No. 783,106. PATENTED FEB. 21, 1905.

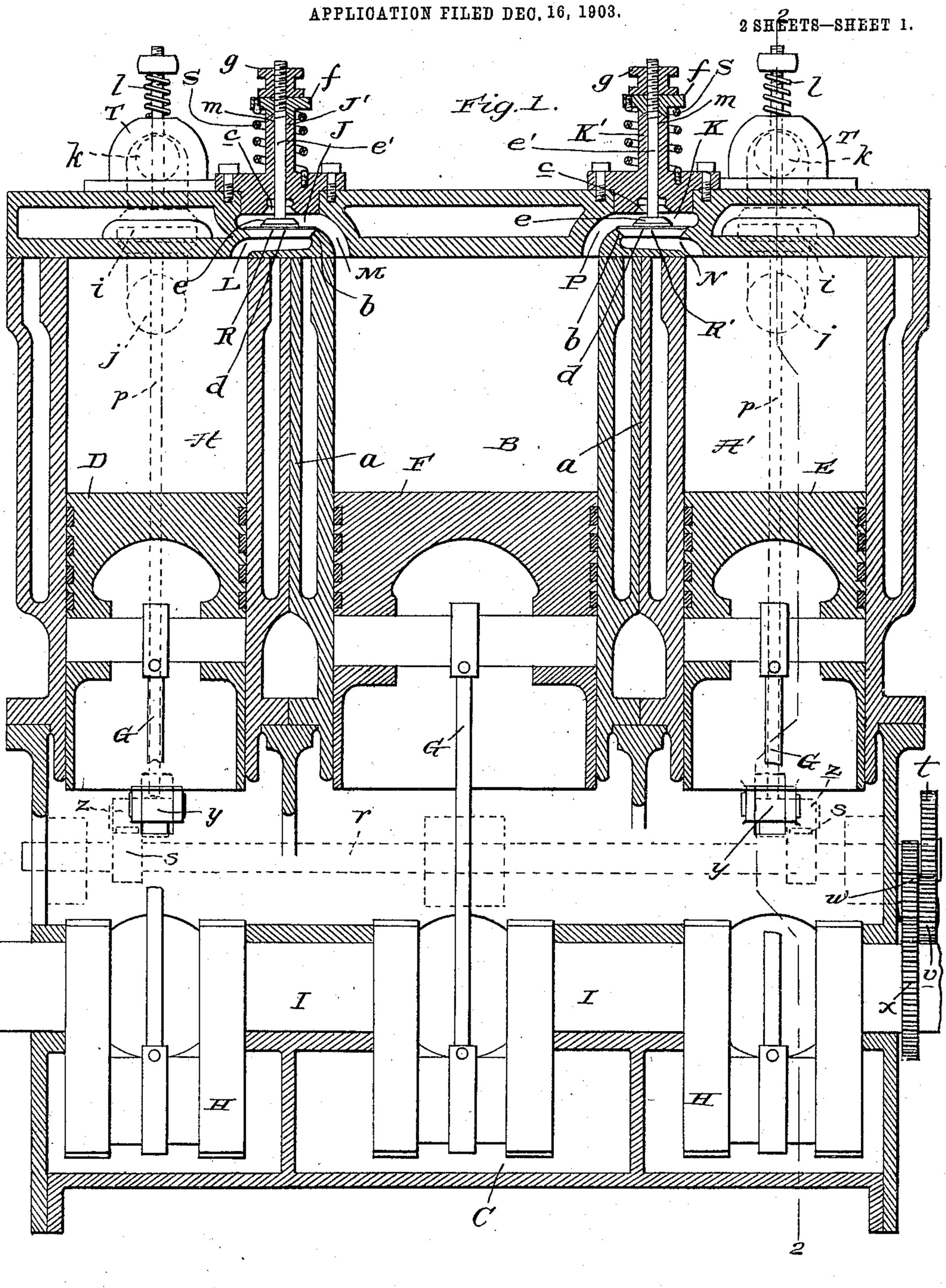
A. G. & C. R. DAELLENBACH.

EXPLOSIVE ENGINE.

APPLICATION FILED DEC. 16, 1903.

2 SHEETS—SHEET 1.

Fig. 1.



Witnesses
C. A. Raudes
N. C. Healy

Inventors
C. R. Daellenbach &
A. G. Daellenbach.
by James L. Shelby Attorney

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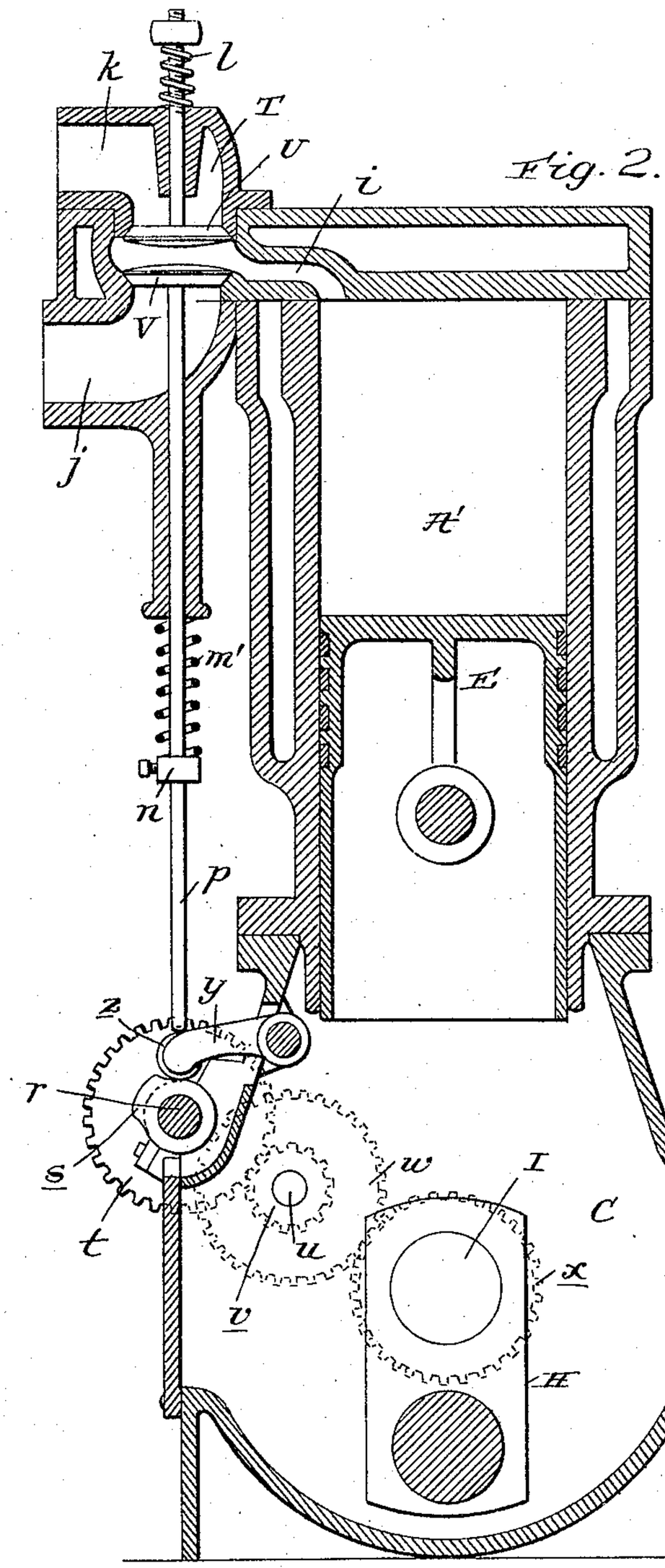

Fig. 2.

Witnesses
C. H. Kaeder
N. C. Healy

Inventors
C. R. Daellenbach &
A. G. Daellenbach.
by James L. Shuhy
Attorney

No. 783,106. Patented February 21, 1905.

UNITED STATES PATENT OFFICE.

ARTHUR G. DAELLENBACH AND CHARLES R. DAELLENBACH, OF PARK GATE, PENNSYLVANIA, ASSIGNORS TO DAELLENBACH GAS ENGINE COMPANY, OF PITTSBURG, PENNSYLVANIA.

EXPLOSIVE-ENGINE.

SPECIFICATION forming part of Letters Patent No. 783,106, dated February 21, 1905.

Application filed December 16, 1903. Serial No. 185,376.

To all whom it may concern:

Be it known that we, ARTHUR G. DAELLENBACH and CHARLES R. DAELLENBACH, citizens of the United States, residing at Park Gate, in the county of Beaver and State of Pennsylvania, have invented new and useful Improvements in Explosive-Engines, of which the following is a specification.

Our invention relates to improvements in explosive-engines, and contemplates the provision of a triple-cylinder explosive-engine the cylinders of which are open at one end to the atmosphere and are adapted to receive explosive mixture in their opposite ends alone, this in order to dispense with ports or passages between the crank-chamber and the explosion-chambers of the engine, which ports or passages have been found to be objectionable because of their tendency to carry the lubricating-oil supplied to the crank-chamber to the explosion-chambers, resulting in the explosions taking place at the wrong time or being altogether omitted, incomplete combustion, and the emission of very smoky products of combustion.

The invention also contemplates the provision of an engine of the kind stated which is simple and inexpensive in construction, is practically noiseless in operation, is capable of being operated at a low rate of speed with high expansion, and is adapted when started to compress the explosive mixture to the point of ignition, this latter to render unnecessary the constant employment of an igniting device, such as a hot tube or a sparker, which are objectionable because of their liability to get out of order, and to insure the explosions taking place at the proper time, which contributes to the power of the engine.

Other objects and advantageous features of the invention will be fully understood from the following description and claims, when taken in conjunction with the accompanying drawings, in which—

Figure 1 is a longitudinal vertical section of an explosive-engine constructed in accordance with our invention, and Fig. 2 a transverse section taken on the broken line 2 2 of Fig. 1.

Similar letters of reference designate corresponding parts in both of the views of the drawings, referring to which—

A A′ are two of the cylinders of my improved engine, and B the third cylinder, which is comparatively large in about the proportion shown in Fig. 1 and is arranged between the cylinders A A′ and separated from the same by walls *a*. The said cylinders in the preferred embodiment of the invention are made separate, as shown in Fig. 1, and are in communication at their lower or outer ends with a crank-chamber C, which in turn is open to the atmosphere. By virtue of the cylinders being separate, as stated, it will be observed that they may be separately cast and machined; also, that when it is necessary to repair one it may be readily removed and as readily replaced without affecting the others.

D, E, and F are pistons arranged in the cylinders A, A′, and B, respectively; G G G, pitmen connecting said pistons with cranks H of a shaft I, journaled in the end walls of the chamber C; J, a valve-chamber disposed between the upper portions of the cylinders A B; K, a valve-chamber arranged between the upper portions of the cylinders A′ B; L, a passage connecting the upper end of cylinder A and valve-chamber J; M, a passage connecting said valve-chamber J and the cylinder B and having its end in the latter disposed downwardly, so as to cause explosive mixture to take a downward course therein; N, a passage connecting the valve-chamber K and the upper end of the cylinder A′, and P a passage connecting the valve-chamber K and the cylinder B and having its end in communication with the latter disposed in the same manner and for the same purpose as the passage M.

In the valve-chambers J K, which are formed by the cylinder-walls in conjunction with caps J′ K′, are valve-seats *b*, while in the under sides of the caps are valve-seats *c*. Disposed in the chambers between the seats *b c* are valves R R′, which have lower portions *d*

to engage the seats *b* and upper portions *e* to engage the seats *c* and also have stems *e'*, which extend through bores in the caps J' K' and are equipped above the said caps with metallic or other suitable disks *f* and nuts *g*. The valves R R' have for their purpose to control communication between the cylinders B and A and B and A', respectively, and they are normally held to their seats *b* by springs S, interposed between and connected to the disks *f* and the caps J' K'. When the valves R R' are thus held to their seats *b*, the disks or valves *f* are designed to bear on the upper ends of the caps J J' and close the bores through which the valve-stems extend, while when said valves R R' are raised against their seats *c* they are adapted to close said bores.

The cylinders A A' are each connected by a passage *i* with a valve-chamber T, Fig. 2, provided with an exhaust-port *j* and an inlet-port *k*, the latter being designed to be connected with a carbureter or other source of explosive-mixture supply. Communication between the port *k* and its complementary cylinder A or A' is controlled by an upwardly-seating valve U, normally held and returned to its seat by a spring *l*, while communication between the exhaust-port *j* and its complementary cylinder A or A' is controlled by a downwardly-seating valve V. Said valve V is closed and normally retained in a closed position by a spring *m'*, which exerts downward pressure on a collar *n* on the valve-stem *p*, and it is designed to be opened at intervals through the medium of mechanism which in the preferred embodiment of our invention comprises a shaft *r*, journaled in suitable bearings and equipped with a cam *s* and a gear *t*, a shaft *u*, arranged in suitable bearings and equipped with a pinion *v*, intermeshed with the gear *t* and also with a gear *w*, a gear *x*, fixed on the crank-shaft I and intermeshed with the gear *w*, and a vertically-swinging arm *y*, having an antifriction-roller *z* interposed between and engaging the cam *s* and the lower end of the valve-stem *p*.

It will be appreciated from the foregoing that the cylinders A A' are similar in size, construction, and appurtenances. We desire it understood, however, that the mechanisms for operating the exhaust-valves V of the two cylinders A A' are so timed or disposed that the said exhaust-valves will be opened at different times and permitted to close under the action of their respective springs at different times, as will be presently described.

In the practical operation of our improved engine the pistons D, E, and F move out and in in concert. When the pistons E F are forced outward by an explosion and the piston D moves outward with them, the valve R is closed, the valve R' is open, the valve V, complementary to cylinder A, is closed, and the valve U, complementary to said cylinder A, is open, the latter to permit the piston D to draw a charge of explosive mixture through port *k* and into the cylinder. When the piston D reaches its outermost point and the cylinder A contains a full charge of explosive mixture, the valve U, complementary to said cylinder, closes and the valve R opens. The valve R' remains open during about two-thirds of the subsequent inward stroke, and the exhaust-valve V, complementary to the cylinder A', is opened and held open during the whole of said inward stroke. Incident to the inward movement of the several pistons a portion of the explosive mixture is forced from cylinder A through the valve-chamber J and connecting-ports into the cylinder B, where it displaces products of combustion of the previous explosion and forces the same through the connecting-ports and valve-chamber K into the cylinder A'. From the cylinder A' the said products of combustion are forced by the piston E through the exhaust-port *j*, complementary to said cylinder. When the pistons D E F have moved inwardly two-thirds of their stroke, the valve R' closes, but the valve R remains open and communication between the cylinders A B is continued. At this time one-third of the charge of explosive mixture remains in the cylinder A, while two-thirds of said charge is contained in the cylinder B, but no compression of the mixture has taken place. The valves U and V, complementary to the cylinder A, and the valve R' are, however, now closed, and hence incident to the remainder of the inward stroke of the pistons the explosive mixture will be compressed in the cylinders A B. As a result of the small size of the chambers containing the explosive mixture, the mixture will be rapidly compressed to the point of ignition when the pistons D F will be forced outwardly. During the compression of the explosive mixture in the cylinders A B the piston E operates to entirely clear the cylinder A' of the products of combustion of the previous explosion, and incident to the expansion of the gases in the cylinders A B said piston E serves to draw a charge of explosive mixture into the cylinder A'. When the pistons reach their outermost point, the valve V, complementary to cylinder A, is opened and the valve R' also opens. The valve R remains open until the pistons have traveled two-thirds of their inward stroke. At this time the cylinder A' has discharged two-thirds of the charge of explosive mixture into the cylinder B, while said cylinder B has discharged the products of combustion of the previous explosion into the cylinder A. At this time the valve R closes and compression commences in cylinders A' B, and at the same time the products of combustion of the previous explosion pass from the cylinder A through its ports *j*. When the charge in cylinders B A' is raised to the point of ignition, the pistons E F are forced downwardly and the exhaust-valve D, complementary to the

cylinder A, is opened, when a fresh charge of explosive mixture will be drawn into said cylinder A and the operation described repeated. On the outstroke of the three pistons the valve R is closed and the valve R′ is open, because the valve V, complementary to cylinder A, is closed, while the valve U, complementary to the cylinder A, is open. The valve R opens when the piston D reaches its outermost point, because at that time the valve U, complementary to the cylinder A, opens. The valve R′ remains open about two-thirds of the inward stroke, because the exhaust-valve V, complementary to the cylinder A′, is open throughout the period of said stroke. The valve R′ closes when the pistons have moved inwardly two-thirds of their stroke, and the valve R remains open, because the valves U and V, complementary to the cylinder A, are closed. The valve R closes when the cylinder B has discharged the products of combustion of the previous explosion into cylinder A, because at that time the cylinder A′ has discharged two-thirds of the charge of explosive mixture into the cylinder B.

We have entered into a detailed description of the construction and relative arrangement of the parts embraced in the present and preferred embodiment of our invention in order to impart a full, clear, and exact understanding of the same. We do not desire, however, to be understood as confining ourselves to such specific construction and relative arrangement of parts, as such changes or modifications may be made in practice as fairly fall within the scope of our claims.

Having described our invention, what we claim, and desire to secure by Letters Patent, is--

1. The combination in an explosive-engine of outer cylinders and an intermediate cylinder open at one end, pistons serving in conjunction with said cylinders to form explosion-chambers, valve-chambers arranged between and connected with the explosion-chamber of the intermediate cylinder and the explosion-chambers of the outer cylinders, valves controlling communication between the outer cylinders and the intermediate cylinder and arranged to seat toward the outer cylinders, a connection between the pistons whereby they are caused to move together, exhaust-ports communicating with the explosion-chambers of the outer cylinders, means for controlling said exhaust-ports, and means whereby said explosion-chambers of the outer cylinders may be supplied with explosive mixture.

2. The combination in an explosive-engine of outer cylinders and an intermediate cylinder open at one end, pistons serving in conjunction with said cylinders to form explosion-chambers, valve-chambers arranged between and connected with the explosion-chamber of the intermediate cylinder, and the explosion-chambers of the outer cylinders, and having lower and upper valve-seats, spring-pressed valves arranged in said chambers between the said seats, a connection between the pistons whereby they are caused to move together, exhaust-ports communicating with the explosion-chambers of the outer cylinders, means for controlling said exhaust-ports, and means whereby said explosion-chambers of the outer cylinders may be supplied with explosive mixture.

3. The combination in an explosive-engine, of outer cylinders and an intermediate cylinder open at one end, pistons serving in conjunction with said cylinders to form explosion-chambers, a crank-shaft, connections between the pistons and the said shaft, spring-pressed valves controlling the fuel-inlet ports of the outer cylinders and arranged to open toward the interior of said cylinders, valves controlling the exhaust-ports of the outer cylinders and arranged to open toward the interiors of said cylinders, connections between the crank-shaft and the exhaust-valves for operating the latter by the former, valve-chambers arranged between and connected with the explosion-chamber of the intermediate cylinder and the explosion-chambers of the outer cylinders, and valves controlling communication between the outer cylinders and the intermediate cylinder and arranged to seat toward the outer cylinders.

4. The combination in an explosive-engine of outer cylinders and an intermediate cylinder open at one end, pistons serving in conjunction with said cylinders to form explosion-chambers, valve-chambers arranged between and connected with the explosion-chamber of the intermediate cylinder and those of the outer cylinders and having bores in their upper walls and also having the lower and upper valve-seats, spring-pressed valves arranged in said chambers and having stems extending through the bores in the upper walls thereof, valves on said stems arranged to seat downwardly on the upper walls of the said valve-chambers, a connection between the pistons whereby they are caused to move together, exhaust-ports communicating with the explosion-chambers of the outer cylinders, means for controlling said exhaust-ports, and means whereby said explosion-chambers of the outer cylinders may be supplied with explosive mixture.

In testimony whereof we have hereunto set our hands in presence of two subscribing witnesses.

ARTHUR G. DAELLENBACH.
CHARLES R. DAELLENBACH.

Witnesses:
M. D. KIFER,
A. R. FRITT.