(No Model.) 2 Sheets—Sheet 1.

E. KÖRTING.

REGULATOR FOR GAS ENGINES.

No. 346,374. Patented July 27, 1886.

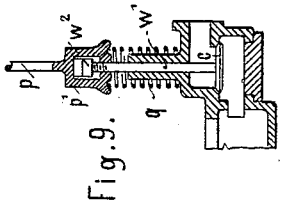


Fig. 9.

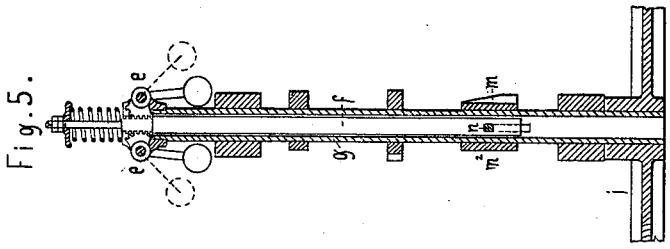
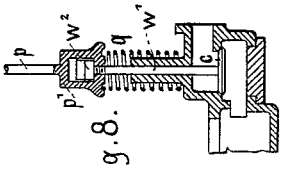


Fig. 5.



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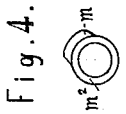

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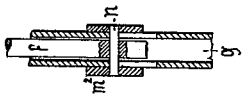

Fig. 3.

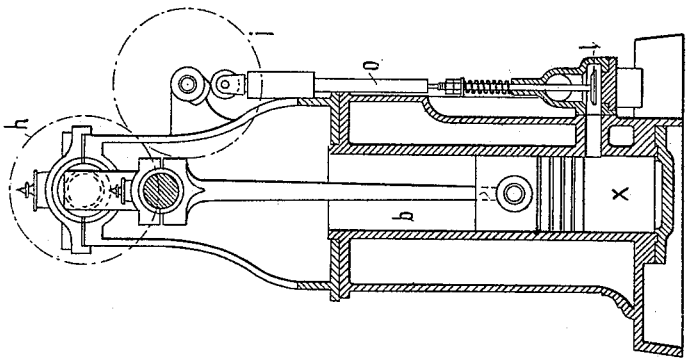

Fig. 2.

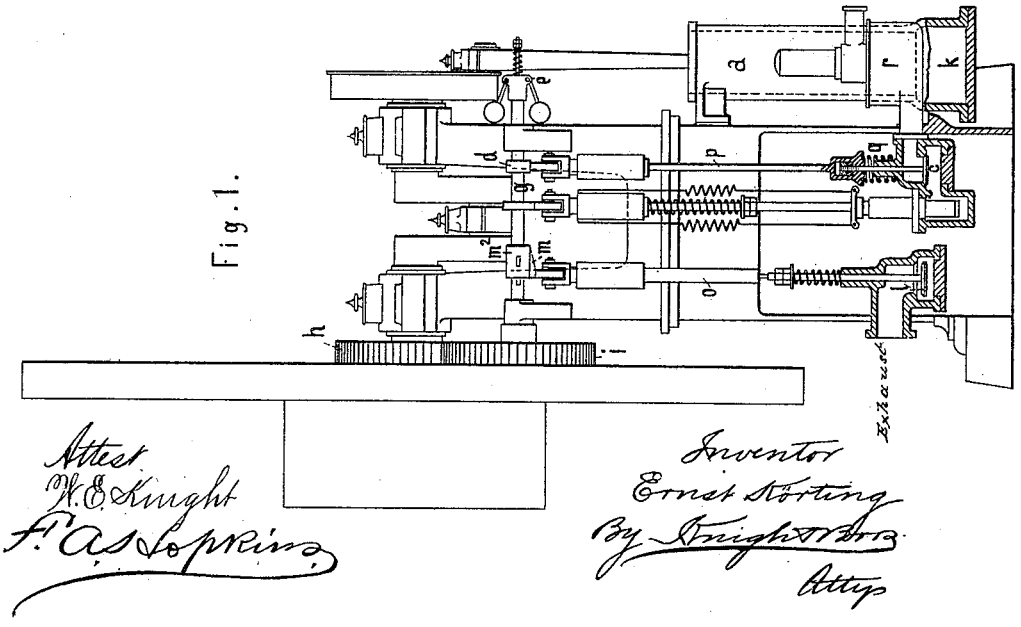

Fig. 1.

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(No Model.) 2 Sheets—Sheet 2.

E. KÖRTING.

REGULATOR FOR GAS ENGINES.

No. 346,374. Patented July 27, 1886.

Fig. 11.

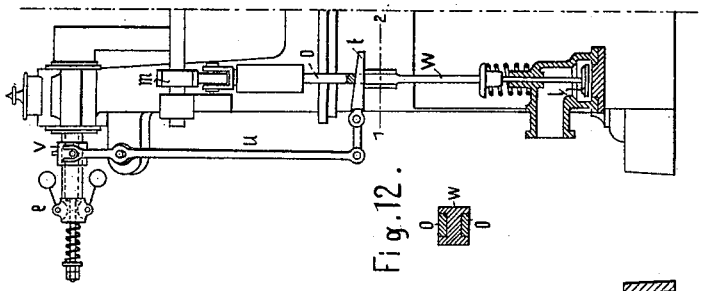


Fig. 12.

Fig. 10.

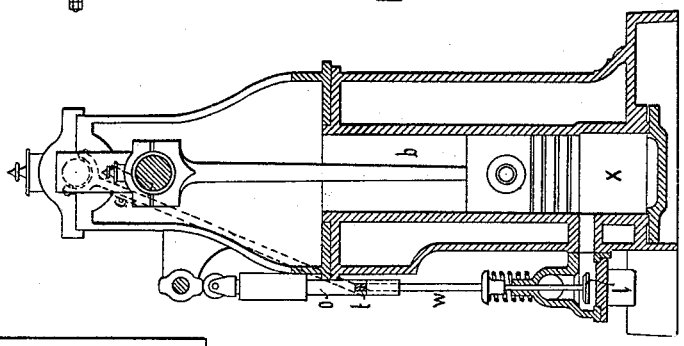


Fig. 7.

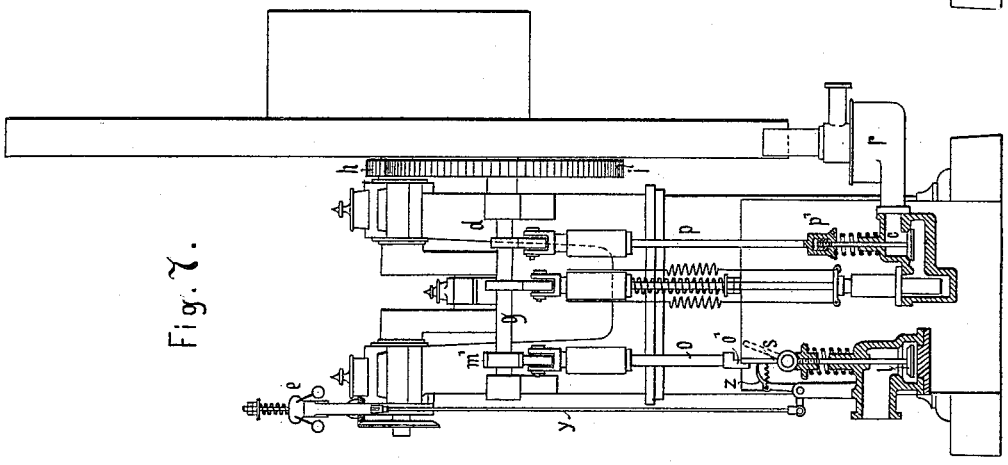
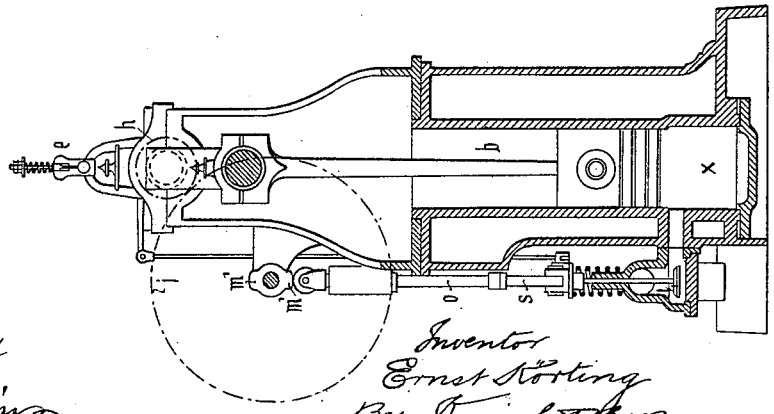


Fig. 6.



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F. A. Hopkins.

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UNITED STATES PATENT OFFICE.

ERNST KÖRTING, OF HANOVER, PRUSSIA, GERMANY.

REGULATOR FOR GAS-ENGINES.

SPECIFICATION forming part of Letters Patent No. 346,374, dated July 27, 1886.

Application filed March 10, 1886. Serial No. 194,741. (No model.) Patented in France June 26, 1885, No. 169,801, and in Belgium June 26, 1885, No. 69,410.

To all whom it may concern:

Be it known that I, ERNST KÖRTING, engineer, a subject of the King of Prussia, and residing in Hanover, Kingdom of Prussia, German Empire, have invented new and useful Improvements in the Regulation of Gas-Motors, (for which I have obtained Letters Patent in France, June 26, 1885, No. 169,801, and in Belgium, June 26, 1885, No. 69,410,) of which the following is a specification.

My invention relates to the regulation of the power of gas-motors working by the explosive combustion of a compressed gas-mixture; and it consists in the method of and means for controlling, by the governor, the quantity of combustion-gas exhausted from the cylinder, and thereby determining the amount of fresh gas-mixture for the next operative stroke, so that, according as more or less combustion-gas is allowed to escape, the amount of fresh gas-mixture entering into the cylinder will be greater or smaller.

The invention also comprises a particular construction of the connections of the governor with the parts controlling the operation of the exhaust-valve, and an improvement in the mechanism for controlling the valve for the inlet of fresh gas-mixture into the cylinder.

On the annexed two sheets of drawings two different gas-motors are represented to which my invention is applied.

Figure 1 is an elevation, partly in section, and Fig. 2 a transverse section, of a gas-motor with compressing-pump. Figs. 3, 4, and 5 are details thereof. Fig. 6 is a transverse section, and Fig. 7 an elevation, partly in section, of a gas-motor in which the explosive gas-mixture is compressed exclusively within the power-cylinder. Figs. 8 and 9 represent, to a larger scale and with different positions of parts, the mechanism for controlling the inlet-valve for gas-mixture. Fig. 10 is a transverse section, and Fig. 11 a portion of the sectional elevation, of the same motor as the one shown by Figs. 6 and 7, but with different construction of the parts connecting the governor with the gear which actuates the exhaust-valve. Fig. 12 is a section on line 1 2 of Figs. 10 and 11.

The gas-motors to which my invention is applicable require either to be provided with a pump for supplying gas-mixture to the cylinder, or the latter has to operate during the alternate strokes of the piston as pump and as power cylinder. Besides, the cylinder, as well as the pump, (if any is used,) must each be connected with, or have at its bottom, a space or chamber adapted to contain the compressed gases when the respective pistons are at the end of their inward stroke, and which shall be called "compression-space." The fresh gas-mixture is so introduced into the compression-space of the cylinder that it will substantially remain at the bottom thereof, while the combustion gases issue through an exhaust-port, being above the volume of fresh gases. In case the motor is fed with gas-mixture by a pump, the introduction of explosive mixture and the exhaust of combustion-gases takes place at every inward stroke of the pistons. Preferably the motor is so arranged that while it works at full power the exhaust-valve is closed at about half-stroke of the pistons, the closing of the valve consequently taking place at an earlier period when the power to be produced is less. So long as the exhaust-valve is open combustion-gases issue and fresh gas-mixture passes over from the pump through an inlet-valve box into the cylinder. Upon the closing of the exhaust-valve the piston of the cylinder compresses within the space at its bottom the remaining combustion-gases as well as the fresh gas-mixture having entered thereinto. The gas-pressure thus produced prevents further influx of gas-mixture from the pump, which then compresses within its own compression-space the gases still contained therein at the time. When, during the outward stroke of the pistons, (the inlet-valve of the cylinder being closed,) the gases in the pump have re-expanded to atmospheric pressure, an additional portion of fresh gas-mixture will be drawn in by the pump, this portion being equal to the amount discharged from the pump into the cylinder at the preceding inward stroke, and consequently dependent upon the quantity of combustion-gas which had been allowed to escape from the cylinder. Thus the power of the engine is regulated by the regulation of the exhaust-valve.

Instead of causing the exhaust-valve to open

but for a very short time, it may be kept closed altogether for one or more strokes of the piston, the engine under these conditions absorbing power instead of producing it. If the engine is so arranged that the cylinder works alternately as pump and as power-cylinder the exhaust-valve is of course opened at every alternate inward stroke of the piston only, and when the engine is to develop its full power the valve is preferably opened during the whole period of this stroke. The mode of regulation is, however, alike to that described.

In Figs. 1 and 2 of the drawings, *a* is the pump; *k*, the compression-space of the same; *b*, the power-cylinder with the compression-space *x*; *r*, the box containing the valves for admission of gas and air to the pump; *c*, the valve for inlet of gas-mixture from the pump to the cylinder, and *l* the exhaust-valve. The valve *l* is operated by means of a cam, *m*, rotating with the shaft *g*, which is connected to the main shaft by the spur-wheels *h* and *i*, the said cam *m* actuating the valve by means of a rod, *o*, which is pressed upward against the cam by a spring.

For the purpose of causing a variation of the length of time during which the valve is kept open, the cam *m* is made integral with a sleeve, m^2, arranged to be shifted lengthwise on the shaft *g* by the governor *e*, and it is constructed of tapering form, so that according to the position of the sleeve m^2 a broader or a narrower portion of the cam will be brought opposite to the roller at the end of the rod *o*. The cam may be tapered in a continuous line or stepwise.

The construction of the parts for shifting the sleeve m^2 preferably consists in placing the governor *e* at the end of the shaft *g*, which is made hollow (see Figs. 3 and 5) in connecting the arms of the governor-balls by toothed sectors to a rod, *f*, inserted into the shaft *g*, and in fixing the sleeve m^2 to the rod *f* by a pin, *n*, passing through slots in the shaft *g*.

In the engine represented by Figs. 6 and 7, the piston of the power-cylinder draws in the explosive gas-mixture during the first outstroke and compresses it during the following instroke. Ignition having then taken place, the piston is propelled outward by the pressure of the combustion-gases during the second outstroke, and, by the instroke following thereupon, the said gases are expelled.

The device shown in combination with this engine for controlling the operation of the exhaust-valve *l* consists in a jack or pawl, *s*, pivoted to the stem of the valve, and the angular position of which is determined by the governor *e*, through the medium of the rod *y* and the bell-crank lever *z*, or by other suitable intermediate gear. According to the position imparted to the said jack, it is either acted upon endwise by one of the steps *o'* at the end of the rod *o*, operated by the cam or cams *m'*, (which are fixed to the shaft *g*,) so that in this case the valve *l* will be opened for a longer or a shorter period, or it is not acted upon at all, (see the position shown in dotted lines,) the valve then remaining closed.

The means shown in Figs. 10 and 11 for controlling the exhaust-valve consist in a wedge, *t*, inserted between the valve-stem *w* and the rod *o*, and so connected to the governor that, when the speed of the engine becomes less, the wedge will be pushed with a thicker portion between the stem *w* and the rod *o*, and the valve *l* will be kept open for a longer period, whereas when the speed becomes greater the wedge, in being drawn back more or less, will present a thinner portion to the action of the rod *o*, and cause the valve to be closed sooner.

The connection between the governor and the wedge *t* may be established by a sliding sleeve, *v*, operated in like manner by the governor-balls as the sleeve m^2 and a lever, *a*.

In respect to the construction of the rod *o* and stem *w*, it may, besides, be observed that in the drawings the rod *o*, forked at the lower end, is supposed to slide with its branches between ledges on the flat upper end of the stem *w*, and that the said branches at the same time form a guide for the wedge *t*. (See also Fig. 12.)

The described valve-controlling devices may be used indiscriminately with either of the two systems of gas-motors represented by the drawings.

In gas-motors having a pump for supplying fresh gas-mixture, and in which the gases are compressed in the cylinder as well as in the pump, means have to be provided by which the inlet-valve *c* inserted between the cylinder and the pump is securely closed before the charge is ignited, but which during the downward stroke of the pistons allow the valve to open and close by the pressures acting on its surfaces. For this purpose the stem *w'* of the valve *c* is so combined with a rod, *p*, operated by a cam, *d*, and with a spring, *q*, that, when the rod *p* is pushed downward by the cam, the spring *q* will be compressed, and the valve-stem *w'* left free to move up and down relatively to the rod *p*, whereas when the cam releases the rod the spring will push the rod upward, and at the same time act upon the stem *w'*, so as to press the valve against its seat. The requisite sliding connection between the stem *w'*, and the rod *p* may be obtained by forming the lower end of *p* with a stirrup, *p'*, having a central hole at the bottom in passing the stem *w'* through this hole, and in fixing to the end of the same a head, w^2, (preferably consisting in two nuts,) which is of such height that it may move up and down within the stirrup when being depressed, whereas when the stirrup is pressed upward it bears from below against the head w^2, and thus keeps the valve closed.

The same arrangement may be employed in engines the cylinder whereof works alternately as pump and as power-cylinder, the

valve in this case controlling the communication between the cylinder and the supply-channel for gas-mixture.

I claim as my invention—

1. In a gas-motor, the combination, with the exhaust-valve *l*, having the stem *w*, rod *o*, operated by the cam or cams *m*, and governor *e*, of a wedge, *t*, inserted between the stem *w*, and the rod *o*, and parts connecting the wedge to the governor, substantially as and for the purpose set forth.

2. In a gas-motor regulated by means of the exhaust-valve, the combination, with a hollow shaft, and a governor, *e*, mounted thereon, of a bar, *f*, inserted into the shaft, and connected to the arms of the governor, so as to be moved by the same longitudinally, a sleeve sliding on the said shaft and fixed to the rod *f* by a pin passing through slots in the shaft, and means for controlling by the displacement of the sleeve the time during which the exhaust-valve remains open, substantially as hereinbefore specified.

3. In a gas-motor regulated by means of the exhaust-valve, the combination, with the inlet-valve *c*, of a bar, *p*, operated by a cam or cams, *d*, and spring *q*, and provided with stirrup *p'*, and the stem *w'* of the valve *c* being provided at its end extending into the stirrup with a head, w^2, substantially as described.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

ERNST KÖRTING.

Witnesses:

ALFRED A. WHITMAN,

C. BORNGRAEBER.