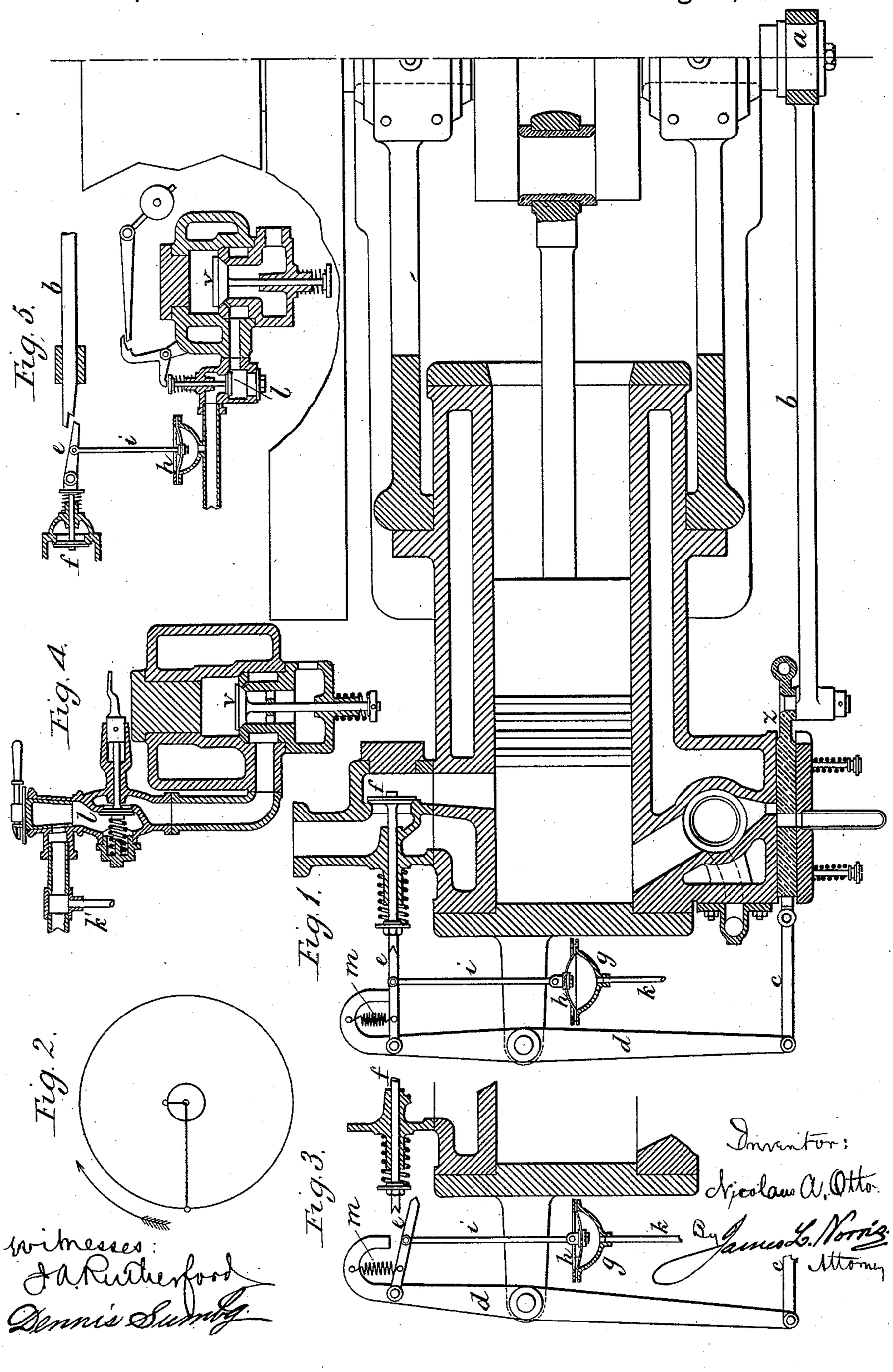
(No Model.)

N. A. OTTO.

GAS OR OIL MOTOR ENGINE.

No. 433,812. Patented Aug. 5, 1890.



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NICOLAUS AUGUST OTTO, OF COLOGNE, ASSIGNOR TO THE GAS-MOTOREN-FABRIK-DEUTZ, OF KÖLN-DEUTZ, GERMANY.

GAS OR OIL MOTOR ENGINE.

SPECIFICATION forming part of Letters Patent No. 433,812, dated August 5, 1890.

Application filed May 7, 1890. Serial No. 350,911. (No model.) Patented in Belgium, April 5, 1890, No. 90,095, and in Italy, April 29, 1890, LIII, 332.

To all whom it may concern:

Be it known that I, NICOLAUS AUGUST OTTO, a citizen of Prussia, residing at Cologne, in the Empire of Germany, have invented new and useful Improvements in Gas or Oil Motor Engines, (for which I have obtained Letters Patent in Belgium dated April 5, 1890, No. 90,095; in Italy dated April 29, 1890, Vol. LIII, 332; in Belgium by Patent of Addition dated April 18, 1890, No. 90,228, and in Italy by Patent of Addition dated May 7, 1890, Vol. LIII, 390,) of which the following is a specification.

My invention relates to a method of and apparatus for working the valve-gear of four-stroke-cycle gas or oil motor engines described in application filed by me April 21, 1890, Serial No. 348,894, whereby the use of a counter-shaft driven at half the speed of the engine-shaft was dispensed with. For this purpose an apparatus was employed which I will describe with reference to the accompanying drawings, in which—

Figure 1 shows a longitudinal section of a gas-motor engine; Fig. 2, a diagram of the crank motion, and Fig. 3 a view of the valve-gear in a different position; Fig. 4, a section through the gas and air supply valves. Fig. 5 shows a modified arrangement.

The crank-shaft of the engine, Fig. 1, has an eccentric *a* or a crank, which is placed at an angle of ninety degrees to the engine-crank, as at Fig. 2, and from which by means of a rod *b*, an igniting-slide *z* is actuated. The igniting device is here assumed to be a heated tube; but any other known igniting device may be used. A double-ended lever *d* is connected at its one end by a link *c* to the slide *z*, so as to have a to-and-fro motion imparted to it thereby, and to the other end of the lever is pivoted a rod or pawl *e*. According to the position given to this rod it will either be made to force open the discharge-valve *f* by bearing against the notched end of its stem during the forward motion of that end of lever *d*, or it will miss the end of the valve-stem when brought into the position shown at Fig. 3, and thus allow the valve to remain closed. This shifting of the rod *e* is effected in the present case by the apparatus *g*, consisting of a hollow vessel or cup closed by an elastic or flexible diaphragm *h*, which is connected by a link *i* to the rod *e*. In my said other application the cup *g* was made to communicate by a pipe *k* either with the air-supply or with the gas-passage on the cylinder side of the gas-valve *l*, and the apparatus operated as follows:

Assuming the engine to be in regular working, the gas-valve *l* being either opened by a known governor arrangement at each forward motion of the piston or being always in the open position and only closed when no explosive mixture is to be drawn into the cylinder, the admission of gas and air to the cylinder being controlled by the valve *v* in the well-known manner, when an explosive charge is drawn into the cylinder by the forward motion of the piston, there will exist in the cylinder and in the gas and air supply pipes a pressure below that of the atmosphere, and this reduced pressure will be transmitted through pipe *k* to the cup *g*. In consequence hereof the diaphragm *h* will be moved inward by the excess of external atmospheric pressure, and the rod *e* will be drawn thereby into the position shown at Fig. 3. On the following inward motion of the piston, during which the slide *z* will be moved to the left hand, the rod *e*, in moving forward with the end of the lever, will consequently miss the stem of the valve *f*, and will move past the same, as indicated. Consequently the discharge-valve will remain closed, and the cylinder charge will be compressed. At the following forward stroke of the piston the explosion and expansion of the gases will take place. At the ensuing inward stroke the slide *z* will again move to the left hand. In the meantime the pressure within the cup *g* will have become equal to the atmosphere, so that the spring *m*, which acts upon the rod *e*, will draw the latter back into the position shown at Fig. 1, so that on the forward motion of the lever *d* the rod *e* will force open the discharge-valve.

The above-described action will be repeated at every cycle of four strokes.

If, now, the pipe of the apparatus *g* be connected with the air-supply or with the gas-

supply pipe on the cylinder side of the gas-valve *l*, as in my said other application, then every time that only air is drawn into the cylinder instead of an explosive mixture, owing to the gas-valve remaining closed on the engine running too fast, the diaphragm *h* will still be acted upon, so as to keep closed the discharge-valve *f* during the compression-stroke of the piston, so that during the cycle of four strokes air will first be drawn into the cylinder, then compressed, then expanded again, and, lastly, discharged through the open valve *f*.

Now, according to my present invention, in order to obtain an increased regularity of the motion of the engine, I modify the above-described mode of action in such a way that the air drawn into the cylinder by the one outstroke when the engine is running too fast is expelled again through the open discharge-valve *f* during the following instroke, instead of being compressed, so that if during this time the speed of the engine has been reduced to the normal again an explosive charge can be again drawn in at the following outstroke of the piston, which would not be possible with the above-described mode of operating on account of the charge of compressed air already contained in the cylinder. I effect this by connecting the pipe *k* of the diaphragm apparatus to a point of the gas-supply pipe on the outer side of the gas-valve—that is to say, at *k'*, Fig. 4. With this arrangement it will be seen that the suction-outstroke of the piston will have no effect upon the diaphragm *h* unless the gas-valve is opened for admitting a combustible charge, and that consequently when only air is being drawn in, owing to the engine running too fast, the rod *e* will not be drawn to one side, and will consequently open the discharge-valve at each instroke of the piston.

In the modification shown in the diagram-section, at Fig. 5, precisely the same mode of operating is carried out as above described, the only difference being that the catch-rod *c* is pivoted to the stem of the discharge-valve *f*, while in place of the lever *d* of the previous arrangement is employed a reciprocating rod *b*, receiving motion in a suitable manner from the engine-shaft, so as to open the discharge-valve when *c* is in line with it. *h* is the diaphragm communicating with the gas-supply pipe on the outer side of the gas-valve *l*. *i* is the rod connecting the diaphragm *h* with the catch *c*.

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

In a four-stroke-cycle gas or oil motor engine apparatus, whereby the discharge-valve of the engine is opened only during the expelling-stroke of the piston when the engine is working with explosive charges, but is opened both during the expelling and the compressing strokes when the engine is running without explosive charges, such apparatus consisting of the combination, with the discharge-valve of the engine, of a diaphragm and vessel, or equivalent device, in communication with the gas-supply pipe at a point on the outer side of the gas-valve, a pivoted catch-rod connected to said diaphragm and arranged between the discharge-valve and a lever, or equivalent device, receiving reciprocating motion from the engine-shaft, so that when the pivoted catch-rod is held in one position by the diaphragm while the gas-valve is closed, it causes the reciprocating rod to open the discharge-valve during every instroke of the piston, but when by the opening of the gas-supply valve during the suction-stroke of the engine the diaphragm is made to move the catch-rod into another position the reciprocating rod fails to open the discharge-valve during the compression instroke, substantially as described.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 21st day of April, A. D. 1890.

NICOLAUS AUGUST OTTO.

Witnesses:
PET. LANGEN,
WILH. SPIECKER.