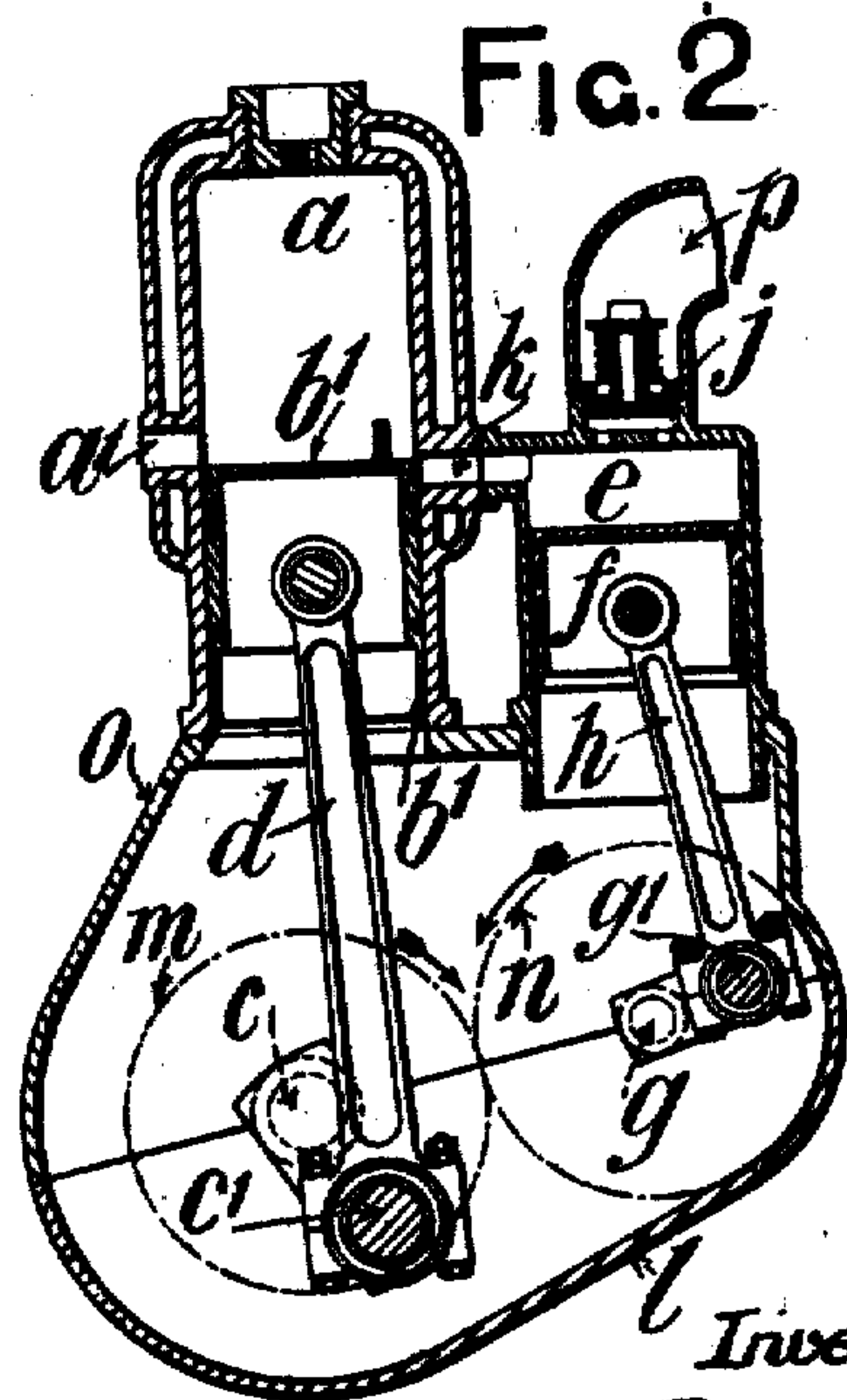
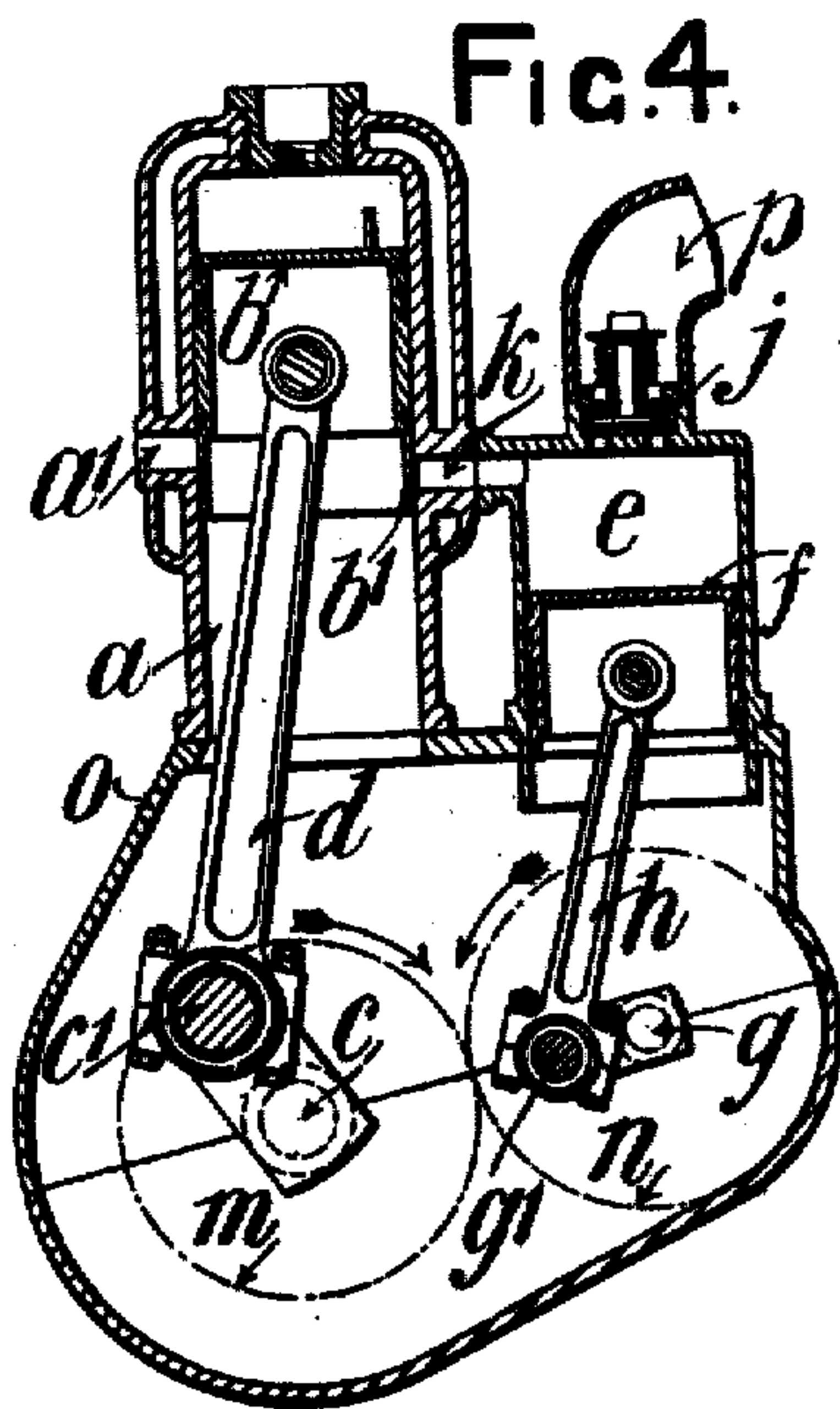
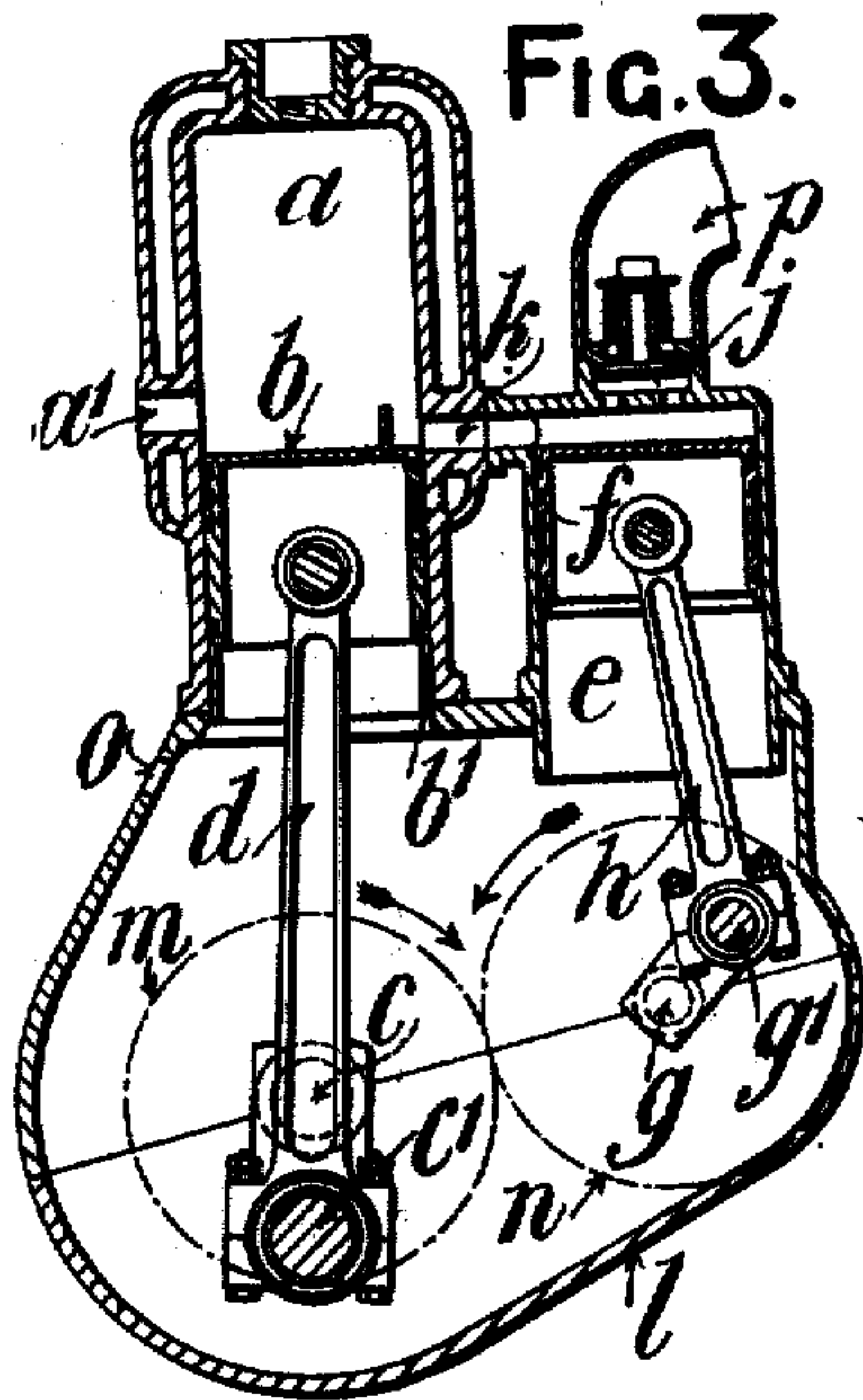
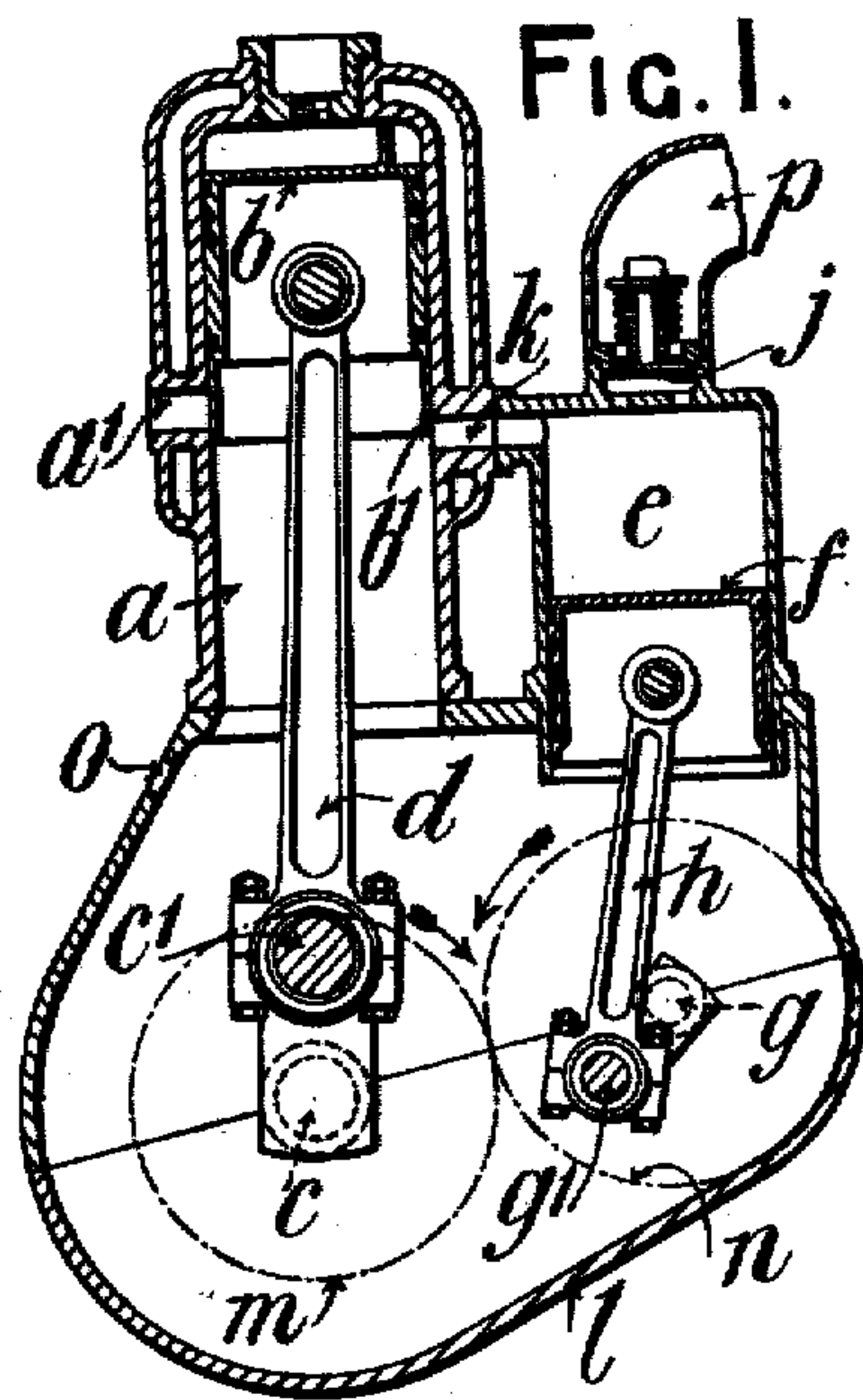


W. BURNELL.  
INTERNAL COMBUSTION ENGINE.  
APPLICATION FILED JAN. 16, 1909.

Patented Aug. 3, 1909.

929,829.



Witnesses:  
E. M. Morgan.  
M. E. Ruebush.

Inventor:  
Walter Burnell  
By *B. Burnell*  
Attorney



# UNITED STATES PATENT OFFICE.

WALTER BURNELL, OF WESTON-SUPER-MARE, ENGLAND.

## INTERNAL-COMBUSTION ENGINE.

No. 929,829.

Specification of Letters Patent.

Patented Aug. 3, 1909.

Application filed January 16, 1909. Serial No. 472,706.

*To all whom it may concern:*

Be it known that I, WALTER BURNELL, a subject of the King of Great Britain and Ireland, residing at 3 Ashcombe Park, Weston-super-Mare, in the county of Somerset, England, have made a new and useful Improvement in Internal-Combustion Engines, of which the following is a full and complete specification.

This invention relates to internal combustion engines of the two-cycle type in which a displacer cylinder is employed, and it consists of the improved construction hereinafter specified whereby the construction is simplified and the number of parts reduced, the object being to pass into the working cylinder a charge of air in advance of the charge of explosive mixture of gas and air so as to more effectually scavenge the working cylinder of the exhaust gases without the loss of any of the gaseous mixture.

According to the present invention the displacer cylinder is connected with the working cylinder by a single port or passage and is provided with an induction pipe fitted with an inlet valve for the admission of the gaseous mixture, the arrangement of the single port or passage and the relative movements of the pistons of the two cylinders being such that during a predetermined period of the suction stroke of the piston of the displacer cylinder the port or passage between the two cylinders is closed by the piston of the working cylinder so that gaseous mixture is drawn into the displacer cylinder through the inlet valve of the induction pipe, and during the remainder of the suction stroke of said piston the port or passage between the two cylinders is opened by the piston of the working cylinder so as to place said passage in communication with the forward end of the working cylinder which is open to the atmosphere through a suitable opening, whereupon the inlet valve in the induction pipe closes and during the remainder of the suction stroke of the piston of the displacer cylinder air alone is drawn into the said cylinder so that when the port or passage between the cylinders is opened as the piston of the working cylinder reaches the end of its working stroke the air passes into the said cylinder in advance of the gaseous mixture and thus scavenges the cylinder without the loss of any gas.

In the accompanying drawing which illustrates this invention:—Figure 1 is a view in sectional elevation showing the piston of the power cylinder at the commencement of its working stroke and the piston of the displacer cylinder approaching the end of its suction stroke; Fig. 2 is a similar view showing the piston of the power cylinder approaching the end of its working stroke and the piston of the displacer cylinder rather more than half-way on its discharging stroke; Fig. 3 is a similar view showing the piston of the power cylinder at the end of its working stroke and the piston of the displacer cylinder approaching the completion of its discharging stroke; and Fig. 4 is a similar view showing the piston of the power cylinder approaching the end of its compression stroke and the piston of the displacer cylinder rather more than half-way on its suction stroke.

Throughout the views similar parts are marked with like letters of reference.

The working cylinder *a* has the usual exhaust port *a'* located at such a position that it is uncovered by the working piston *b* just before it reaches the end of its forward or working stroke. The piston *b* is of such a length that it does not uncover the exhaust port when it is at the end of its inward or return stroke. The piston *b* is connected to the crank-pin *c'* of the crank-shaft *c* by a connecting rod *d* in the usual manner. The back end of the displacer cylinder *e* is in connection with the working cylinder *a* by means of a port or passage *k* the opening of which into the displacer cylinder is so located that it is never covered by the piston *f* and the opening of said passage into the working cylinder is so located that it is in communication with the front end of said cylinder when the piston *b* of the working cylinder is at the front end of its return stroke. The relative positions of the exhaust port *a'* and the port or passage *k* are such that both are opened to the closed end of the working cylinder as the piston *b* reaches the end of its forward or working stroke, the exhaust port *a'* being uncovered in advance of the port or passage *k*, and when said piston is at the end of its inward or return stroke the exhaust port *a'* is covered and closed by said piston and the port or passage *k* is in open communication with the front



end of the working cylinder and therefore with the atmosphere through the opening *o* in the crank-chamber. As the front end of the piston *b* does not clear the port or passage *k* when said piston is at the end of its return stroke a gap or recess *b*<sup>1</sup> is cut or formed in the front edge of the piston for the purpose of opening said port or passage to the front end of the working cylinder. The back end of the piston *b* may be fitted with a deflector for diverting the air and gaseous mixture flowing out of the passage *k* toward the back end of the working cylinder. The induction pipe *p* from the carbureter leads into the closed end of the displacer cylinder *c* and is fitted with an automatic non-return valve *j*. The piston *f* of the displacer cylinder is coupled to the crank-pin *g*<sup>1</sup> of the crank-shaft *g* by a connecting rod *h* in the usual manner. The two crank-shafts *c* and *g* are geared together by spur wheels *m* and *n* of equal size so that they rotate at the same speed in opposite directions and said wheels are so meshed that the piston *f* of the displacer cylinder is moving on its suction stroke during the whole of the time the passage *k* is open to the atmosphere through the front end of the working cylinder, so that during the latter part of the said suction stroke air is drawn into the displacer cylinder through the passage *k*, the cylinder *a*, the crank-chamber *l*, and hole *o*, the inlet valve *j* closing immediately the vacuum in the cylinder is destroyed by the opening of the passage *k* to the atmosphere. A stratum of air is thereby obtained in the displacer cylinder above the gaseous mixture which air is first discharged into the working cylinder which thus scavenges it in advance of the introduction of the gaseous mixture. The valve *j* may be mechanically operated without departing from the spirit and scope of my invention.

The cycle of operation is as follows:—  
 Commencing with the working stroke of the working cylinder, the piston of said cylinder first closes the passage between the two cylinders to the front end of the working cylinder and then as it approaches the end of its working stroke it first uncovers the exhaust port and subsequently opens the passage between the two cylinders to the back end of the working cylinder. On the return stroke of the piston of the working cylinder it first closes the passage between the two cylinders, next closes the exhaust port, and as it reaches the end of said stroke it opens the passage between the two cylinders to the atmosphere through the front end of the working cylinder. At the end of the return stroke and the commencement of the working stroke of the piston of the working cylinder the piston of the displacer cylinder is reaching the end of its outer or suction stroke and draws air into

the displacer cylinder through the front end of the working cylinder until the port or passage between the two cylinders is closed by the piston of the working cylinder. During the remainder of the working stroke of the piston of the working cylinder the piston of the displacer cylinder is making its return or discharge stroke which operates to compress the gaseous mixture and the air until the passage between the two cylinders is opened by the piston of the working cylinder which allows first the air and then the gaseous mixture to flow into the working cylinder. The air operates to scavenge the said cylinder and passes out by the exhaust port until said port is closed by the piston of the working cylinder on its return stroke. During the return stroke of the piston of the working cylinder when the passage between the two cylinders is closed the piston of the displacer cylinder is on its suction stroke drawing in gaseous mixture through the inlet pipe or passage until said piston opens the passage between the two cylinders and puts the displacer cylinder into communication with the atmosphere through the front end of the working cylinder when the inlet valve closes and air only is drawn into the displacer cylinder as before described.

What I claim as my invention and desire to secure by Letters Patent is:—

The combination in an internal combustion engine of the two-cycle type, of a working cylinder the front end of which is open to the atmosphere, a piston in said cylinder, an exhaust port located at the forward end of said cylinder so as to be opened by the piston as it approaches the end of its working stroke, a displacer cylinder, a piston in said cylinder, a single port or passage between the displacer and working cylinders, the opening of said port or passage into the working cylinder being so located that it is uncovered by the piston of the working cylinder as it approaches the ends of both of its strokes thereby placing the displacer cylinder in communication alternately with the back and front ends of the working cylinder, and the opening of said port or passage into the displacer cylinder being so located that the piston of said cylinder does not operate as a valve to said port or passage, a recess in the front edge of the piston of the working cylinder to coincide with the orifice of the port or passage between the two cylinders when said piston is at the end of its return stroke, crank-shafts to which the pistons of the two cylinders are coupled by connecting rods, spur wheels on the two crank-shafts for gearing said shafts together, the angularity of the crank of one shaft with respect to that of the other being such that the piston of the displacer cylinder is moving on its suction stroke during the whole of the time the port or passage

between the two cylinders is open to the atmosphere through the front end of the working cylinder, a port or passage in the back end of the displacer cylinder for the admission of the explosive mixture, and a non-return valve in said port or passage, as set forth.

In testimony whereof I have signed my name in the presence of two subscribing witnesses.

WALTER BURNELL.

Witnesses:

W. M. APPLETON,  
G. E. APPLETON.