(No Model.)

N. A. OTTO.

GAS OR OIL MOTOR ENGINE.

No. 433,814. Patented Aug. 5, 1890.

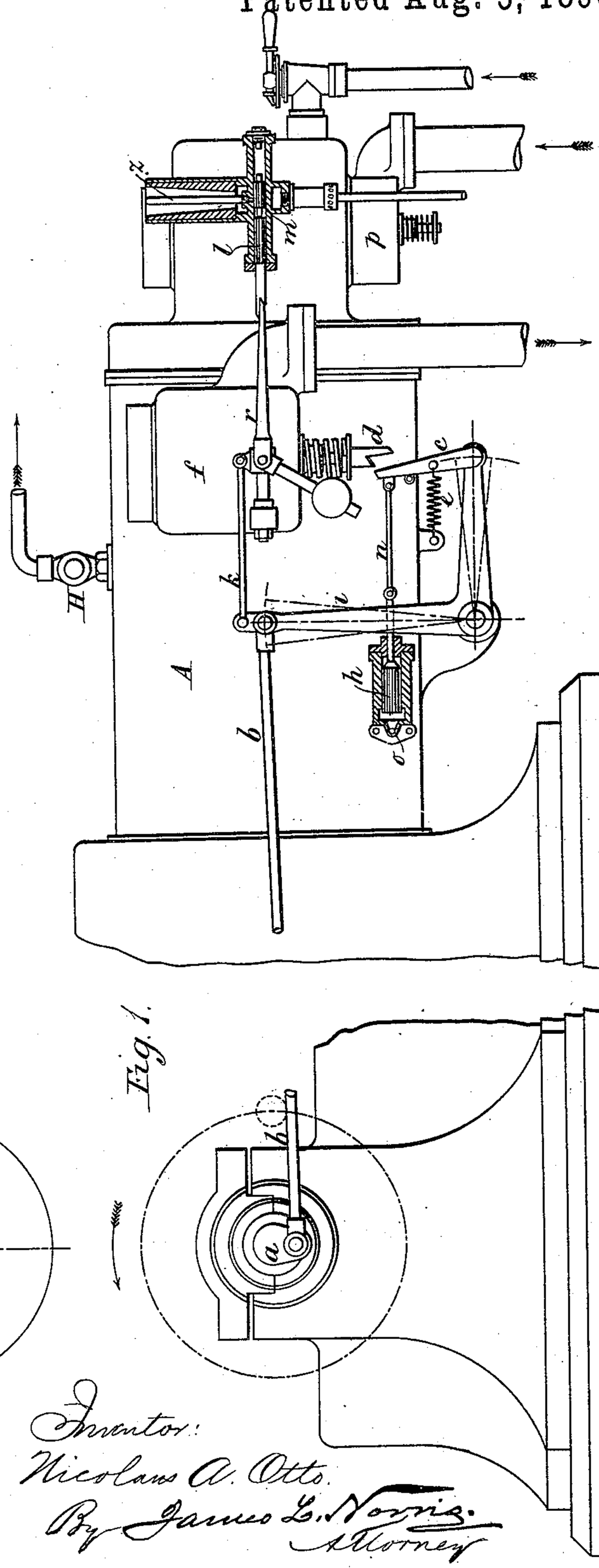

Fig. 2.

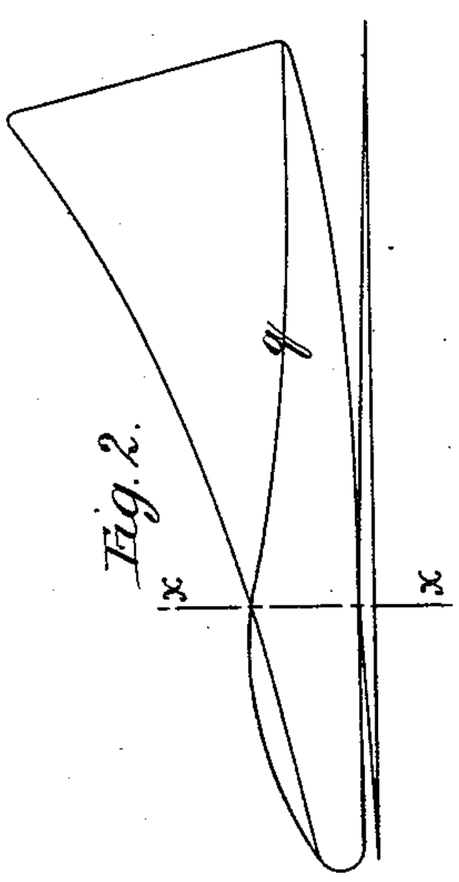

Fig. 3.

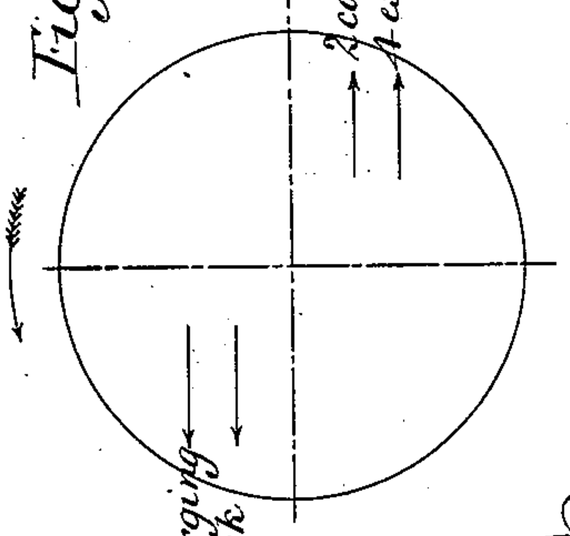

Fig. 1.

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UNITED STATES PATENT OFFICE.

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. 433,814, dated August 5, 1890.

Application filed May 22, 1890. Serial No. 352,750. (No model.) Patented in Belgium May 2, 1890, No. 90,400, and in Italy May 28, 1890, LIII, 490.

To all whom it may concern:

Be it known that I, NICOLAUS AUGUST OTTO, a citizen of Prussia, residing at Cologne, in the German Empire, have invented new and useful Improvements in Gas or Oil Motor Engines, (for which I have obtained Letters Patent in Belgium, dated May 2, 1890, No. 90,400, and in Italy, dated May 28, 1890, Vol. LIII, 490,) of which the following is a specification.

This invention relates to apparatus for obtaining in four-stroke-cycle gas or oil motor engines a higher degree of uniformity of action by causing the igniting device of the engine-cylinder to be put out of action during one or more working-strokes, so that the explosive charge drawn in cannot be ignited, but is successively compressed and allowed to expand again in the cylinder until the regulating mechanism puts the igniting apparatus into action again, so that at the end of the next following compressing-stroke the explosive charge will be ignited.

I will describe the said apparatus with reference to the accompanying drawings, in which—

Figure 1 shows a side view of a gas-motor engine with the igniting apparatus in section. Fig. 2 shows an indicator diagram, and Fig. 3 a diagram of the engine's action, the arrows 1 2 3 4 indicating, respectively, the suction or charging stroke, the compressing-stroke, the working-stroke, and the expelling-stroke.

The engine-shaft carries a crank or eccentric *a*, the connecting-rod *b* of which actuates a bell-crank lever *i*, whose vertical arm imparts motion by means of a link *k* to the slide of an inertia governor *r*, while the horizontal arm has pivoted to it a catch-rod *c*. The end of the governor-arm engages, at the normal speed of the engine, with a notch on the stem of a piston *l*, having a circular groove *m*, and being capable of working backward and forward in the cylindrical casing of the igniting apparatus. This piston is acted on by a spring at its inner end, tending to keep it in the forward position, in which the groove *m* does not communicate with the opening leading to the heated igniting-tube, nor with a second opening leading to the cylinder, this being the position shown on the drawings. When, however, the piston *l* is pushed backward by the forward motion of the governor *r*, the groove *m* is made to establish the communication between the cylinder A and the igniting-tube *z*, whereby the ignition of the explosive charge is effected.

The catch-rod *c* on the lever *i* is held out of gear with the notched end of the discharge-valve stem *d* by a spring *e*, and it is connected by a link *n* with the rod of a piston *h*, (or it might be a flexible diaphragm,) the cylindrical casing of which communicates by a connecting-passage *o* with the interior of the cylinder as soon as the engine-piston, in the course of its outstroke, passes beyond the point *o*. This position is indicated by the line *x x* on the indicator diagram at Fig. 2. When, during such outstroke, the pressure in the cylinder A is above that of the atmosphere, the piston *h* will be forced forward by such pressure at the time above mentioned, and will bring the catch-rod *c* in line with the discharge-valve stem *d*, so that when by the motion of the crank *a* the lever *i* is made to raise the catch-rod *c* it will force open the discharge-valve *f* against the action of its spring so as to allow the products of combustion to escape.

Referring to the work-diagram, Fig. 3, the action of the machine is as follows: On the suction or charging stroke of the engine-piston an explosive charge will enter the cylinder through the mixing-valve *p* of known construction. The piston, when arrived at the point *x x*, will open the communication with the casing of piston *h;* but the partial vacuum then existing in the cylinder A will not affect the position of piston *h*, and the catch-rod *c* will remain out of line with the valve-stem *d*, so that at the return-stroke, when the catch-rod will be raised, it will fail to open the discharge-valve, and the explosive charge will consequently be compressed. Toward the end of such compressing-stroke the rod of the inertia governor *r* will have pushed back the piston *l* so far against the action of its spring that when arrived at the

dead-center the groove *m* will establish the communication between the cylinder A and the igniting-tube *z*, so as to effect the ignition of the compressed charge. The engine-piston being thereupon made to perform its working-outstroke, it will again establish the communication with the piston *h* through passage *o* when it passes the point *x x*, Fig. 2, so that the pressure then existing in the cylinder A being communicated to piston *h*, this will push catch-rod *c* in line with the valve-stem *d*, and consequently when *c* rises at the commencement of the return expelling-stroke it will force valve *f* open and keep it open during the stroke, so as to allow the combustion-gases to escape. At the end of the expelling-stroke the catch-rod *c* in descending is freed from the notch of *d*, and can then be drawn back into position shown by the spring *e*, at the same time moving the piston *h* into its backward position again. The above-described action will be repeated at each cycle of four strokes. It will be seen from the above that the catch-rod *c* will only be brought in gear with the discharge-valve stem *d* when the ignition of a charge has been effected, and this will take place as well with a perfect ignition as with an imperfect ignition of the charge (see diagram *q*, Fig. 2) if the communication *o* is effected at the point *x* shown. If, now, owing to the engine running too fast, the rod of the inertia governor *r* fails to push back the piston *l*, so that no communication is established between the cylinder A and the igniting-tube *z*, and consequently the compressed charge is not ignited, then on the following outstroke the charge will expand again, and as by the time the piston has arrived at the point *x*, where it establishes the communication through *o* with the piston *h*, the pressure is not sufficient to cause this to overcome the pull of the spring *e*, the catch-rod *c* will remain drawn back, and the discharge-valve will remain closed during the following instroke, and the engine-piston will consequently continue to alternately compress and expand the explosive charge in the cylinder until the speed has become sufficiently reduced to cause the inertia governor to act on the piston *l* again, so as to ignite such charge at the end of a compression-instroke, and thus at once effect a working-outstroke again.

In the arrangement shown on the drawings the regulation is effected by an inertia governor and the ignition-heated igniting-tube; but it will be readily understood that any other suitable modes of regulation and of ignition may be employed in carrying out the above-described invention.

The starting of the engine is effected by the aid of the cock H, through which on starting a portion of the charge drawn in is discharged again into the escape-flue until, on attaining the correct proportions of gas and air, the charge becomes ignited, whereupon the cock H is closed again.

I do not herein claim the method described of obtaining a higher degree of uniformity of action in a four-stroke-cycle gas or oil motor engine, as the method is claimed in my application filed May 22, 1890, Serial No. 352,749.

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

Apparatus for retaining an unignited combustible charge in the cylinder of a four-stroke-cycle gas or oil motor engine when it is running too fast, consisting of the combination of a piston *h* or equivalent device in a cylinder communicating with the engine-cylinder A, a catch-rod *c*, connected to said piston and pivoted to a lever, by which it receives a to-and-fro motion for the engine-shaft, said piston *h* being adapted to bring the catch-rod *c* in line with the stem of the discharge-valve, so as to effect the opening thereof when the piston *h* is subject to the pressure due to the explosion of a charge, an igniting device *z*, the communication between which and the engine-cylinder is controlled by a slide *l*, and an inertia governor *r*, moved to and fro by the engine-shaft and adapted to act on the slide *l*, so as to establish communication between igniting device *z* and the cylinder when the engine is running at normal speed, but which does not act on the slide when the engine runs too fast, substantially as described.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 2d day of May, A. D. 1890.

NICOLAUS AUGUST OTTO.

Witnesses:

PET. LANGEN,

WILH. SPIECKER.