E. A. RUNDLÖF.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED AUG. 28, 1908.

931,346. Patented Aug. 17, 1909.

2 SHEETS—SHEET 1.

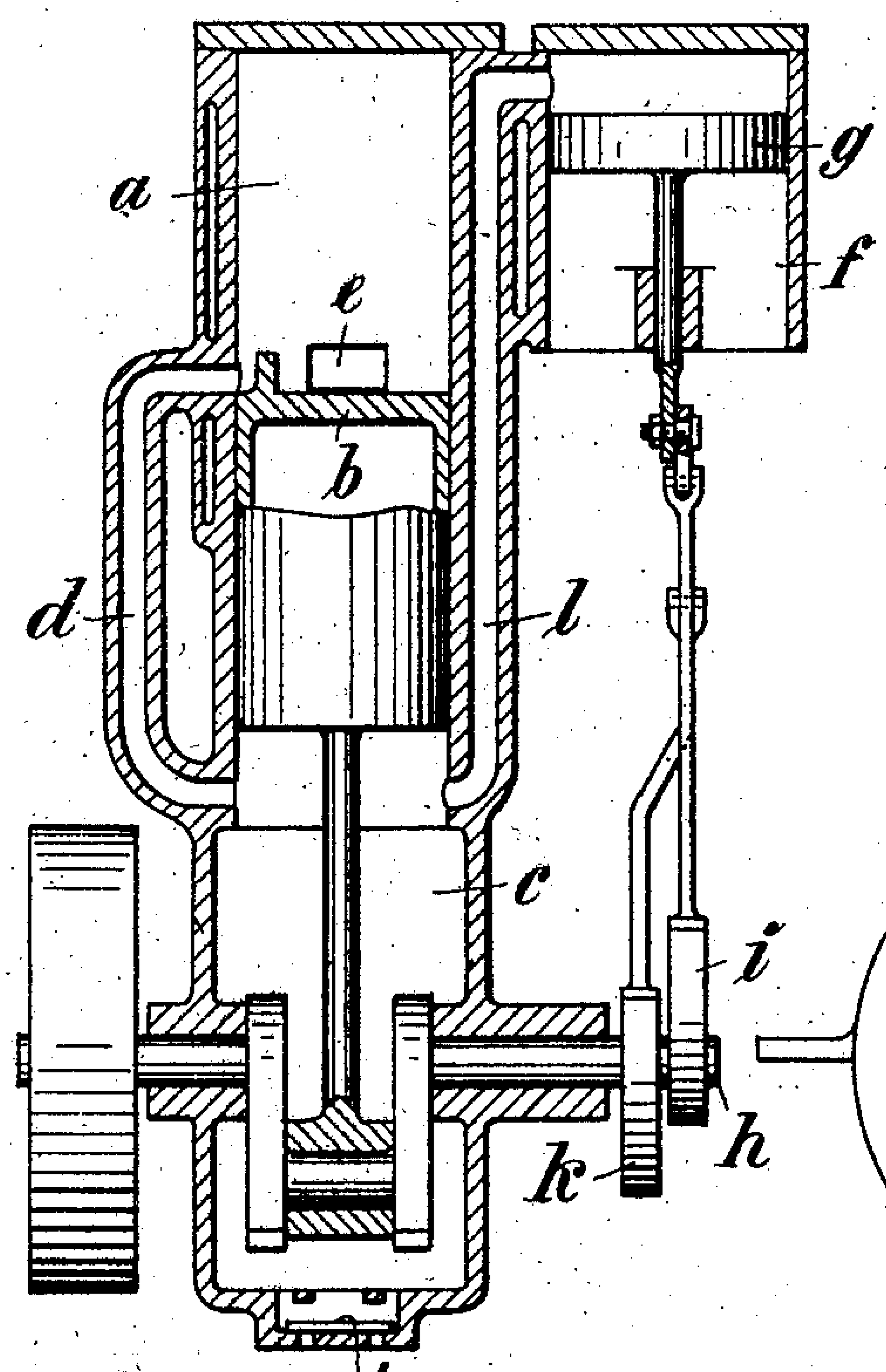

Fig. 1.

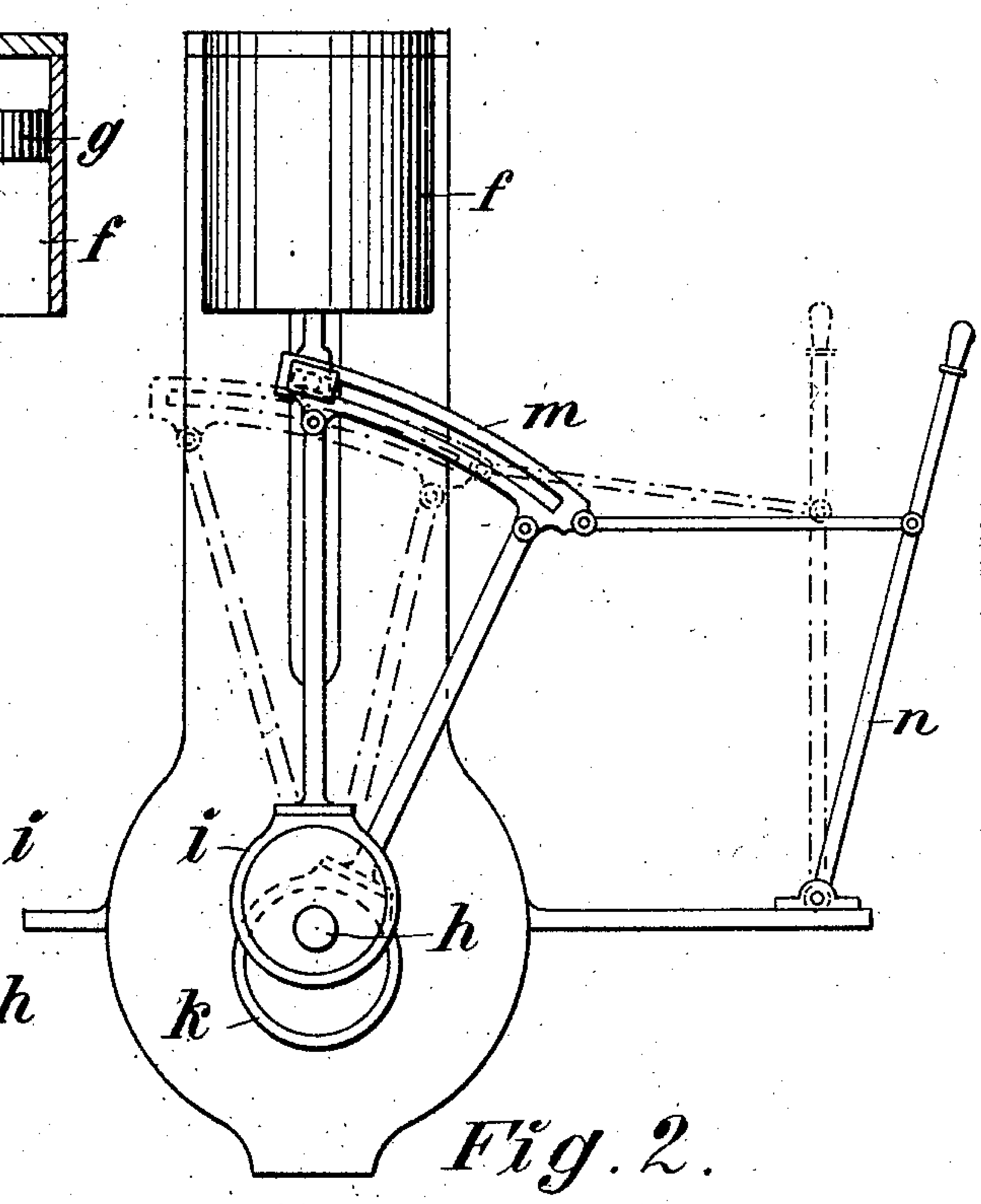

Fig. 2.

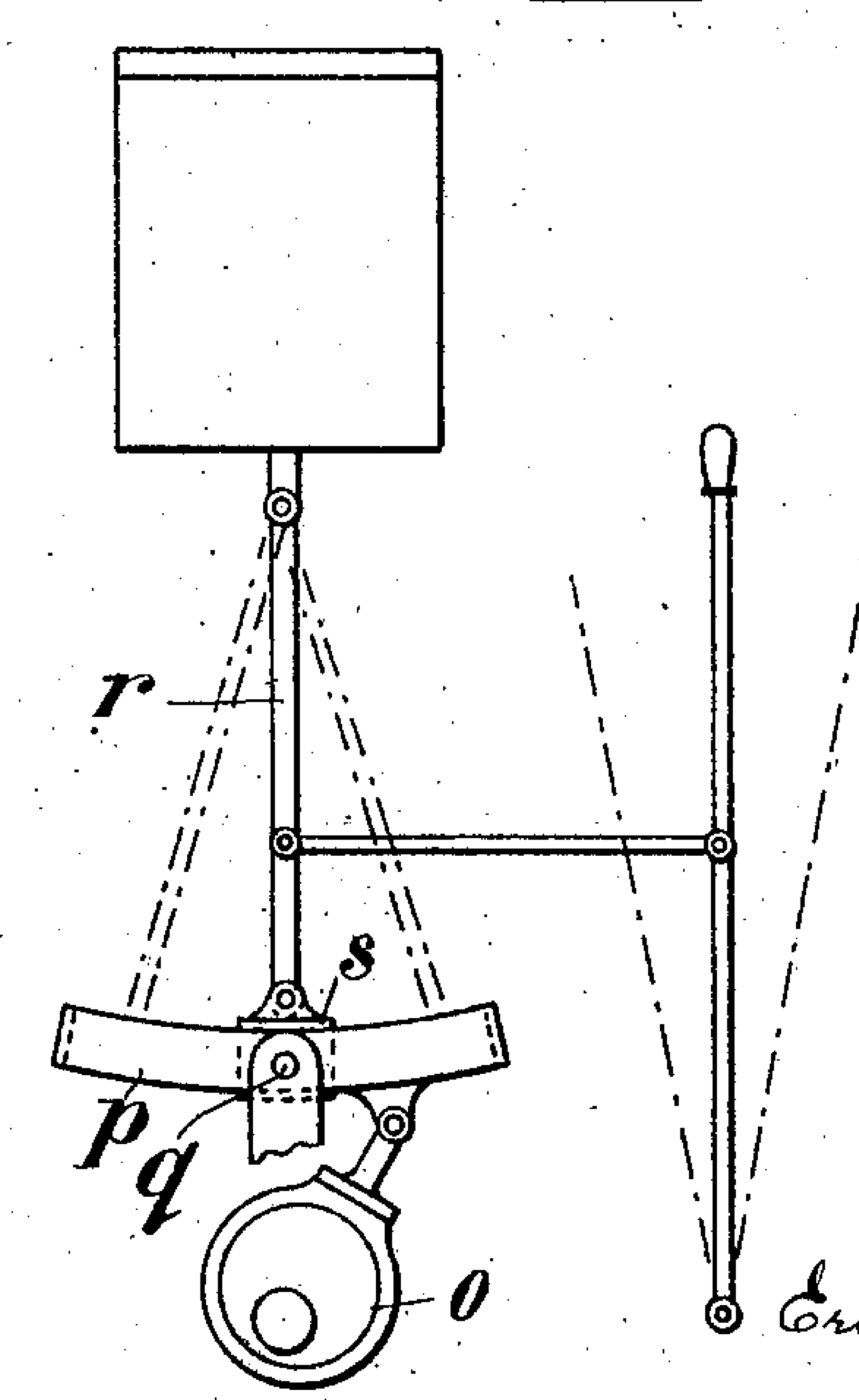

Fig. 3.

Witnesses

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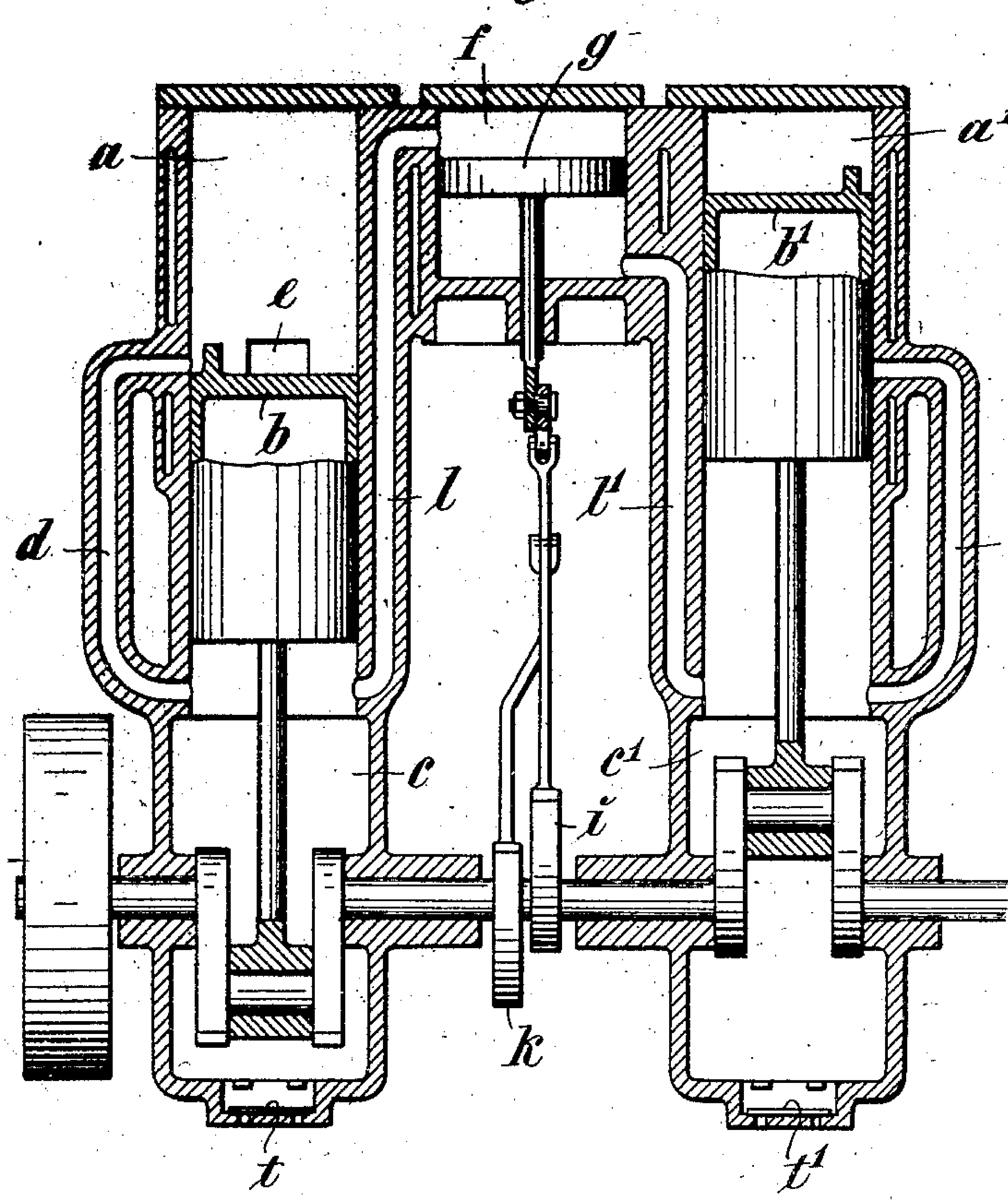
Fig. 4.



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INTERNAL-COMBUSTION ENGINE.

No. 931,346. Specification of Letters Patent. Patented Aug. 17, 1909.

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To all whom it may concern:

Be it known that I, Erik Anton Rundlöf, a subject of the King of Sweden, residing at Stocksund, in the Kingdom of Sweden, have invented new and useful Improvements in Internal-Combustion Engines, of which the following is a specification, reference being had to the drawing accompanying and forming a part hereof.

This invention relates to improvements in internal combustion engines.

Internal combustion engines in general, and particularly that class known as self-igniting two-cycle engines, have the drawback that the combustion gases formed within the explosion chamber cannot be satisfactorily expelled, when the engine works with full power. When, therefore, a greater or less quantity of combustion gases remains in the combustion chamber, the working gas mixture will not have the desired purity, and, moreover, the remaining hot gases contribute to keep the explosion chamber excessively heated. It is true that, in order to always effect a thorough scavenging, the pump, or the like, serving to press air into the cylinder might be made of such a size as to supply a quantity of air sufficient for the greatest loads, or the greatest gas mixtures burned, but if the said quantity of air remains the same at lower loads, the engine will be supplied with too large a quantity of air, by which the cylinder is rapidly cooled. In order to overcome the said drawback it has been suggested to regulate the amount of air admitted into the explosion chamber by means of an auxiliary air-pump whose length of stroke may be varied from zero to a certain maximum length, whereby the amount of air admitted into the explosion chamber may be increased, when required, so as to more thoroughly drive out the combustion gases therefrom. All devices of this kind hitherto proposed have, however, the disadvantage that the auxiliary air-pump must work more or less, even at a normal load or it will not be capable of regulating the amount of air admitted into the explosion chamber at loads smaller than the normal one.

The object of this invention is to still further increase the possibility of varying the quantity of air admitted into the explosion chamber, so that the said quantity of air may be varied within wide limits for loads greater or smaller than the normal one while at the same time the auxiliary air-pump may be adjusted so as to be inactive at the normal load, by which unnecessary friction and resistances are done away with.

The invention consists, chiefly, in the combination, in an internal combustion engine, of a suction and compression chamber for supplying air to the engine, an auxiliary air-pump communicating with the said chamber, and means enabling the said air-pump to coöperate with or counteract the normal air-supplying means so as to increase or decrease the quantity of air supplied by the suction and compression chamber, when working alone.

The invention further comprises the arrangements and combinations of parts hereinafter particularly described.

In the drawing, Figure 1 is a vertical section of an internal combustion engine embodying the invention. Fig. 2 is an end-view of the same engine viewed in the longitudinal direction of the engine shaft. Fig. 3 is an elevation of a modified controlling device for the air-pump. Fig. 4 is a vertical section of an internal combustion engine having two working cylinders and a double-acting auxiliary air-pump.

Referring to Figs. 1 and 2 of the drawing, *a* is the working cylinder, *b* is the working piston, and *c* is the closed crank casing communicating, in the ordinary manner, through the passage *d* with the cylinder *a*. *e* is the outlet for burned gases, and *t* is the air-valve through which air is sucked into the chamber *c*. The air-pump coöperating with the chamber *c* is, suitably, attached to the side of the cylinder *a*. The pump is an ordinary air-pump having a cylinder *f* and a piston *g* whose stroke may be regulated by means of a common link-gear comprising two eccentrics *k* and *i* attached to the engine-shaft *h*. The suction and compression chamber of the air-pump constantly communicates, through a passage *l*, with the closed crank casing *c*.

The device operates in the following manner. If the slotted bar or link *m* of the link-gear is adjusted by the lever *n* in the middle position shown by dotted lines in Fig. 2, the eccentrics *k* and *i* impart to the link *m* a rocking motion about the center of the link, which coincides with the axis of the pump rod, whereby the pump piston *g* remains at rest so that the air-pump is inactive. This adjustment may be said to suit the normal load of the engine, the pressure air sucked in by the piston *b* of the engine into the closed crank casing *c* being alone active in expelling the combustion gases. If the load on the engine is increased, a greater quantity of air is required, which is obtained by moving the link *m* toward the right (Fig. 2). By this a movement is imparted to the pump piston *g* opposite to that of the working piston *b*, *i. e.* when the working piston moves into the cylinder *a*, the pump piston *g* moves out of the pump cylinder *f*. As a consequence, the two pistons coöperate in sucking air through the valve *t*, the piston *b* sucking air into the crank casing *c* and the piston *g* sucking air into the said crank casing as well as into the pump cylinder *f*. Thus, the quantity of air sucked in is increased, corresponding to the length of the pump stroke, to suit the increase in load on the engine. The whole quantity of air sucked in is compressed in the crank casing *c*, when the working piston *b* moves outward and, at the same time, the pump piston *g* moves into the pump cylinder, whereupon, at the end of the stroke, the compressed air is pressed through the passage *d* into the working cylinder. The length of the pump stroke varies according as the axis of the pump rod is at different points of the one half of the link *m*. If the link is moved toward the left, in relation to the position shown in Fig. 2 by dotted lines, the pump piston *g* obtains a movement opposite to that in the former case in relation to the working piston *b*, *i. e.* the suction and compression strokes are reversed. Both pistons will thus move in one and the same direction. Thus, when the working piston *b* moves into the cylinder *a* and sucks air into the crank casing *c*, the pump piston *g* moves into the pump cylinder and presses the air therein into the crank casing. When thereupon the piston *b* turns and compresses the air within the crank casing, the pump piston *g* moves out from the cylinder *f* and sucks a quantity of air, corresponding to the volume of the stroke of the pump piston, from the crank casing *c*, thus producing a decrease in quantity or pressure of the air corresponding to the decrease in load on the engine.

Obviously, any other air pump, or its equivalent, enabling a regulation of the kind described, and any other regulating means than the link-gear shown and described, may be employed. Fig. 3 shows a simplified link-gear suitable for the purpose, said link-gear consisting of an eccentric *o* connected to the link *p* which is adapted to swing about its center *q*. The pump rod is connected by a rod *r* to a slide *s* movable along the link *p* which, in the middle position shown by full lines, does not transmit any motion to the pump piston, whereas a motion acting to increase or decrease the quantity of air is produced by moving the slide toward one or the other end of the link *p*.

It is obvious that the auxiliary air-pump employed may be arranged so as to be double-acting for the purpose of exhausting two explosion chambers. Such a construction is shown in Fig. 4 in which there are two working cylinders *a*, *a'*, each having a working piston *b*, *b'*, respectively. The different parts of Fig. 4 are denoted by letters (with or without indices) corresponding to those of Fig. 1. The cranks are shown to be set at an angle of a semicircle to each other so that the two pistons are always moving in opposite directions.

I claim:

1. The combination in an internal combustion engine having a suction and compression chamber for supplying air to the engine, of an auxiliary air-pump communicating with the said chamber, and means enabling the said air-pump to coöperate with or counteract the normal air-supplying means, respectively, substantially as and for the purpose set forth.

2. In an internal combustion engine, the combination of a suction and compression chamber for supplying air to the engine, a piston movable in the said chamber, an auxiliary air-pump comprising a cylinder communicating with the said chamber and a piston movable in the said auxiliary cylinder, and connections between the two pistons enabling the piston of the auxiliary air-pump to be driven in either direction in relation to the direction of movement of the first-mentioned piston, substantially as and for the purpose set forth.

3. In an internal combustion engine, the combination of a working cylinder, a main air-pump for supplying air to the said cylinder, an auxiliary air-pump communicating with the main pump, and connections between the two air-pumps enabling the auxiliary air-pump to be driven in either direction in relation to the direction of movement of the main pump, substantially as and for the purpose set forth.

4. In an internal combustion engine, the combination of a working cylinder, a piston working in the said cylinder, a suction and compression chamber arranged at the outer side of the working piston and communicating at intervals with the working cylinder, an auxiliary air-pump comprising a cylinder communicating with the said suction and compression chamber and a piston movable in the said last-mentioned cylinder, and connections between the two pistons enabling the piston of the auxiliary air-pump to be driven in either direction in relation to the direction of movement of the working piston, substantially as and for the purpose set forth.

5. In an internal combustion engine, the

combination of a working cylinder, a main air-pump for supplying air to the said cylinder, an auxiliary air-pump communicating with the main pump, and a link-gear connection between the two air-pumps enabling the auxiliary air-pump to be driven in either direction in relation to the direction of movement of the main pump, substantially as and for the purpose set forth.

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