

(No Model.)

2 Sheets—Sheet 1.

E. KÖRTING & G. LIECKFELD.

GAS MOTOR.

No. 289,774.

Patented Dec. 4, 1883.

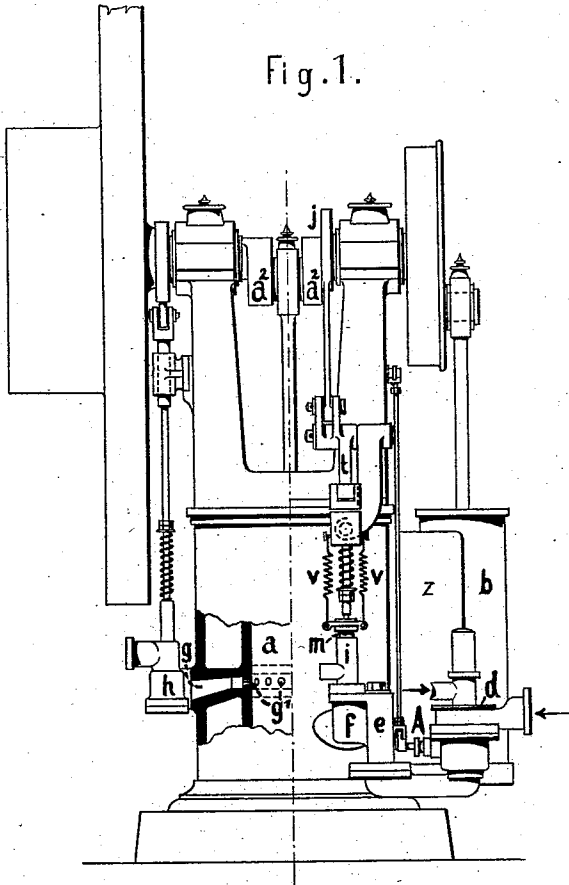
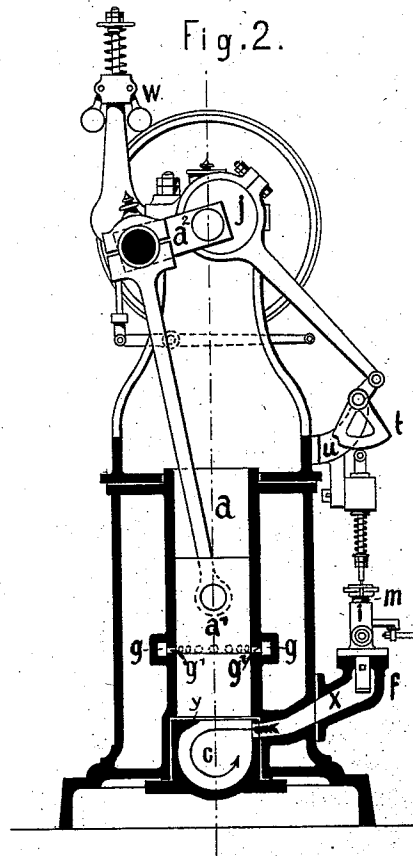


Fig. 3.

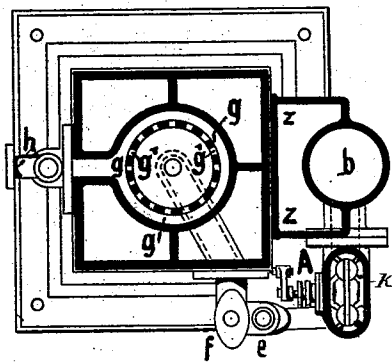
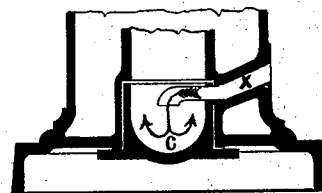


Fig. 4.



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2 Sheets—Sheet 2.

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Fig. 5.

Fig. 6.

Fig. 9.

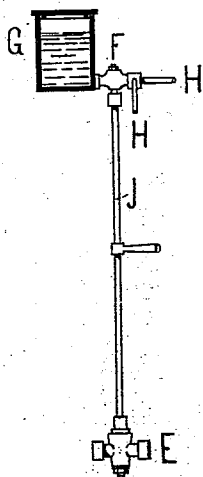
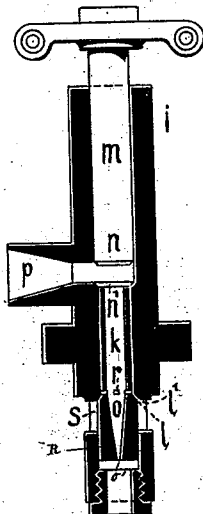
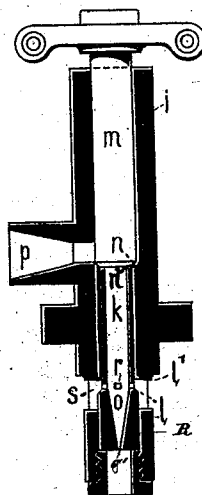
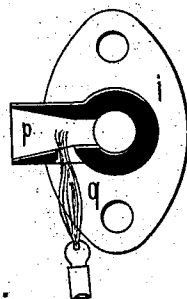
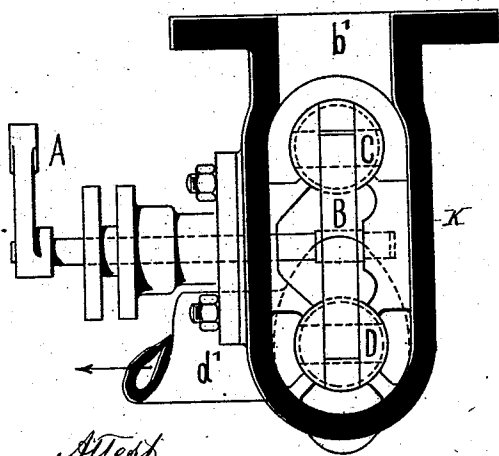
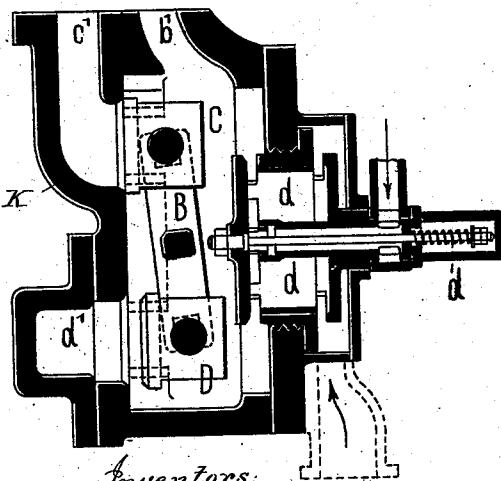


Fig. 7.

Fig. 8.



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UNITED STATES PATENT OFFICE.

ERNST KÖRTING AND GEORG LIECKFELD, OF HANOVER, PRUSSIA,
GERMANY.

GAS-MOTOR.

SPECIFICATION forming part of Letters Patent No. 289,774, dated December 4, 1883.

Application filed June 30, 1883. (No model.)

To all whom it may concern:

Be it known that we, ERNST KÖRTING and GEORG LIECKFELD, engineers, both residing in Hanover, Kingdom of Prussia, German Empire, have invented new and useful Improvements in Gas-Motors, of which the following is a specification.

Our invention relates to gas-motors in which motive power is produced by the combustion within the working-cylinder of a mixture of inflammable gas and air supplied by a force-pump; and the improvements consist, first, in placing a supplemental chamber having curved walls at the end of the main cylinder, and locating the mouth of the ingress-port in such position as to adapt it to discharge its volume against said curved walls, whereby the gas becomes localized in said supplemental chamber, while a layer of residual combustion gases remains inclosed between the fresh gases and the piston; secondly, in the particular device employed for igniting the gas-mixture; thirdly, in the construction of mechanism for regulating the speed of the engine.

A gas-motor embodying our improvements is represented on the annexed sheet of drawings.

Figure 1 is a front view of the motor partly in section; Fig. 2, a sectional side view, and Fig. 3 a sectional plan thereof. Fig. 4 shows a modification of a part of the same in transverse section. Figs. 5 and 6 are sections of the igniting device with different positions of movable parts drawn to a larger scale. Figs. 7 and 8 show in horizontal and in vertical section the speed-regulating mechanism, also drawn to a larger scale. Fig. 9 finally represents the arrangement for suppressing a flow of oil to the cylinder while the engine is at rest.

a is the working-cylinder. The power produced within the same is transmitted by the piston-head *a'* and a connecting-rod to the crank *a''*.

b is the pump for the supply of fresh gaseous mixture, the piston thereof being connected to a wrist-pin mounted on a wheel driven by the main shaft, said piston occupying the same position relatively to said main shaft as the piston which operates it, so as to move in unison therewith.

c is a space, which we have called "localizing-space" and which is provided with curved

walls. By preference, the same is made hemispherical or spheroidal, so that for a given capacity its refrigerating-surface may be as small as possible.

d is a valve, serving at the same time as suction-valve for the pump *b* and as apparatus for mixing gas and air, in such a manner that the piston of the pump will always draw in a uniform mixture during the whole length of its course. This valve is described in the specification of the German Patent No. 19,435.

In *e* is contained a self-acting delivery-valve of the pump *b*.

f is the apparatus for igniting the charge.

g is the exhaust-channel, which communicates by a number of orifices, *g'*, with the interior of the cylinder.

h is the exhaust-valve, which is opened by a cam-disk keyed on the main shaft, and closed by a spring.

x is the channel by which the mixture of gas and air passes from the pump to the cylinder.

y is a partial partition or screen, arranged at the top of the space *c*, opposite to the mouth of the channel *x*, when said channel conducts into the cylinder from the side, as in Fig. 2.

The operation of the engine is as follows: During the upward or outward motion of the working-piston the piston of the pump moves in the same direction and aspires an inflammable mixture of gas and air during the whole length of its stroke. When the working-piston is at or near the upper end of its stroke the exhaust-valve *h* opens, so that the residual or consumed gases under the piston are then free to issue by the orifices *g'* in the wall of the cylinder, the channel *g* and the valve *h* into the atmosphere. The working-piston thereupon descending displaces the residual or consumed gases and forces them out by the valve *h*. Nearly at the same time the pump forces fresh explosive mixture through the channel *x* into the localizing-space *c*. The current of the gaseous mixture is so directed that it will pass across the space *c* and impinge against the opposite wall of the same. It thereby loses its initial velocity and spreads out over the wall of the space. The screen *y*, however, prevents the current from diverging upward, and forces it to spread out downward and toward the sides. The cold gaseous mixture being, moreover, heavier than the hot residual gases, will thus, while displacing the

latter, be brought to a state of rest in the space *c*, or become localized in the same, without commingling to any greater extent with the hot gases floating above it than is unavoidable on account of the diffusion of the gases. In the measure as the fresh mixture is introduced into the cylinder, an equal volume of residual or consumed gases is thereby expelled through the exhaust-valve, until, when the working-piston is about at the middle of its inward or downward stroke, the said valve is closed. A distinct layer of residual gases is then inclosed between the piston and the explosive gaseous mixture. Hereafter a compression of the gases takes place, this compression being caused on one hand by the further descent of the working-piston, and on the other hand by the further introduction of fresh gaseous mixture from the pump, the piston whereof is also still descending. By this process the localization of the explosive charge is, however, not prejudiced. When the working-piston has arrived at the bottom end of its stroke, or soon after, the charge is set on fire by means of the igniting device *f*. By the combustion of the charge the neutral gases above the same are heated, and by the expansive force of the entire contents of the cylinder the working-piston is driven upward.

Fig. 4 shows a modification of the manner of introducing the current of gaseous mixture, the inlet-channel *x* being in this case extended to about the middle of the space *c* and bent downward at its end. By means of this arrangement, also, the impinging of the current of gaseous mixture against the wall of the space *c*, and the complete annihilation of its speed at the place where the localization is to be effected is attained.

The improved igniting device, which forms the second part of the invention, is shown by Fig. 5, with its movable parts in the position they occupy previous to the ignition of the charge, and by Fig. 6, with these parts in their position at the moment of the ignition. The apparatus consists, in the first place, of a fixed barrel, *i*, open at the bottom, and projecting with its lower part into the gaseous mixture to be ignited. By preference, it is inserted into the channel *x*, as shown by the drawings. This barrel has one or more lateral ports, *s*, opening out into the gaseous mixture, and another port, *p*, situated above the former, and by which a communication is established between its interior and the outer air. In front of the port *p* the permanent gas-jet *q* burns. In the lower part of the barrel there is a movable tube, *k*, the inside of which forms, at the bottom end, a cone, *o*, having at its apex a very small hole. The side of the tube is provided with apertures *r*, which, when the tube is in its lowest position, communicate with the port or ports *s*. In the upper part of the barrel *i* there is a plunger, *m*, constituting a valve and operated by any suitable means from the main shaft of the engine. When the said

plunger is depressed, it closes the port *p*, as shown in Fig. 6. When it is lifted, and the port *p* thereby opened, the gaseous mixture is admitted into the cylinder and compressed. The pressure of the gas, acting on the bottom of the tube *k*, raises the same and thus causes a closing of the apertures *r*. Simultaneously a small quantity of gas-mixture passes through the hole at the bottom of the tube into the interior thereof and ignites at the permanent jet of lighting-flame *q*. A small flame, fed with gas from the cylinder, will then continue to burn inside of the tube *k*. The plunger being hereupon depressed and the port *p* thereby closed, the tube *k* is cut off from communication with the atmosphere. The pressure inside of the same will therefore speedily become as great as on its outside, and this will cause it to drop into the position, Fig. 6. By preference, the tube is so arranged that upon the descent of the plunger the latter will strike against it, and thus accelerate its downward motion. The tube having come into its bottom position, its lateral apertures *r* are in register with the ports *s* of the barrel, and establish free communication between the inside of the tube and the inlet-channel *x*, or other part of the cylinder to which the igniting device is attached. This causes the mixture in the cylinder to take fire from the flame in the tube. In order to make the tube close tight on the outside when lifted it is provided below the apertures *r* with a shoulder, *l*, fitting in the manner of a valve against an offset, *l'*, arranged in the barrel *i* above the ports *s*. In a like manner the plunger *m* closes with its bottom edge, *n*, against an offset, *n'*, below the port *p*.

To the plunger *m* motion may with advantage be imparted by means of an eccentric, *j*, keyed on the main shaft of the engine and operating by its rod upon a cam, *t*, oscillating on a fixed pivot placed in the center line (or nearly so) of the barrel *i*, and at a right angle thereto. This cam, during the greater part of every oscillation, presses, by the medium of a bar, *t'*, and a roller pivoted thereto, against the plunger *m* and keeps it down on its seat *n'*. When, however, the recess *u* of the cam comes opposite to the said roller the pressure of the cam ceases and the plunger is lifted by the force of the two springs *v*. The position of the eccentric and the amplitude of oscillation of the cam are to be so determined, that the time during which the recess *u* is opposite to the roller of the rod *t'* corresponds nearly with the time from the closing of the exhaust-valve to the arrival of the working-piston at the bottom end of its course. At all events the arrangement is to be made in such a manner that the cam *t* will have pressed down the plunger *m* and thereby caused ignition when the working-piston has attained the end of its stroke, or soon after. The plunger *m* may, however, also be operated in other manner—for instance, by a cam keyed directly on the main shaft, or on an auxiliary shaft. Moreover, the ignition may be brought

about by known means, such as a slide-valve, a red-hot bar, or an electric spark.

For the purpose of regulating the speed of the engine an auxiliary chamber, *z*, which we have termed "receiver," is put in communication with the feed-pump and the cylinder by suitable channels, and in these channels valves are arranged which are controlled by the governor, and which, according to their position, operate to conduct the gaseous mixture from the feed-pump either to the cylinder or to the receiver. Figs. 7 and 8 show an arrangement for this purpose. K is a valve-box communicating by the channels *b'*, *c'*, and *d'*, respectively, with the pump, the receiver, and the cylinder. C is a valve adapted to close the channel *c'*, and D a valve by which the channel *d'* may be closed. These valves are connected to the ends of the double-armed lever B, operated upon by the centrifugal governor *w*, through the medium of suitable connections, such as shown in the drawings, and the crank A. When the speed of the engine is too great, the balls of the governor, flying out, will close the valve D of the cylinder-channel *d'*, and thereby cause the pump to force the gaseous mixture into the receiver, and to aspire therefrom. When, on the other hand, the speed decreases, the valve C closes, so that the entire quantity of mixture delivered by the pump is forced through the open channel *d'* into the cylinder. Considering that during the period of aspiration of the pump-piston the valves C and D are completely equilibrated, the regulation takes place without frictional resistance, excepting only the slight amount thereof arising in the stuffing-box of the lever-axle. The pump under this system of regulation always works with a uniformly-constituted gaseous mixture, which it aspires either through the mixing-valve *d* or from the receiver. A great certainty of ignition is hereby attained under the different conditions of the regulation.

Instead of two separate valves, a single valve with two faces may be employed, which, according as it is moved one way or the other, will close either of the two channels *c'* and *d'*, while it opens the other one. There are, however, besides these various other arrangements of valves and combinations of channels which will answer the same purpose, and, instead of the drop-valves shown, slide-valves or cocks may be used.

The part of the invention relating to the prevention of waste of oil required for lubricating the cylinder is shown by Fig. 9. E is the gas-cock of the engine, and G an oil-reservoir, from which oil is conducted through the cock F and the pipes H H to the two cylinders. The plugs of the cocks E and F are so connected by a rod, J, that both cocks will be opened and closed at the same time and by one operation. According to the relative position of the two cocks, the connection of the plugs of the same may be carried out in other manner—for instance, by means of levers, toothed

wheels, pulleys, or by a flexible shaft, as will easily be understood by any competent person. With this arrangement the lubricating of the cylinders begins with the working of the engine and stops when the engine is stopped, all waste of oil from the reservoir G during such stoppage being thus precluded.

Any novel subject-matter which we have described but not claimed in this application is hereby reserved to be claimed in future applications.

We claim as our invention—

1. In a gas-motor, the combination, with a working-cylinder, *a*, having exhaust-orifices *g'*, and a space, *c*, at the bottom, of a supply-pump, *b*, for the mixture of gas and air, arranged to supply a fresh gaseous mixture to the space *c* and the cylinder while the cylinder-piston is moving downward or inward, this mixture being compressed within the cylinder, together with a superposed layer of residual gases, after the exhaust-passages have been closed, substantially as hereinbefore described.

2. In a gas-engine, the combination, with a main cylinder having at one end a space, *c*, with curved walls, of an inlet-channel arranged to direct the current of the mixture of gas and air against said curved walls, whereby it is localized in said space *c*, as set forth.

3. The combination, with the cylinder *a*, of a space, *c*, of hemispherical or spheroidal form, and having a flange, *y*, as and for the purpose set forth.

4. In the described gas-motor, the igniting apparatus consisting of the barrel *i*, having valve-seats *l'* and *n'*, port *p*, with lighting-flame *q*, and communicating by a port or ports, *s*, and by its open bottom end with the gas-mixture to be ignited, in combination with the tube *k*, having conical bore *o*, and having ports *r*, hole *o'*, and valve-surface *l*, and with the valve *m*, operated from the main shaft of the motor, substantially as and for the purpose specified.

5. In combination with the valve *m* of the described igniting apparatus, the oscillating cam *t*, operated from the main shaft and actuating the said valve, as hereinbefore set forth.

6. The combination, with the piston *a* and the pump *b*, of a receiver, *z*, and of channels connecting the pump with the cylinder and the receiver, together with a valve or valves controlled by the governor of the engine, and operating to close either the channel from the pump to the receiver or the one from the pump to the cylinder, substantially as and for the purpose stated.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

ERNST KÖRTING.
GEORG LIECKFELD.

Witnesses:

WILLIAM C. FOX,
JOHS. KRACKE.