No. 708,029. Patented Sept. 2, 1902.

R. DIESEL.

INTERNAL COMBUSTION ENGINE.

(Application filed Jan. 18, 1901.)

(No Model.)

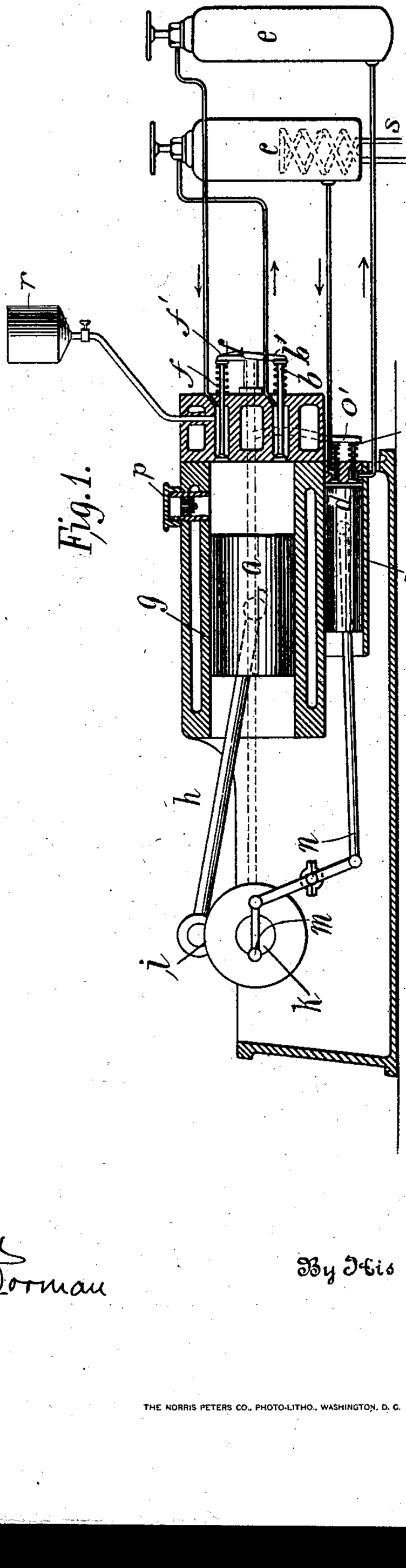

Fig. 1.

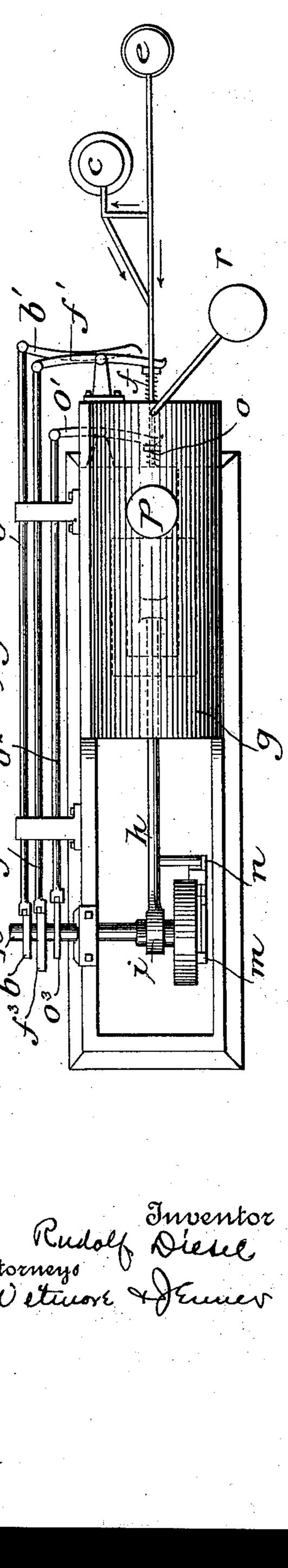

Fig. 2.

Witnesses
Edgworth Bruce
Theodor T. Norman

Inventor
Rudolf Diesel
By His Attorneys
Wetmore & Emmet

UNITED STATES PATENT OFFICE.

RUDOLF DIESEL, OF MUNICH, GERMANY, ASSIGNOR TO DIESEL MOTOR COMPANY OF AMERICA, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

INTERNAL-COMBUSTION ENGINE.

SPECIFICATION forming part of Letters Patent No. 708,029, dated September 2, 1902.

Application filed January 18, 1901. Serial No. 43,683. (No model.)

To all whom it may concern:

Be it known that I, RUDOLF DIESEL, a subject of the German Emperor, residing at Munich, Kingdom of Bavaria, Germany, have invented new and useful Improvements in Internal-Combustion Engines, of which the following is a specification.

My invention relates to the type of internal-combustion engine in which a primary or secondary combustible is introduced into a combustion-cylinder previously filled with compressed air or compressed primary combustible and ignited. An engine of this type working with air is described in the patent issued to me July 16, 1895, No. 542,846.

The object of my invention is to provide a new and improved means for producing the compressed air or gaseous mixture which is necessary to inject the combustible into the working cylinder. For the production of this air or gaseous mixture, the tension of which must be sufficient to act against the pressure existing in the working cylinder, it is necessary to use a special air pump or pumps, (injection-pump.) When this pump draws the air for injection from the atmosphere, its dimensions must be comparatively large and its frictional resistances, and consequently the lack of efficiency of the motor, are proportionate to its size. To reduce this, there has been sometimes employed a separate pump to partially compress air or gaseous mixture received at atmospheric pressure and then delivered to the injection-pump. The new apparatus herein described makes it possible to reduce the size of the injection-pump to a minimum without the use of a separate pump for preliminary compression. The essential feature is that the pump receives its air or gaseous mixture not at atmospheric or low tension, but from the previously compressed contents of the combustion-space of the working cylinder and thereupon compresses it in a second stage to the desired tension, the withdrawn mixture being cooled after its withdrawal from the working cylinder and before its introduction into the pump, if desired.

In the drawings, Figure 1 shows diagrammatically in vertical section an engine embodying the improved apparatus. Fig. 2 is a plan thereof, showing the valve-operating parts.

The working cylinder g contains the working piston a, connected by the usual connecting-rod h and crank i to the shaft k. The drawings show the engine arranged for horizontal working; but it is as well adapted to run in a vertical position. Valve b, located in the head of the working cylinder g, is mechanically operated and controlled from the shaft k, so as to open near the end of the compressing stroke of the piston a and allow a portion of the compressed contents of cylinder g to escape through the pipe connection into the receiver c. The working cylinder is supplied from a suitable source of supply with air or gaseous mixture through the valved inlet p. If desired, artificial cooling means may be applied to the receiver c, (shown in Fig. 1,) by a cooling-coil S. The receiver may be simply a line of pipe of sufficiently large diameter to act as a receiver. A small compressing-pump l, with piston d preferably placed close beside the combustion-cylinder g, is connected with the receiver c or the equivalent line of pipe. The piston d receives motion from the shaft k by a suitable crank m and connecting-rod n or from any other suitable source of power. It delivers by a mechanically-operated release-valve o through a pipe connection to the receiver e, which in turn is connected to the mechanically-controlled fuel-feed valve f of the combustion-cylinder g. The valves b f o are respectively actuated by pivoted levers b' f' o', connected by the rods b^2 f^2 o^2 with the cams b^3 f^3 o^3, mounted on the shaft k. The rods b^2 f^2 o^2 are suitably mounted, so as to reciprocate in guides, and the levers b' f' o' are supported by suitable brackets.

The operation is as follows: Air or combustible mixture at atmospheric or a low pressure is taken in by the cylinder g either in two-stroke or four-stroke cycle and compressed by the piston a. Before the end of the stroke the valve b opens momentarily, and a portion of the compressed contents es-

capes into receiver *c*, where it may be cooled, if desired. From here the partially-compressed gas is taken by the pump *l* and compressed up to the pressure necessary to inject the fuel against the pressure existing in the working cylinder and discharged into the receiver *e*. From time to time as the fuel-valve *f* opens a portion of the contents of receiver *e* escapes into the combustion-cylinder, carrying with it the fuel supplied at valve *f* from the fuel-tank *r*, the velocity of entrance into the combustion-space being dependent on the excess of the pressure of the injection air or mixture in the valve-chamber of the fuel-valve over the pressure in the combustion-space.

Having described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In an internal-combustion engine, the combination of a working cylinder, having a valved inlet and a mechanically-controlled outlet for air or combustible mixture, and means for withdrawing, cooling, and compressing to a high tension a portion of the air or mixture from the working cylinder, substantially as described.

2. In an internal-combustion engine, the combination of a working cylinder having a valved inlet and a mechanically-controlled outlet, for air or combustible mixture, and a fuel-feed valve, and means for withdrawing a portion of the air or combustible mixture from the working cylinder, compressing it to a tension higher than the ultimate tension due to compression in the working cylinder, and delivering the highly-compressed mixture to the fuel-feed valve, substantially as described.

3. In an internal-combustion engine, the combination of a working cylinder having a valved inlet, and a mechanically-controlled outlet, for air or combustible mixture, and a fuel-feed valve; a compressing-pump having an inlet connected to the outlet of the working cylinder and an outlet connected to the fuel-feed valve; and means for operating the compressing-pump, substantially as described.

4. In an internal-combustion engine, the combination of a working cylinder and piston, the working cylinder having a valved inlet, and a mechanically-controlled outlet for air or combustible mixture, a fuel-feed valve, and an exhaust; a source of supply connected to the inlet for air or combustible mixture; a compressing-pump, having an inlet connected to the outlet for air or combustible mixture of the working cylinder, and an outlet connected to the fuel-feed valve; and means for operating the compressing-pump, substantially as described.

5. In an internal-combustion engine, the combination of a working cylinder and piston, the working cylinder having a valved inlet and a mechanically-controlled outlet for air or combustible mixture, a fuel-feed valve, and an exhaust; a source of supply connected to the inlet for air or combustible mixture; a receiver connected with the fuel-feed valve; a compressing-pump, having an inlet connected to the outlet for air or combustible mixture of the working cylinder, and an outlet connected to the receiver; and means for operating the compressing-pump; substantially as described.

6. In an internal-combustion engine, the combination of a working cylinder and piston, the working cylinder having a mechanically-controlled inlet and a valved outlet for air or combustible mixture, a fuel-feed valve, and an exhaust; a source of supply connected to the inlet for air or combustible mixture; a compressing-pump, having an inlet and an outlet; a connection between the inlet of the compressing-pump and the mechanically-controlled outlet of the working cylinder, and a receiver interposed in said connection; a connection between the outlet of the compressing-pump and the fuel-feed valve of the working cylinder, and a receiver interposed in the connection; and means for operating the compressing-pump; substantially as described.

In testimony whereof I have signed my name, in the presence of two subscribing witnesses, this 11th day of December, 1900.

RUDOLF DIESEL.

Witnesses:
RUDOLF W. HEIHL,
FRANZ WALTER.