating and starting devices.

Figure 1 of the accompanying drawings shows a vertical section of an engine constructed according to my invention. Fig. 2 shows a part elevation and part section at right angles to Fig. 1. Figs. 3 and 4 show details. Figs. 5 and 6 are details of modifications.

A is the working-cylinder, with compression-space A′, at the upper end of which is the inlet and discharge passage *a*.

b is the inlet-valve for the combustible charge; *c*, the discharge-valve, and *d* is a tubular extension on the inlet-passage, heated externally.

E is the piston, with the inlet-valve *e*, spring *e′*, and contact-plate *e″*.

F is a forked projection fixed to the framing, with which fork the plate *e″* comes in contact, toward the end of each instroke of the piston, so as to force back the spring *e′*, and thus cause the valve *e* to be free and automatic in its action during a certain time before and after the dead-center of the instroke of the piston, so as only to open when the pressure in the crank-chamber exceeds that in the cylinder.

G is the gas-tight crank-chamber, with inlet-valve *g′*, for combustible mixture and cover *g″*, which latter is made sufficiently large to enable the crank-plate, with its shaft, to be taken out of the chamber.

H′ H″ are crank-plates that can be made heavy, so as to serve at the same time as fly-wheels, and which occupy the greater part of the chamber in order to make the pump-chamber in the same as small as possible, and thus to obtain a compression in the same of from one-fifth to one-half atmosphere over pressure.

In order to simplify the machine, one of the crank-plates might be omitted. The valve-gear is actuated by a cam-groove, *k k′*, formed in the crank-plate H′, and which passes twice round the crank-shaft and returns into itself, and in combination with which is the sliding block *o* and the rod L, which acts upon the

rod c' of the escape-valve c. It will be seen that the cam-groove $k\,k'$ is so formed that at one revolution of the crank the sliding block o is moved from the groove k into the groove k', whereby the rod L is withdrawn from the rod c' of the escape-valve c, which consequently remains closed during the corresponding in and out strokes of the piston. At the next revolution of the crank the block o is moved back from the groove k' into the groove k, whereby the rod L in rising is made to open the escape-valve, such opening being effected after the piston has performed its working instroke. The groove k' is circular, and is connected by branches, as shown, with the groove k, by means of which the block o is made to pass from the one to the other.

The regulation of speed is effected by means of the governor-arm m, with spring and centrifugal action, and the switch n, which, on the normal speed being exceeded, move out of the working position at Fig. 2 into the position at Fig. 3, whereby the block o is caused to remain in the cam-groove k' during the rotation of the crank, and the rod L is thus brought to a standstill until, by the reduction of speed, the switch is again moved back to the position at Fig. 2. The governor m is suspended from the axis i, and has a spring action in the direction of rotation round this point. The switch n is formed with an incline, and is connected to the axis i by its extension, which has a spring action at right angles to the axis, as shown at Fig. 4, in order that in the event of the two edges n' o' meeting they may escape one another, so as to allow o to pass on the one or the other side of n. The governor m is pressed inward by a spring, u, in the contrary direction to the centrifugal force due to the speed of rotation. The ignition of the charge is effected by the compression of the charge by means of the working-piston, whereby a certain part of the charge is brought, in a compressed condition, in contact with the tubular extension d, heated externally by a gas-flame, v. In order to retard this ignition until the crank is on the dead-center at the compressing outstroke, the last portion of the charge of combustible mixture is reduced in strength from one-third to one-half that of the main charge, so that the passage a and tube d will only contain such weak mixture during the compressing-stroke. The weak charge is produced by the action of the gas-valve q, which, toward the end of the suction-stroke, is pressed downward by the arm l of the valve-rod, and thus restricts the passage of gas. By the adjustment of the screw s the strength of the charge, and consequently the moment of ignition, is accurately regulated. The temperature of the cylinder can be kept tolerably high, and in the absence of water sufficient cooling can be effected by a moderate current of air through the surrounding jacket. The engine is started by rotating the crank-shaft by means of the crank-handle r, attached to the belt-pulley w, the discharge-valve c and suction-valve g' being opened, this being effected by placing the support p under the stop on the valve-rod c' and by screwing inward the screw t, so as to open the valve g'. The crank-handle is drawn out when the engine is started.

The mode of operating is as follows: Just before the end of the working instroke the discharge-valve is opened, the pressure in the cylinder sinks below that in the pump-chamber, the piston-valve e opens automatically in this position, and admits a charge of combustible mixture under pressure, or of air, into the cylinder, which drives the products of combustion out in front of it. By the outstroke of the piston, and by the charge of mixture or air forced in, the lighter products of combustion situated in the upper part of the cylinder are expelled through the discharge-valve. The combustion-space of the cylinder is now charged with combustible mixture or air. To this preliminary charge is now admitted, during the instroke of the piston, the main charge, entering through the admission-valve b, such charge consisting of air mixed with either gas or petroleum in the form of vapor or spray. During the first part of the instroke the piston at the same time compresses the combustible charge drawn in beneath it into the pump-chamber until shortly before the end of the stroke, when the piston-valve e is rendered free in its action again, and the third portion of the charge now passes from the pump-chamber into the cylinder until the pressure in the two is equalized. At the second outstroke of the piston the total charge is further compressed, and is ignited, as above described, when the end of the stroke is reached.

The above-described mode of operating may be varied by omitting either the preliminary charge or the supplemental charge of combustible mixture or air. For this purpose the admission-valve g' to the crank-chamber would be arranged on the cover g^2 beneath the rod L, that actuates the discharge-valve, and for the first mentioned case, where the preliminary charge is to be omitted, the rod L would be made to hold the valve open by means of a loop, L', while it is rising during the working instroke of the piston, as shown at Fig. 5, so that the charge of combustible mixture or of air that had previously been drawn in through the valve g', would be driven out again, and consequently there would be no compressed charge in the crank-chamber at the end of such working instroke, whereas during the following instroke, when the rod L would be in the lowered position, the valve would remain closed, so that the before-described supplemental charge would then be formed.

For the second above-mentioned case, where the supplemental charge is to be omitted, the valve g' would be arranged as shown at Fig. 6, it being held closed by a spring during the working instroke of the piston, so that the preliminary compressed charge would be formed during the following instroke, when the rod L would be moving downward. This is

caused to press the valve open, so that the charge previously drawn into the crank-chamber would be forced out again.

When working with petroleum, the gas-passages must be modified in proportion to the heating-power thereof.

The advantages resulting from this construction of motor-engine are that, by means of the purer combustible mixture and the large volume of the charge, a more effectual combustion takes place, and that on account of the greater speed here attainable less loss of heat takes place, resulting in a decreased consumption of gas, and lastly, that with this arrangement the cheaper carbonic-oxide gas—for instance, the so-called "Dowson gas"—may be used with advantage.

I do not herein claim the method of introducing the main charge of combustible mixture and the preliminary charges of combustible mixture or air, nor the method of retarding the ignition of the charges, nor the method of regulating the speed of the engine, as such constitute the subject-matter of my application Serial No. 165,390, filed May 13, 1885.

Having thus described the nature of my invention and the best means I know of carrying the same into practical effect, I claim—

1. In motor-engines, the inclosed crank-chamber G, operating, in combination with the inlet-valve g', cylinder A, and piston E, with valve e, so as to constitute a compressing-pump by which combustible mixture or air is introduced into the cylinder through the piston, substantially as herein described.

2. In combination with the crank-chamber G, closed by the cover g'', the crank-disks H' H'', with cam-grooves $k\,k'$, sliding block o, and rod L, actuating the discharge-valve c, substantially as herein described.

3. For producing a weaker combustible mixture for the last part of the cylinder-charge, the gas-admission valve q, operating, in combination with the arm l and screw s, on the rod L, so that the valve is partly closed and the supply of gas consequently restricted during the latter part of the suction-stroke.

4. The governor-arm m, operating, in combination with the spring u and spring-switch n, with incline, and the cam-grooves $k\,k'$, whereby when the normal speed is exceeded the block o is caused to remain in the circular groove k', substantially as and for the purpose set forth.

5. The removable crank-handle r, operating in combination with the pivoted strut p, for keeping open the discharge-valve, and the screw t, for keeping open the suction-valve g', for starting the engine, substantially as set forth.

6. The forked projection F, in combination with the valve e, spring e', and contact-plate e'', whereby the valve e is rendered free to open to the pressure in the crank-chamber at the end of the instroke, substantially as herein described.

7. In a gas-motor engine, a closed crank-chamber acting as a pump-chamber, in which the crank is formed as a disk or disks to more or less completely fill out the chamber, substantially as herein set forth.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 2d day of September, 1885.

GOTTLIEB DAIMLER.

Witnesses:
WILHELM MAYBACH,
H. GERSTENLAUER.