(No Model.) 2 Sheets—Sheet 1.

G. DAIMLER.

GAS OR PETROLEUM MOTOR ENGINE.

No. 418,112. Patented Dec. 24, 1889.

Fig. 1.

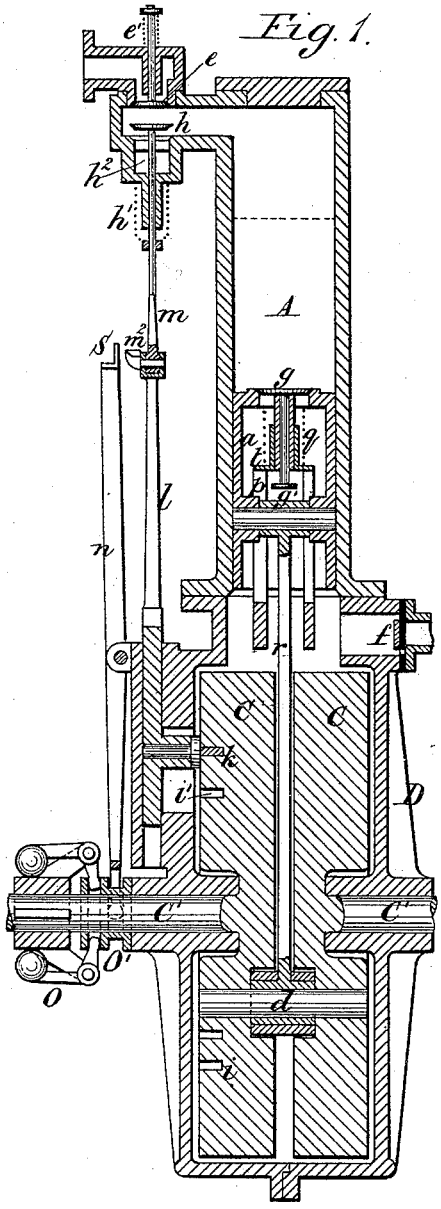
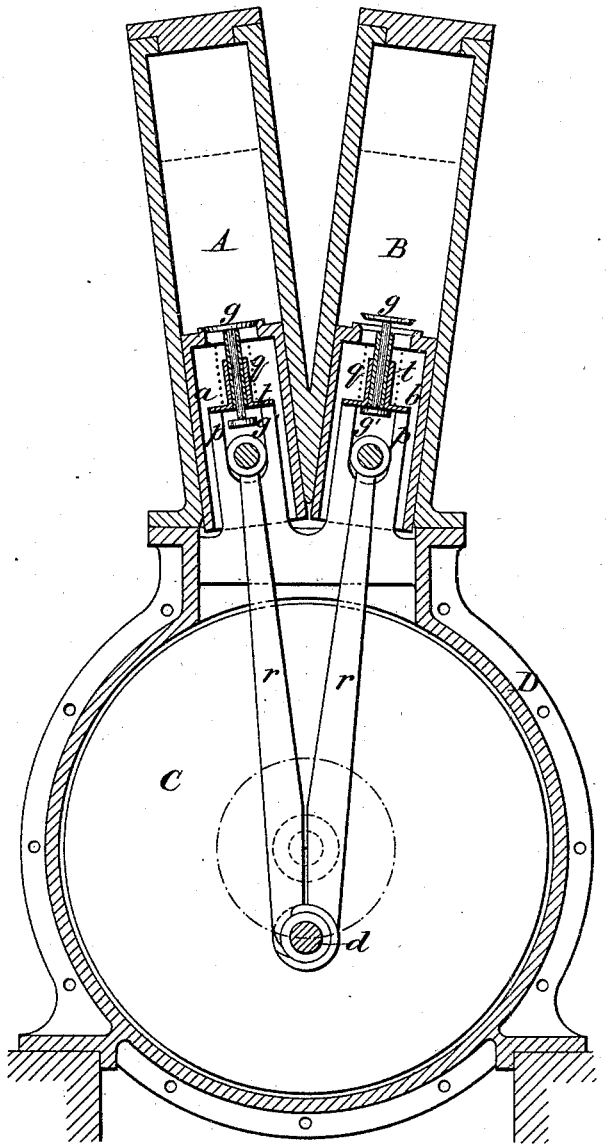


Fig. 3.



Witnesses:
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Dennis Sumby

Inventor:
Gottlieb Daimler
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(No Model.) 2 Sheets—Sheet 2.

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Fig. 2.

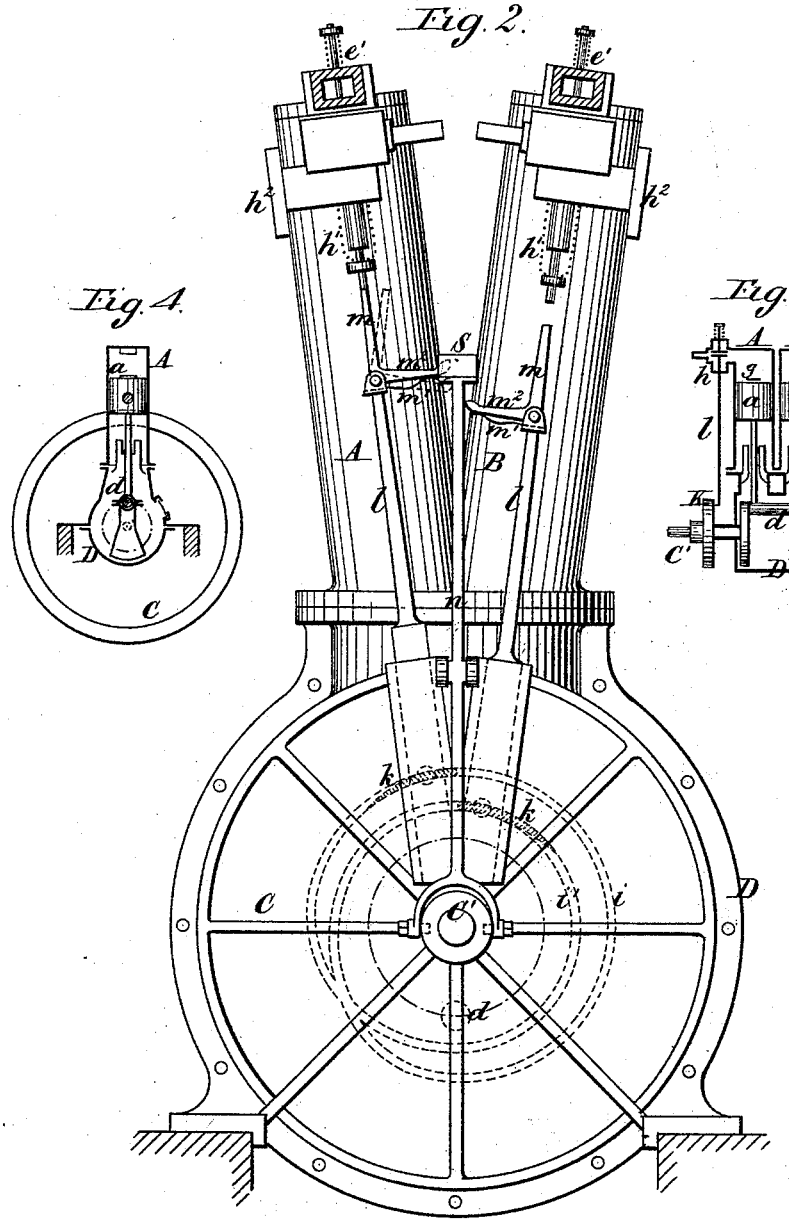

Fig. 4.

Fig. 5.

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UNITED STATES PATENT OFFICE.

GOTTLIEB DAIMLER, OF CANNSTADT, WÜRTEMBERG, GERMANY.

GAS OR PETROLEUM MOTOR ENGINE.

SPECIFICATION forming part of Letters Patent No. 418,112, dated December 24, 1889.

Application filed June 6, 1889. Serial No. 313,330. (No model.) Patented in France June 18, 1889, No. 199,024; in Belgium June 19, 1889, No. 86,695; in Switzerland June 25, 1889, No. 1,151; in India August 7/23, 1889, No. 169, and in Italy September 10, 1889, XXIII, 25,796.

To all whom it may concern:

Be it known that I, GOTTLIEB DAIMLER, a subject of the Emperor of Germany, residing at Cannstadt, Würtemberg, in the Empire of Germany, have invented new and useful Improvements in Gas or Petroleum Motor Engines, (for which I have obtained patents in France, June 18, 1889, No. 199,024; in Belgium, June 19, 1889, No. 86,695; in Switzerland, June 25, 1889, No. 1,151; in Italy, September 10, 1889, Vol. XXIII, No. 25,796, and in India, August 7/23, No. 169 or 1718/379–5,) of which the following is a specification.

This invention relates to a construction of gas or petroleum motor engine such as was described in my patent of September 28, 1886, No. 349,983, in which an inclosed chamber containing a fly-wheel was made to communicate with one end of the engine-cylinder, the space left in the said chamber being made to constitute a reservoir of either air or of gaseous mixture drawn into the same by the back-stroke of the piston and compressed therein by its forward stroke, the piston being provided with a valve which was automatically opened at the end of the compressing and working forward strokes, so as to admit a portion of the compressed charge into the cylinder through the piston at those times. The fly-wheel was provided with a double cam-groove returning in itself and containing a slide by means of which the opening of the escape-valve was only effected at the end of the working forward stroke.

My present invention relates to a modified construction of engines of this type wherein two working-cylinders are connected to and communicate with one and the same closed space containing the crank-shaft, the rods of both pistons being connected to the same crank, so that they perform their strokes together, both acting as pumps for compressing a charge of air or of gaseous mixture in the said closed space, but the admission of the combustible charges into the cylinders being so regulated that while the one piston is performing its working forward stroke the other is performing its suction or charging forward stroke. By this construction I obtain an engine of double the power of that described in my said prior patent, but having only the additional weight of the second cylinder, piston, piston-rod, and valve-gear.

The engine can be constructed in various ways in carrying out my said invention. Thus, according to one arrangement, I place the cylinders side by side at a slight angle to one another in a plane at right angles to the crank-shaft, with their piston-rods connected to one and the same crank-pin, in which case the valve-gear of both cylinders can be worked by one and the same double cam-groove. According to another arrangement I place the two cylinders one behind the other, with their axes in a plane parallel with the crank-shaft, but with their piston-rods still connected to one and the same crank, in which case there are provided two double cam-grooves—one for the valve-gear of each cylinder.

The governing of the engine is effected by mechanism whereby, when the engine runs beyond the normal speed, the escape-valve is prevented from being opened at the end of the working-stroke, so that, the combustion-gases being retained in the cylinder, no combustible charge will be drawn in on the next suction-stroke.

The construction and mode of operating of the engine will be readily understood on reference to the accompanying drawings, in which—

Figure 1 shows a vertical longitudinal section of the engine. Fig. 2 shows a front elevation. Fig. 3 shows a vertical transverse section of the first above-mentioned construction of the engine, and Figs. 4 and 5 are sectional views showing a modification of the invention.

The working-cylinders A and B both communicate at their lower ends with the closed casing D, in which is the double fly-wheel C C, carried by the shaft C′ C′, running air-tight in bearings formed on the casing D. The pistons *a b* of the two cylinders are both connected by rods *r r* to one and the same crank-pin *d* on the fly-wheel. These pistons have openings through them, which are closed by valves *g g*, held down by springs *q q*, act-

ing on flanged sleeves t t, sliding on the guide of the valve-stem and butting against a collar g' g' on the latter. Into the lower ends of the cylinders project fixed forks p p, which, when the pistons are arriving at the ends of their forward strokes, butt against the flanges of the sleeves t, so that as the pistons complete their strokes the forks compress the springs q q, leaving the valves g g free to be opened by any excess of pressure of air or gaseous mixture that may exist below them.

The casing D has an opening closed by a valve f, opening inward, through which either air or a mixture of gas and air can be admitted into the casing. The cylinders A B receive their charges of combustible gaseous mixture on the suction forward stroke through the automatically-opening valve e, held closed by a spring e', and the products of combustion escape at the end of the working forward strokes through the valves h h and opening h^2, the valves being held closed by springs h' h' and pushed open at the required moment by the rods l m l m, actuated by sliding blocks k k, situated in the double cam-groove i i', formed in the fly-wheel C. This cam-groove is formed of a double loop returning in itself, operating in the same manner as described in my said prior patent—that is to say, the larger loop i is of such a diameter that as it revolves the slide k situated in it for the time being is made to raise the rod l m into the position shown at Fig. 1 and to the left hand in Fig. 2, whereby it is made to push against the stem of the valve h, so as to open this. The loop i', on the other hand, is so much smaller that the slide k situated in it for the time being does not raise the rod l m far enough to open the valve h. It will be seen from Fig. 2 that the slide k of the cylinder A is situated in the loop i when the slide k of the cylinder B is situated in the loop i', so that the escape-valve h of the cylinder A will be opened while that of B is closed, and vice versa. It will be seen from the foregoing that the action of engine is as follows:

Assuming the two pistons a and b to have just arrived at the end of their forward strokes, as at Fig. 3, they will first have both compressed by that stroke a charge of air or of gaseous mixture previously admitted to the casing D through valve f. The piston B will have drawn in a charge of combustible mixture on its upper side through valve e, while piston a will have performed its working-stroke after the firing of its charge. As the piston b arrives at the end of its stroke, the fork p will free its valve g from the spring q, and the valve will be opened by the compressed air or mixture in casing D, a portion of which will consequently enter the cylinder above the piston and put the combustible charge therein under a corresponding pressure. In the cylinder A the fork p will also have released the valve g from the spring q; but as the discharge-valve h is only just being opened the cylinder above piston a will still contain combustion-gases under pressure from the previous charge, and consequently the compressed air or mixture in D will not force open the valve g until by the escape of the said gases the pressure above the piston is reduced below the pressure in D. When this takes place, a portion of the air or mixture in D will also enter cylinder A and will assist in driving out the remainder of the combustion-gases as the piston A performs its backward expelling-stroke. During this time the piston B is performing its backward compressing-stroke, the valve g being closed as soon as the pressures above and below it are *in equilibrio*. When both pistons have completed their back-strokes, the compressed charge in cylinder B will be fired, causing the piston b to perform its working forward stroke, while the piston A will draw in its combustible charge, the discharge-valve h having been closed toward the end of the previous back-stroke by the slide k passing from the loop i into the loop i'. During such forward strokes of the pistons they will have again compressed a charge of air or mixture previously admitted into casing D, and at the end of these strokes the cylinder A will be in the condition first described with reference to B, and B will be in the condition described with reference to A, its discharge-valve h being opened by the passage of its slide k into the loop i of the cam-groove, and so on. Thus it will be seen that while the spaces of the cylinders above the pistons alternate in their functions the spaces below them act continuously as pumps, drawing in and compressing air or gaseous mixture in the casing D.

The regulation of the engine is effected by keeping the escape-valves h closed when the engine runs too fast by the following arrangement:

The part m of the rods l m is hinge-jointed to l, and is kept in the straightened position, in which it effects the opening of the valve h, by a spring m'. It is provided with an arm m^2, projecting at right angles, so that when the head S of the lever n is moved inward from the position shown at Fig. 1 the arm m^2, as the rod l m rises, will come in contact with S, and will cause rod m to be deflected into the dotted position, Fig. 2, whereby it will be prevented from actuating the valve h when l m is raised to the highest position by slide k in groove i. Such inward motion of the upper end of the lever m is effected by a sliding sleeve O' on the shaft C', into a groove on which the lower forked end of lever n takes, which is in the position shown at Fig. 1 when the engine runs at the normal speed, and which is slid outward, when the engine runs too fast, by the action of the governor O. The ignition of the combustible charges may be effected in any known manner, such as that described in my

said prior patent, and need not be further described. Figs. 4 and 5 show, respectively, a vertical transverse section and a longitudinal section of an engine constructed according to the second above-described modification—that is to say, with the two cylinders A and B arranged one behind the other in line with the crank-shaft C′, the piston-rods of both cylinders being connected to one and the same crank-pin *d*. The discharge-valves *h h* of the cylinders are in this case worked by two separate double cam-grooves formed in disks K K, fixed on the crank-shaft C′ outside the casing D. The fly-wheel C is also situated outside the casing in this case.

The construction and mode of operating of the engine are otherwise precisely the same as described with reference to the first arrangement, and need, therefore, not be further referred to.

I claim as my invention—

1. In a gas or petroleum motor engine working with a cycle of four strokes, the combination of two working-cylinders having their pistons connected by rods to one and the same crank, with a closed casing containing the crank-shaft, with which casing the forward end of both cylinders communicates, and which serves as a reservoir of air or gaseous mixture drawn into the same by the simultaneous backward motion of the pistons and compressed therein by their simultaneous forward motion, the admission of the combustible charges into the two cylinders being regulated, substantially as described, so that while one piston is performing its working forward stroke the other is performing its suction or charging forward stroke.

2. In a gas or petroleum motor engine working with a cycle of four strokes, the combination of two working-cylinders having their pistons connected by rods to one and the same crank, a closed casing containing the crank and fly-wheel, and a cam-groove formed in the fly-wheel, having a double loop containing two slides, each of which operates the discharge-valve of one of the cylinders, the admission of the combustible charges into the two cylinders being regulated, substantially as described, so that while one piston is performing its working forward stroke the other is performing its suction or charging forward stroke.

3. In a gas or petroleum motor engine working with a cycle of four strokes, the combination of a revolving cam-groove with double loop, a slide situated in the said cam-groove and actuating a rod with hinge-jointed end that effects the opening of the discharge-valve of the cylinder, a lever whose one end has a head that can be brought into the path of an arm on the hinge-jointed part of the rod, so as to deflect it, and a sleeve gearing with the other end of said lever and operated by a governor, so as to move the said lever into the said position when the normal speed of the engine is exceeded, substantially as and for the purposes described.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 16th day of May, A. D. 1889.

G. DAIMLER.

Witnesses:

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