(No Model.) 3 Sheets—Sheet 1.

H. SCHUMM.

APPARATUS FOR WORKING GAS OR OIL MOTOR ENGINES.

No. 548,142. Patented Oct. 15, 1895.

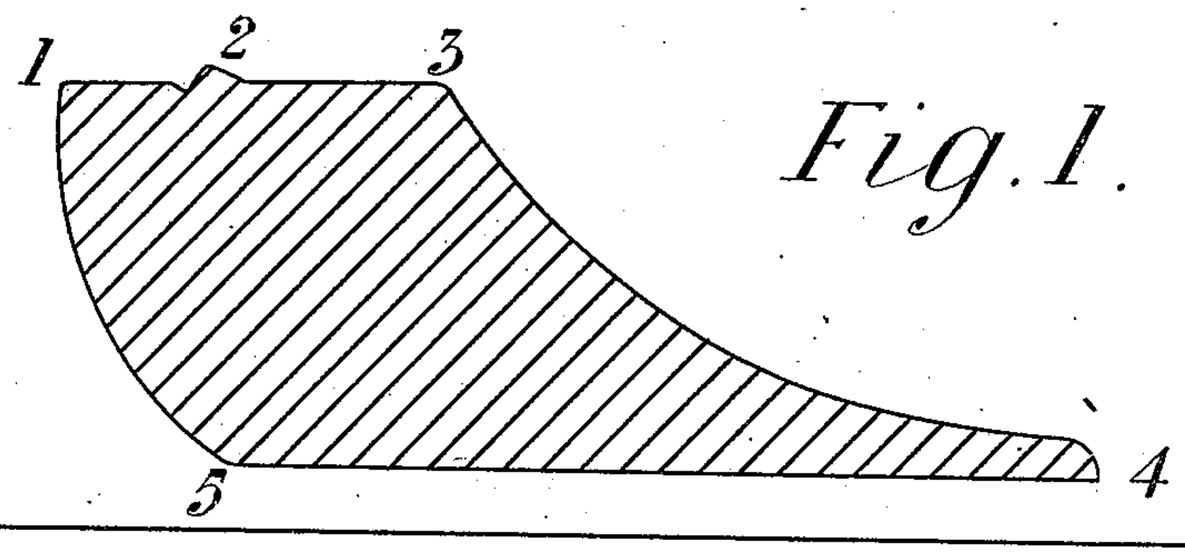


Fig. 1.

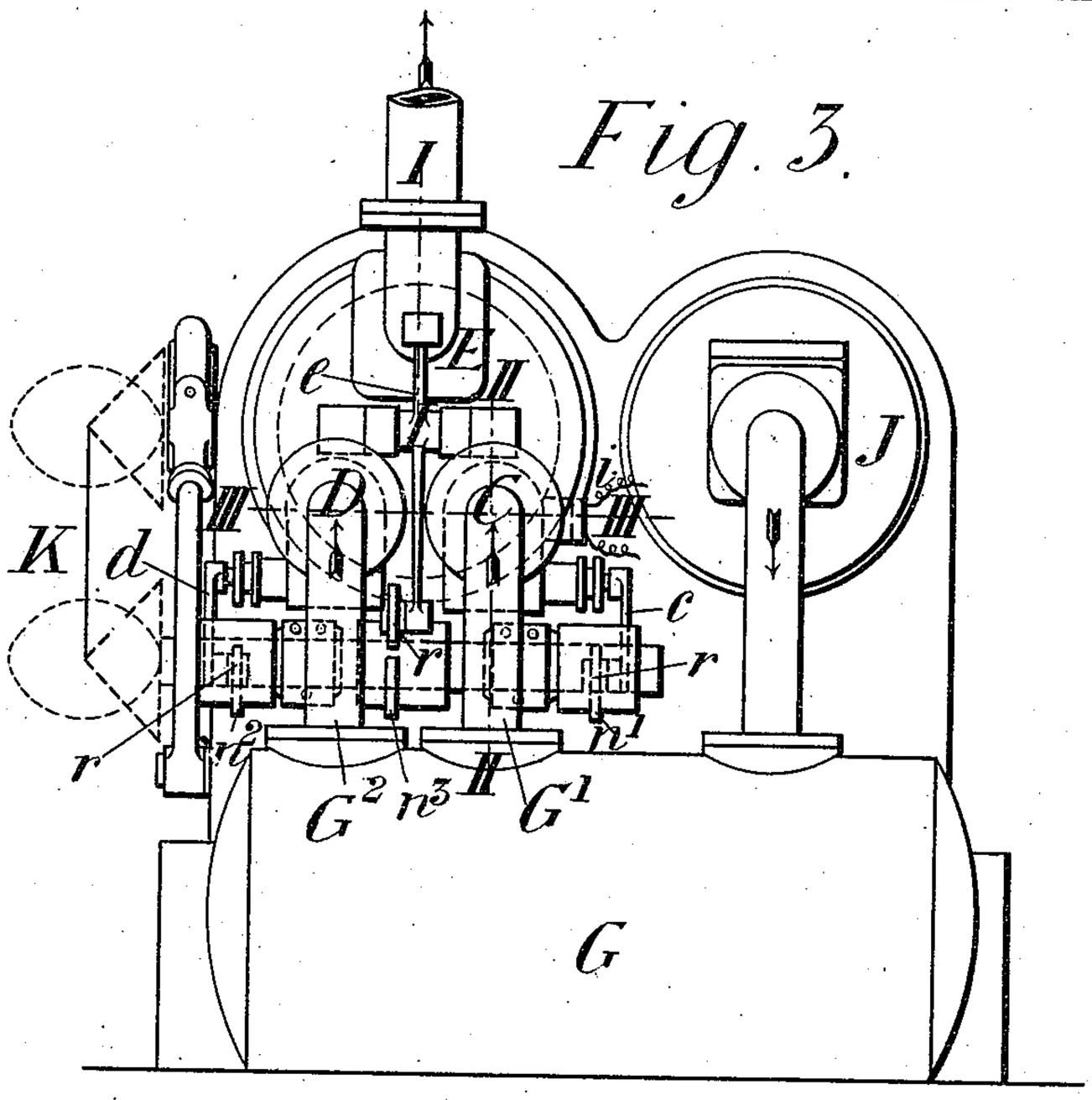
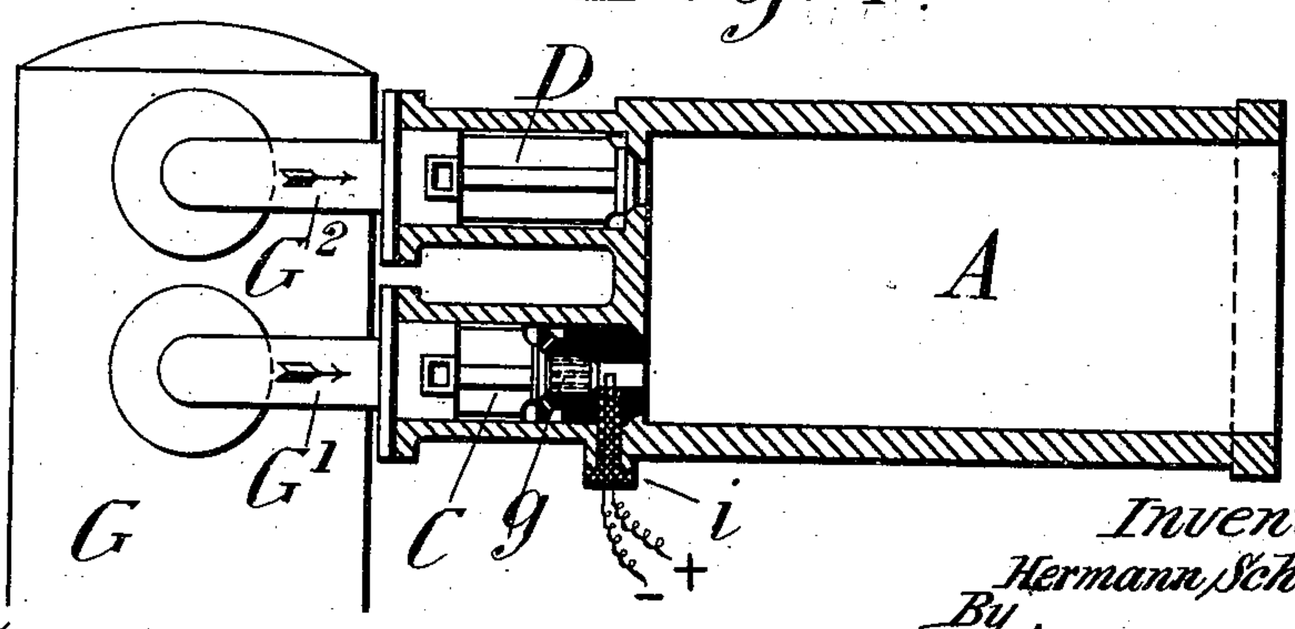


Fig. 3.

Fig. 4.



Witnesses.
G. W. Rea,
Robert Everett.

Inventor:
Hermann Schumm.
By James L. Norris.
Atty.

(No Model.) 3 Sheets—Sheet 2.

H. SCHUMM.

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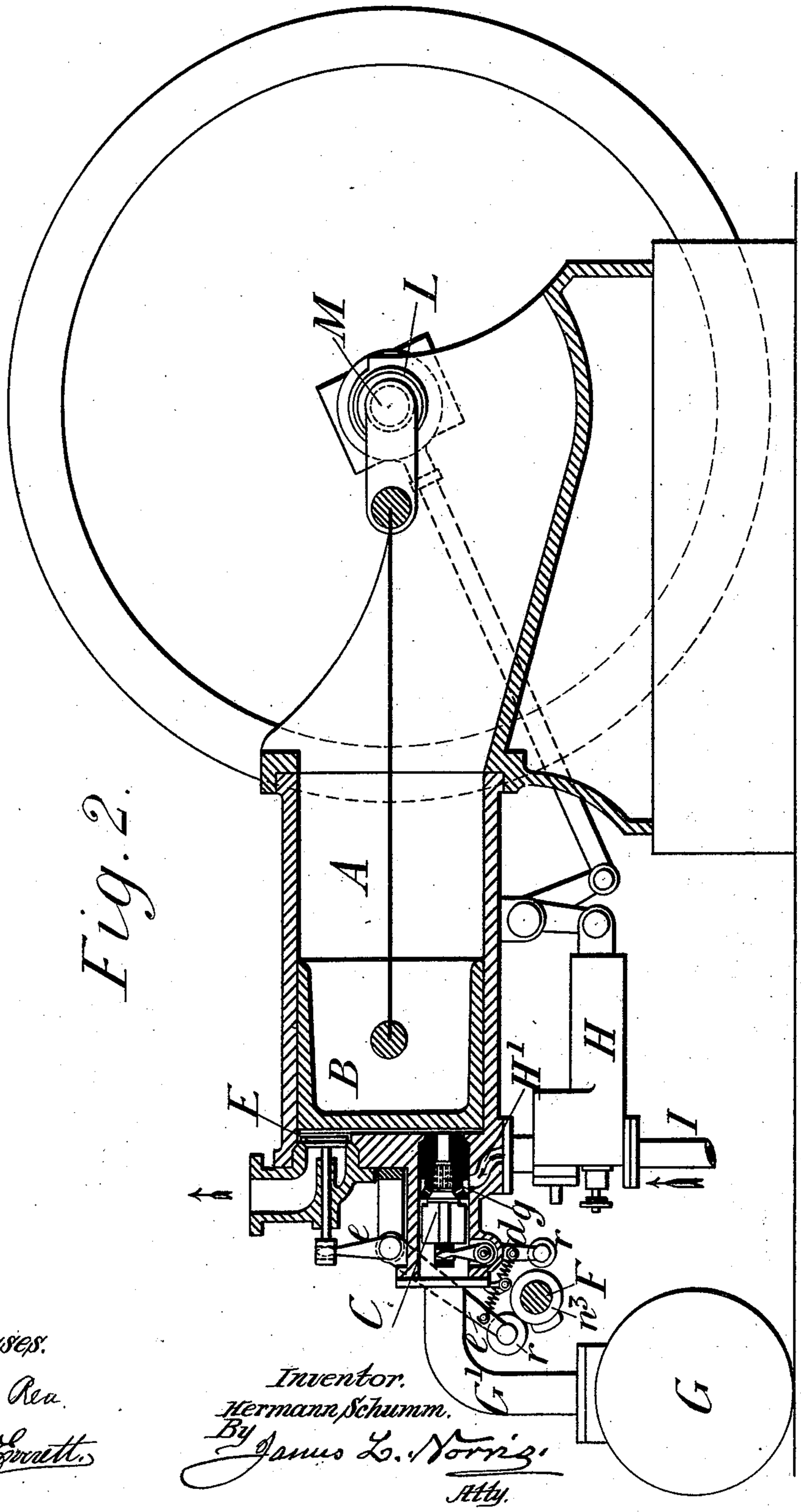

Fig. 2.

Witnesses.
G. N. Rea.
Robt Everett.

Inventor.
Hermann Schumm.
By James L. Norris.
Atty.

(No Model.) 3 Sheets—Sheet 3.

H. SCHUMM.

APPARATUS FOR WORKING GAS OR OIL MOTOR ENGINES.

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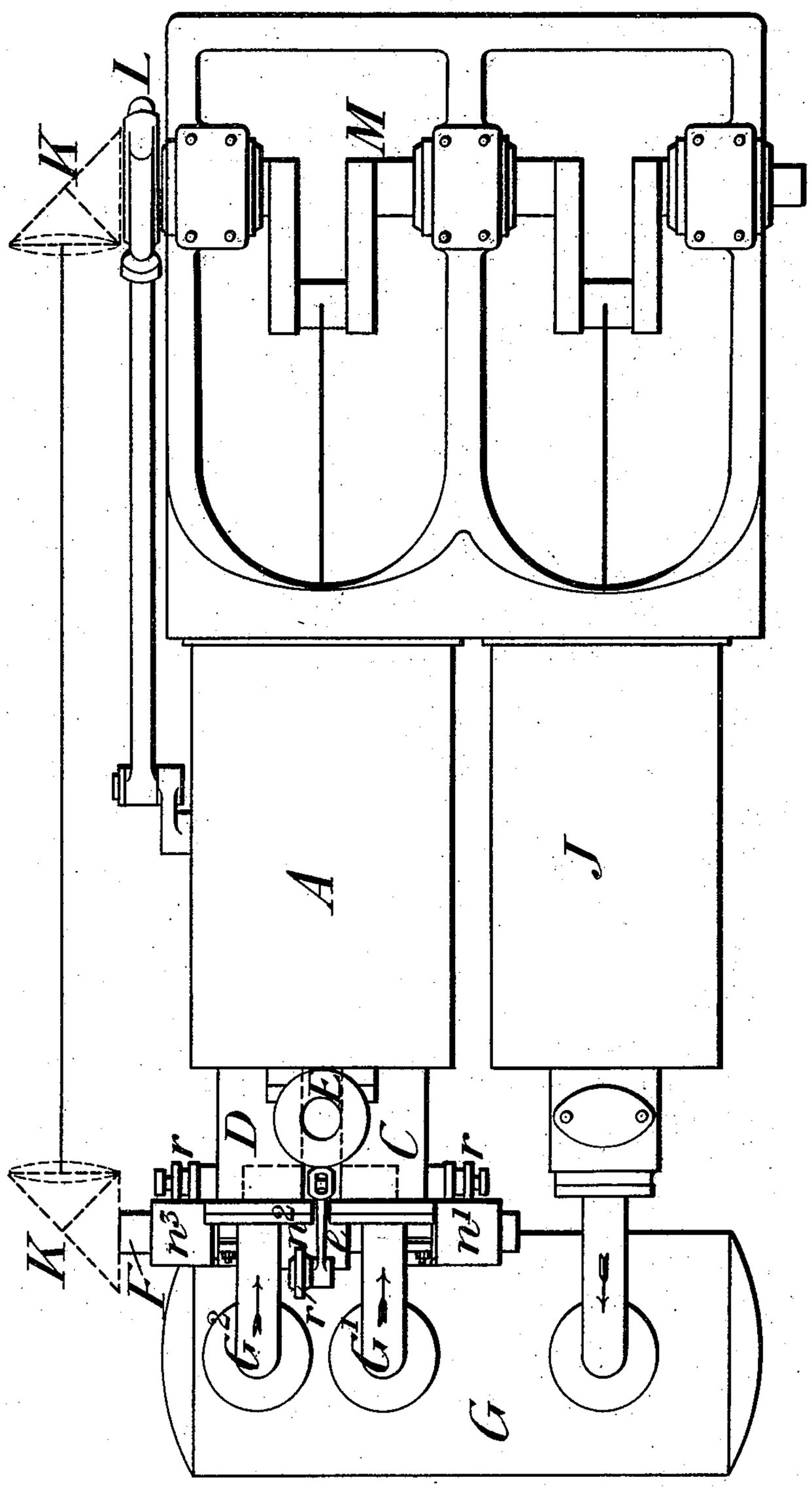
Fig. 5.



Witnesses.
G. W. Rea.
Robert Everett.

Inventor.
Hermann Schumm.
By James L. Norris.
Atty.

UNITED STATES PATENT OFFICE.

HERMANN SCHUMM, OF DEUTZ, GERMANY, ASSIGNOR TO THE GAS-MOTOREN-FABRIK-DEUTZ, OF SAME PLACE.

APPARATUS FOR WORKING GAS OR OIL MOTOR ENGINES.

SPECIFICATION forming part of Letters Patent No. 548,142, dated October 15, 1895.

Application filed January 3, 1895. Serial No. 533,728. (No model.)

To all whom it may concern:

Be it known that I, HERMANN SCHUMM, a citizen of Switzerland, residing at Deutz, Germany, have invented a new and useful Improvement in Apparatus for Working Gas or Oil Motor Engines, of which the following is a specification.

As is well known, gas or oil motor engines working with slow combustion operate in such manner that a combustible mixture of gas or oil vapor and air under pressure is forced into the engine-cylinder during the first part of the stroke of the piston, the said mixture being at the same time ignited and made to burn gradually without great increase of pressure—that is to say, with a corresponding increase of volume. At a certain point of the piston's stroke the inlet for the combustible mixture is closed and the hot gaseous products of combustion in the cylinder are made to expand to the end of the piston's stroke and are then expelled on the return stroke of the piston. In order to work economically with this class of motor-engine, very considerably diluted combustible mixtures must be employed, because the richer the mixture is in combustible gas the higher will be the temperature of combustion and the greater will be the proportion of heat lost by conduction through the cylinder-walls; but in diluting the mixture a limit is soon reached at which the ignition thereof becomes uncertain.

According to the present invention it is rendered possible to employ a rich gaseous mixture in such engines, and thus to insure certainty of ignition and yet to keep the temperature sufficiently low to prevent material loss, by first drawing in air only or an inert gas at the commencement of the piston's stroke and afterward admitting the charge of rich mixture. The quantity of combustible mixture admitted under these conditions is so proportioned that the increase of volume of the charge due to the heat generated is about equal to the volume of the space formed in the cylinder by the motion of the piston, so that the evolution of heat takes place without material increase or decrease of pressure. When the admission of the combustible mixture ceases, the hot gases expand to the end of the stroke.

In the accompanying drawings, illustrating my invention, Figure 1 is a diagrammatic view of the engine. Fig. 2 is a longitudinal section on the lines I I II II of Fig. 3. Fig. 3 is an end view, and Fig. 4 a sectional plan, on the line III III of Fig. 3. Fig. 5 is a plan view.

At the commencement of the outstroke air or inert gas under pressure is admitted for a certain part of the stroke, such as to the point 2. From this point the supply of air is cut off and a supply of combustible mixture under pressure takes place, which continues, say, up to the point 3 of the stroke, such mixture being ignited as it enters and burning gradually during the continuance of its introduction, the heat generated being imparted to the charge of air or inert gas in the cylinder, so that this charge expands and performs work conjointly with the combustion-gases. The quantity of the admitted combustible mixture is so proportioned that the increase of volume due to the heat generated by its combustion is about equal to the volume of the space produced in the cylinder by the forward motion of the piston, so that the addition of heat is effected without appreciable increase or decrease of pressure. When the admission of combustible gas ceases at point 3 of the diagram, the heated gases in the cylinder begin to expand and such expansion continues till the end of the stroke—*i. e.*, from 3 to 4. At 4 the discharge of the combustion-gases commences and continues until near the end of the return stroke at point 5, when the discharge-valve is closed. Thus contrary to the mode of operating in existing gas-motor engines working with slow combustion the ignition in the present case does not take place at or about the dead-center of the stroke, but only after the piston has moved through a substantial part of its stroke.

With the existing engines a sudden increase of pressure could easily occur on ignition, which would operate prejudicially upon

the uniform admission of fresh combustible mixture. This cannot occur with the above-described improved method of operating, as at the commencement of ignition a considerable space already exists behind the piston, which is filled with air, so that the sudden increase of pressure of the first-admitted particles of combustible mixture cannot cause any detrimental increase of pressure of the charge in the cylinder.

Figs. 2, 3, 4, and 5 of the drawings show a construction of engine working according to the above-described method. Fig. 2 shows a longitudinal section on line I I II II of Fig. 3; Fig. 3, an end view, and Fig. 4 a sectional plan on line III III, Fig. 3. Fig. 5 shows a plan.

A is the engine-cylinder; B, the piston; C, the inlet-valve for combustible mixtures; D, the inlet-valve for air; E, the discharge-valve; *i*, the electrical igniting device consisting either of an incandescent platinum wire or a continuous electric spark, and *g* a wire-gauze diaphragm for preventing any backward flash of the flame, which device is advantageous, but not necessary to the purposes of this invention.

The air-supply is compressed in a reservoir G either by means of an air-pump J, worked by a crank on the engine-shaft M, or by a separate pump, and is led thence through pipes G' G^2 to the chambers of the valves C and D. The gas-supply from pipe I is compressed by a gas-pump H, operated by an eccentric L on the engine-shaft M, and is forced through channel J to the perforated seat of the valve C, so that on the opening of this it mixes with the compressed air to form the combustible mixture that burns as it enters the cylinder. The valves are actuated by a counter-shaft F, driven by suitable gearing, such as indicated at K, Fig. 3, at the same speed as the engine-shaft, and having cams n' n^2 n^3 suitably formed for operating, respectively, upon the valves C D E through levers *c d e*, having rollers *r*. The cams are so arranged that valve D is made to open at point 1 of the diagram Fig. 1 or somewhat earlier and is closed at point 2 or somewhat later and that valve C is opened during the period from 2 to 3 and valve E during the period from 4 to 5.

Although in the foregoing I have described the use of a separate air-supply valve D for the supply of air under pressure alone during the first part of the outstroke of the piston, yet it will be obvious that this valve may be dispensed with and the supply of air under pressure during the first part of the stroke be effected by means of the same valve C that afterward serves for the admission of the charge of combustible mixture. For this purpose it is merely necessary to form the cam n' on shaft F in such manner that it opens valve C, already at the commencement of the outstroke, in which case an additional cam is provided for controlling an additional inlet-valve on the passage leading from the gas-pump H to the valve-seat of C, so that the gas-supply under pressure only enters and mixes with the air-supply for forming the combustible mixture when the piston has performed a part of its stroke, as above described. It is preferred, however, to admit the said charge of air at the beginning of the stroke by means of a separate valve D, as described. Furthermore, in place of introducing the combustible mixture through a single valve C there might be provided for this purpose separate valves and corresponding cams for the admission of the gas and the air supplies in the required proportions for forming the slow-combustion mixture. In this case there would consequently be three admission-valves—one for gas, one for the air required for admixture with the gas, and the third for the charge of air alone. Lastly, it is to be observed that the term "inert gas" herein employed for the charge introduced during the period 1 2 of the diagram Fig. 1 is to be understood in the widest sense, as steam or other inert vapors might be employed for this purpose, in which case such steam might be formed in the engine-cylinder itself, for example, by the injection of water into the cylinder during the first part of the outstroke, which water would be at once converted into steam, owing to the high temperature of the cylinder.

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

1. In a two stroke cycle slow combustion gas or oil motor engine a valve actuated by a cam or equivalent device so as to admit air or inert gas under pressure during the first part of the piston's outstroke; a second valve actuated by a cam or equivalent device so as to admit compressed combustible mixture of gas or vapor and air during the following part of the stroke, an electrical igniter or equivalent means for igniting said combustible mixture as it enters the cylinder so that the heat produced by the resulting combustion shall be imparted to the body of air first admitted, and a discharge valve operated by a cam or equivalent device through which the products of combustion are expelled during the return stroke of the piston, substantially as and for the purposes described.

2. In a two stroke cycle slow combustion gas or oil motor engine, the combination with a working cylinder and piston, of a pump for compressing combustible gas, a pump for compressing air or inert gas into a reservoir a valve for admitting compressed air or inert gas from the reservoir to the cylinder during the first part of the outstroke, a valve for admitting compressed combustible mixture of gas or vapor and air during the following part of the outstroke, means for igniting such

combustible mixture as it enters the cylinder, a discharge valve for discharging the combustion gases during the return stroke, and a countershaft running at the same speed as the engine shaft, having cams for operating the said valves, substantially as described.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 15th day of December, A. D. 1894.

HERMANN SCHUMM.

Witnesses:
FRITZ SCHRÖDER,
SOPHIE NAGEL.