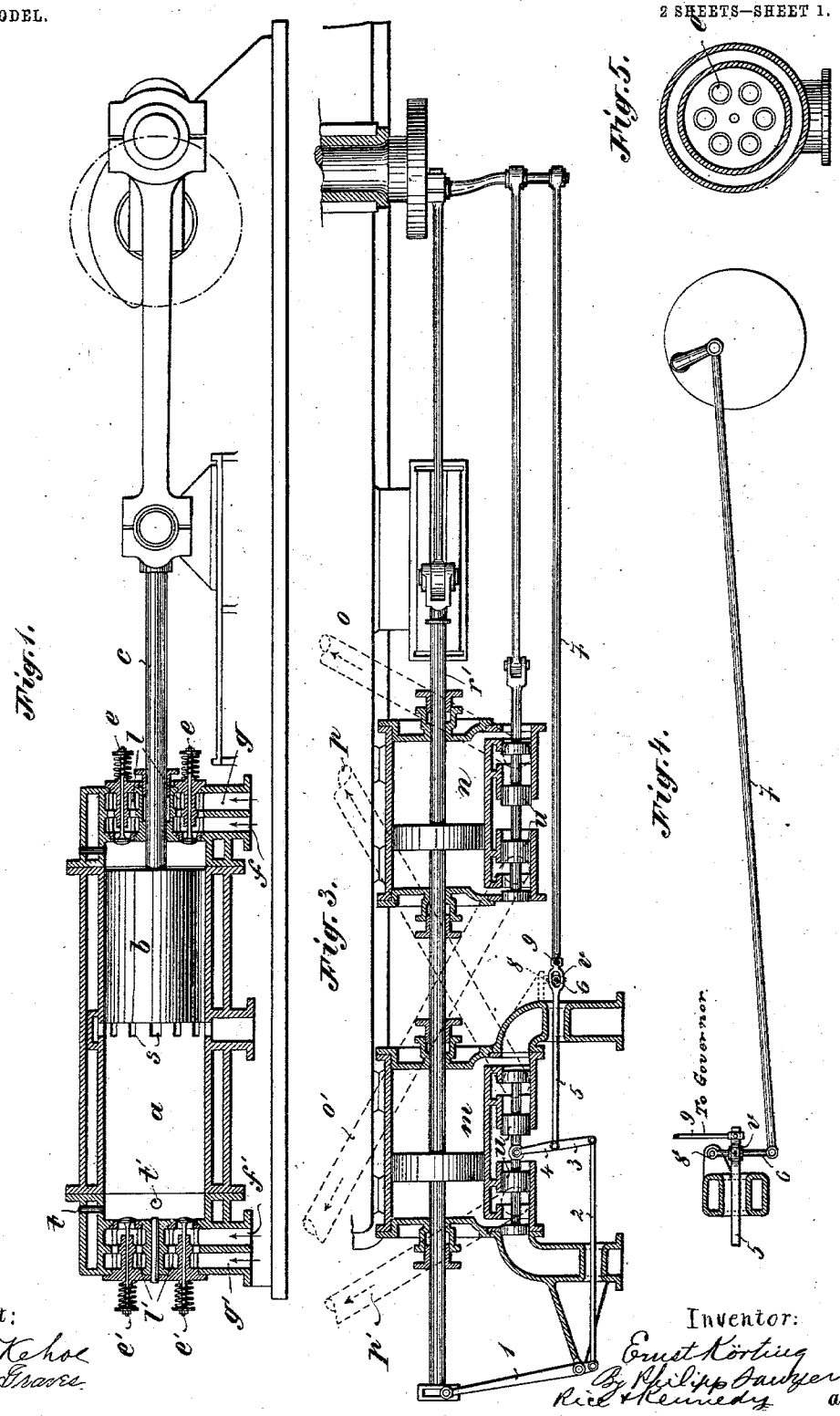
No. 748,959. PATENTED JAN. 5, 1904.

E. KÖRTING.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED FEB. 28, 1902.

NO MODEL. 2 SHEETS—SHEET 1.



Attest:
P. G. Kehoe
J. A. Graves.

Inventor:
Ernst Körting
By Philipp Bachzer
Rice & Kennedy
Attys

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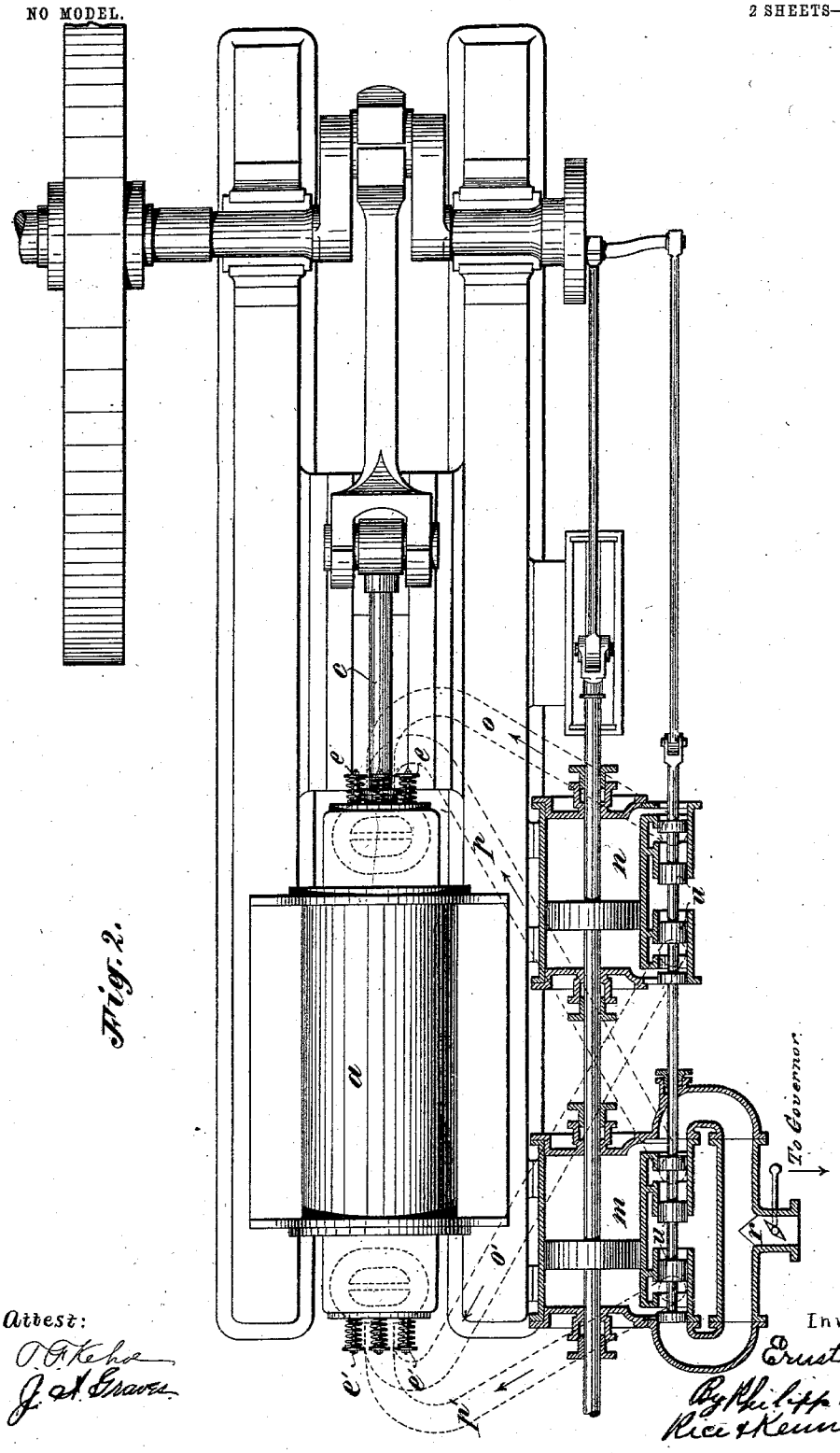

Fig. 2.

Attest:
T. G. Kehoe
J. A. Graves

Inventor:
Ernest Körting
By Philipp Sawyer
Rice & Kennedy Attys.

No. 748,959. Patented January 5, 1904.

UNITED STATES PATENT OFFICE.

ERNST KÖRTING, OF KÖRTINGSDORF, NEAR HANOVER, GERMANY.

INTERNAL-COMBUSTION ENGINE.

SPECIFICATION forming part of Letters Patent No. 748,959, dated January 5, 1904.

Application filed February 28, 1902. Serial No. 96,036. (No model.)

To all whom it may concern:

Be it known that I, ERNST KÖRTING, engineer, of Körtingsdorf, near Hanover, Prussia, German Empire, have invented certain new and useful Improvements in or Appertaining to Internal-Combustion Engines, of which the following is a specification.

This invention relates to improvements in or appertaining to internal-combustion engines in which the charge introduced into the cylinders by special devices at the end of the outward or at the beginning of the inward stroke sweeps away the residues of combustion of the preceding power-stroke. According to the present invention the charge is as it enters the cylinder given a whirling and rolling motion more or less at right angles to the axis of the cylinder, and this in such a manner that the charge is as far as practicable maintained in a coherent mass and is prevented from radiating and becoming mixed with the residues of the previous power-stroke. In such an engine it is, however, absolutely necessary that a layer or stratum of inert gas (air) should be located between the still glowing residues of the previous explosion and the new charge, so that the latter does not ignite by contact with the said residues. It is also necessary to provide special means whereby the quantity of the charge may be altered without affecting its location and relation to the air and residues or altering its composition whenever the load on the engine varies. It is also desirable to provide a valve mechanism for the admission of the charge into the cylinder which acts at very short intervals of time and as noiselessly as possible, and, finally, a special device is requisite by means of which the combustible charge which in these engines varies in volume according to the load is made to burn completely and with sufficient rapidity.

In order to impart a whirling and rolling motion to the new charge, which motion is necessary for separating the same from the residues of the previous power-stroke, I provide a number of flat disk-shaped puppet-valves with axial motion in the bottom of the combustion-chamber. The current of gas entering through each valve is caused by the disk to assume the form of an annular jet at right angles to the axis of the cylinder. All these jets impinge against one another and against the walls of the cylinder, in consequence of which the required motion is obtained. For bringing the necessary layer of inert gas (air) between the residues and the explosive charge I use two pumps which have equal strokes. One of these pumps delivers the air and the other supplies the combustible gas, the ratio of the piston areas being equal (or nearly so) to that of the quantities of air and gas to be admitted. The gas-pump is fitted with a device which is so contrived that the piston after having accomplished a certain portion of its "instroke" commences to compress the gas in the cylinder of the pump and continues the compression during the remaining portion of the instroke. The air-pump, on the contrary, compresses the air contained in its cylinder from the very beginning of the instroke. The delayed compression of the gas in the pump is effected either by throttling the gas-inlet during the suction-stroke of the pump-piston or by establishing during the required portion of the stroke a communication between the suction and pressure chambers. The air-pump therefore forces first air alone into the engine-cylinder and as soon as the gas-pump begins to coöperate both pumps force into the said cylinder gas and air in the ratio of their piston areas, so that the mixture in the required proportions is formed at the entrance into the cylinder. Owing to the above-described construction of the inlet this mixture is as far as practicable kept separated from the air that precedes it, while at the same time and for the same reason this air is as far as possible prevented from mixing with the residues of the previous power-stroke. For obtaining a variable quantity of the gaseous mixture having a constant composition the governor is connected either with the aforementioned throttle-valve in such a manner that when the load decreases the gas-inlet is throttled during the suction-stroke of the gas-pump or the governor is connected to the device which establishes the communication between the suction and delivery chambers of the said pump in such a manner that when the load decreases the said communication remains open for a longer time. The inlet-valves in

the form of puppet-valves are self-acting valves and admit the air and gas into the engine-cylinder, while the closing is effected automatically through the action of springs.

For securing a regular ignition of a charge which is at one time large and at another small a number of igniters is provided. One of these igniters is located in proximity to the inlet-valve, while the other is near the limit of the piston-instroke.

The invention is best understood by reference to the accompanying drawings, in which—

Figure 1 is a longitudinal section of a double-acting gas-engine fitted with the hereinbefore-described improvements. This figure is diagrammatic as regards the parts of the engine which do not affect the invention. Fig. 2 is a plan of the engine partly in section. Fig. 3 is a horizontal section of a modified construction for controlling the action of the gas-pump. Fig. 4 is a detail of parts shown in Fig. 3; Fig. 5, a vertical cross-section through the working cylinder.

In the drawings, *a* is the working cylinder of the gas-engine, *b* the piston, and *c* the piston-rod. The periphery of the middle part of the cylinder is provided with a plurality of exhaust-ports *s*, that open into a passage connected to the exhaust-pipe. The air is supplied to the valve-chambers *l* and *l'* by the air-pump *n* through pipes *o* and *o'* and openings *f* and *f'*, while the gas is delivered by gas-pump *m* through pipes *p* and *p'* and openings *g* and *g'* to said valve-chambers. *r* is the throttling-valve, disposed in the gas-supply pipe and actuated by the governor. The charge is introduced at the cylinder-head through a plurality of valves *e* and *e'*, arranged in a circle, whereby the described internal motion of the particles of the entering gas by the impinging of the annular gas streams against one another is also obtained.

The operation of the engine is as follows: As soon as the working piston *b* uncovers the ports *s* the burnt charge escapes and the compressed contents of pipes *o'* and *p'* pass through the valve-chamber *l'*, in which the mingling of the gases takes place, and then enter the combustion-chamber through the valves *e'*, which open automatically when the pressure in the valve-chamber is sufficiently greater than the pressure in the combustion-chamber to move the valves against their springs. The action of the pumps is so regulated that their pistons are in or near the dead-points of their inward stroke when the engine-piston covers again the ports *s* on beginning its instroke. The whole of the compressed charge must, therefore, be delivered into the combustion-chamber during the short time the ports *s* remain uncovered, and at the same time the products of combustion must be swept out of the cylinder. The piston of the gas-pump begins to discharge the gas into the pipe *e'* only after part of its instroke has already been achieved, whereas the piston of the air-pump discharges the air into the discharge-pipe *o'* from the very beginning of its instroke. The inlet-valves *e'* will be closed when the two pump-pistons commence their instrokes, and since the discharge-pipes of the two pumps are in communication with each other through the valve-chamber *l'* part of the compressed air will enter through said chamber into the pipe *p'*, pushing the gas in the pipe backward and simultaneously compressing it until the piston of the gas-pump also begins to discharge. From this moment both pumps act to compress, the pipe *p'*, however, remaining partly filled with pure air. Then when the valves *e'* open both pipes *o'* and *p'* discharge their contents through the valves *e'* into the cylinder. These contents are pure air, to begin with, until the pipe *p'* is emptied so far that the pushed-back gas reaches the valves, whereupon the gas and air together enter the valve-chamber *l'*, and after being mixed therein pass through the valves *e'* into the combustion-chamber. As soon as both pump-pistons reach the end of their stroke valves *e'* close automatically under the action of their springs. The gas particles passing through valves *e'* impinge against one another and so form a layer of gas which rolls and whirls on itself, more or less, at right angles to the axis of the cylinder as it advances. This body of gas, consisting, first, of a stratum of pure air and then of a combustible gaseous mixture, sweeps the residues of the previous explosion through the aforesaid ports *s*. The charge is then compressed by the instroke of the piston and ignited by the igniters *t* and *t'*. While these operations take place on the one side of the piston, the other side of the same accomplishes its power-stroke, followed again by the working phases just described. The governor acts, as already stated, on the throttling-valve *r*, so as to decrease the free area for the passage of the gas as soon as the load on the engine decreases. By this means both the quantity of gas supplied by the gas-pump and that of the combustible mixture are decreased.

Figs. 3 and 4 illustrate a modified device for commencing the compressing of the gas in the gas-pump after the piston of this pump has accomplished a portion of its stroke, and consists of means for establishing during the required portion of the stroke a communication between the suction and the pressure chambers. The distributing-valves *u* are operated by the combined action of two crank movements and regulated by the governor-rod. For this purpose the two-armed lever 3 4 of the valve mechanism is connected by means of the rod 2 and a two-armed lever 1 to the piston-rod *r'*, which receives its reciprocating motion from a crank, the second crank movement being imparted to the valves *u* by a reciprocating rod 7. The movement of rod 7 is transmitted to the two-armed lever 3 4 by a link 6, swinging around a fixed point

8 and provided with a slide-block *v*, which is attached to the rod 5, connected with the two-armed lever 3 4, the end of the rod 5 being connected with the governor-rod 9. When this block is near the point 8 around which the link swings, the motion of the link has no effect on the distributing-valve, and this valve is actuated by the piston-rod alone. In this position the communication between the suction and pressure spaces is kept open for a period of the stroke that corresponds to the minimum of power required from the engine. If now the block is moved to the other end of the link, the reciprocating movement of the link 6 exerts its full action, and the valve keeps the aforesaid communication open during a smaller portion of the stroke of the gas-pump, so that the pump can then deliver the maximum quantity of gas. Each intermediate position of the block corresponds to a different rate of admission in the pump. The rod 5, on which the slide-block is arranged, is so connected to the governor that when the power to be exerted is small the block comes nearer the point around which the link oscillates, and vice versa.

What I claim, and desire to secure by Letters Patent of the United States, is—

1. In an internal-combustion engine the combination of a cylinder having an exhaust-port located at or near the point of the end of the power-stroke of the piston, a combustion-chamber located at the end of the cylinder from which the piston makes its power-stroke, a plurality of inlet-openings in the head of the combustion-chamber, and puppet-valves for controlling the passage of the charge through said inlet-openings and acting to impart a whirling and rolling motion to the charge as it enters the combustion-chamber, whereby the charge is caused to advance in a body through the combustion-chamber and the cylinder without diffusion with other gas, substantially as described.

2. In an internal-combustion engine the combination of a cylinder having an exhaust-port located at or near the point of the end of the power-stroke of the piston, a combustion-chamber located at the end of the cylinder from which the piston makes its power-stroke, a mixing-chamber, a pump for supplying air to the mixing-chamber, a pump for supplying gas to the mixing-chamber, a plurality of inlet-openings in the head of the combustion-chamber leading from the mixing-chamber to the combustion-chamber, and puppet-valves controlling the passage of the charge through said openings and acting to impart a whirling and rolling motion to the charge as it enters the combustion-chamber, whereby the charge is caused to advance in a body through the combustion-chamber and the cylinder, without diffusion with other gas, substantially as described.

3. In an internal-combustion engine, the combination with a cylinder having an exhaust-port located at or near the point of the end of the power-stroke of the piston, of a combustion-chamber located at the end of the cylinder from which the piston makes its power-stroke, a plurality of inlet-openings in the head of the combustion-chamber, and means for deflecting the charge as it enters through said openings, to impart a whirling and rolling motion to the charge as it enters the combustion-chamber, whereby the charge is caused to advance in a body through the combustion-chamber and the cylinder without diffusion with other gas, substantially as described.

4. In an internal-combustion engine the combination with a cylinder having an exhaust-port located at or near the point of the end of the power-stroke of the piston, of a combustion-chamber located at the end of the cylinder from which the piston makes its power-stroke, a plurality of inlet-openings through the head of the combustion-chamber, means for introducing a charge of inert gas (as air) before the introduction of the charge of explosive gas for the purpose of separating the explosive gas from the residues of the previous explosion, and means for deflecting the charges of inert gas and explosive gas as they enter the combustion-chamber through said openings to impart a whirling and rolling motion to said charges, whereby they are caused to advance bodily through the combustion-chamber and the cylinder without diffusion, substantially as described.

5. In an internal-combustion engine the combination of a cylinder having an exhaust-port located at or near the point of the end of the power-stroke of the piston, a combustion-chamber located at the end of the cylinder from which the piston makes its power-stroke, a mixing-chamber, a pump for supplying air to the mixing-chamber, a pump for supplying gas to the mixing-chamber, a plurality of inlet-openings in the head of the combustion-chamber leading from the mixing-chamber to the combustion-chamber, puppet-valves controlling the passage of the charge through said openings and acting to impart a whirling and rolling motion to the charge as it enters the combustion-chamber, whereby the charge is caused to advance in a body through the combustion-chamber and the cylinder without diffusion with other gas, and means for automatically controlling the quantity of gas pumped by the gas-pump to maintain an even speed of the engine, substantially as described.

6. In an internal-combustion engine, the combination with a cylinder having an exhaust-port located at or near the point of the end of the power-stroke of the piston, of a combustion-chamber located at the end of the cylinder from which the piston makes its power-stroke, a plurality of inlet-openings in the head of the combustion-chamber, means for deflecting the charge as it enters through said openings, to impart a whirling and rolling motion to the charge as it enters the com-

bustion-chamber, whereby the charge is caused to advance in a body through the combustion-chamber and the cylinder without diffusion with other gas, a mixing-chamber communicating with said inlet-openings, a pump for air, a pump for gas, and means for establishing communication between the suction-pipe and the pressure side of the cylinder of the gas-pump during a part of each compression-stroke of the pump-piston and closing during such time communication between the pump-cylinder and its discharge-pipe, substantially as described.

7. In an internal-combustion engine, the combination with a cylinder having an exhaust-port located at or near the point of the end of the power-stroke of the piston, of a combustion-chamber located at the end of the cylinder from which the piston makes its power-stroke, a plurality of inlet-openings in the head of the combustion-chamber, means for deflecting the charge as it enters through said openings, to impart a whirling and rolling motion to the charge as it enters the combustion-chamber, whereby the charge is caused to advance in a body through the combustion-chamber and the cylinder without diffusion with other gas, a mixing-chamber communicating with said inlet-openings, a pump for air, a pump for gas, distribution-valves for the gas-pump actuated by the combined action of two crank movements, and means, controlled by the governor, for regulating the movement imparted to said valves for controlling the quantity of gas supplied to the combustion-chamber, substantially as described.

8. In an internal-combustion engine, the combination with a cylinder having an exhaust-port located at or near the point of the end of the power-stroke of the piston, of a combustion-chamber located at the end of the cylinder from which the piston makes its power-stroke, a plurality of inlet-openings in the head of the combustion-chamber, means for deflecting the charge as it enters through said openings, to impart a whirling and rolling motion to the charge as it enters the combustion-chamber, whereby the charge is caused to advance in a body through the combustion-chamber and the cylinder without diffusion with other gas, distribution-valves, and two or more igniters in the combustion-chamber for securing a regular ignition, substantially as described.

9. In an internal-combustion engine the combination of a cylinder having an exhaust-port located at or near the point of the end of the power-stroke of the piston, a combustion-chamber located at the end of the cylinder from which the piston makes its power-stroke, a plurality of inlet-openings arranged in a circle in the head of the combustion-chamber, and puppet-valves for controlling the passage of the charge through said inlet-openings and acting to impart a whirling and rolling motion to the charge as it enters the combustion-chamber, whereby the charge is caused to advance in a body through the combustion-chamber and the cylinder without diffusion with other gas, substantially as described.

ERNST KÖRTING.

Witnesses:
LEONORE RASCH,
C. C. STEVENSON.