No. 637,660. Patented Nov. 21, 1899.

# E. E. PETTEE & J. J. McCUTCHAN.

## UTILIZATION OF COMPRESSED AIR FOR MOTIVE PURPOSES.

(Application filed Mar. 9, 1899.

(No Model.) 2 Sheets—Sheet 1.

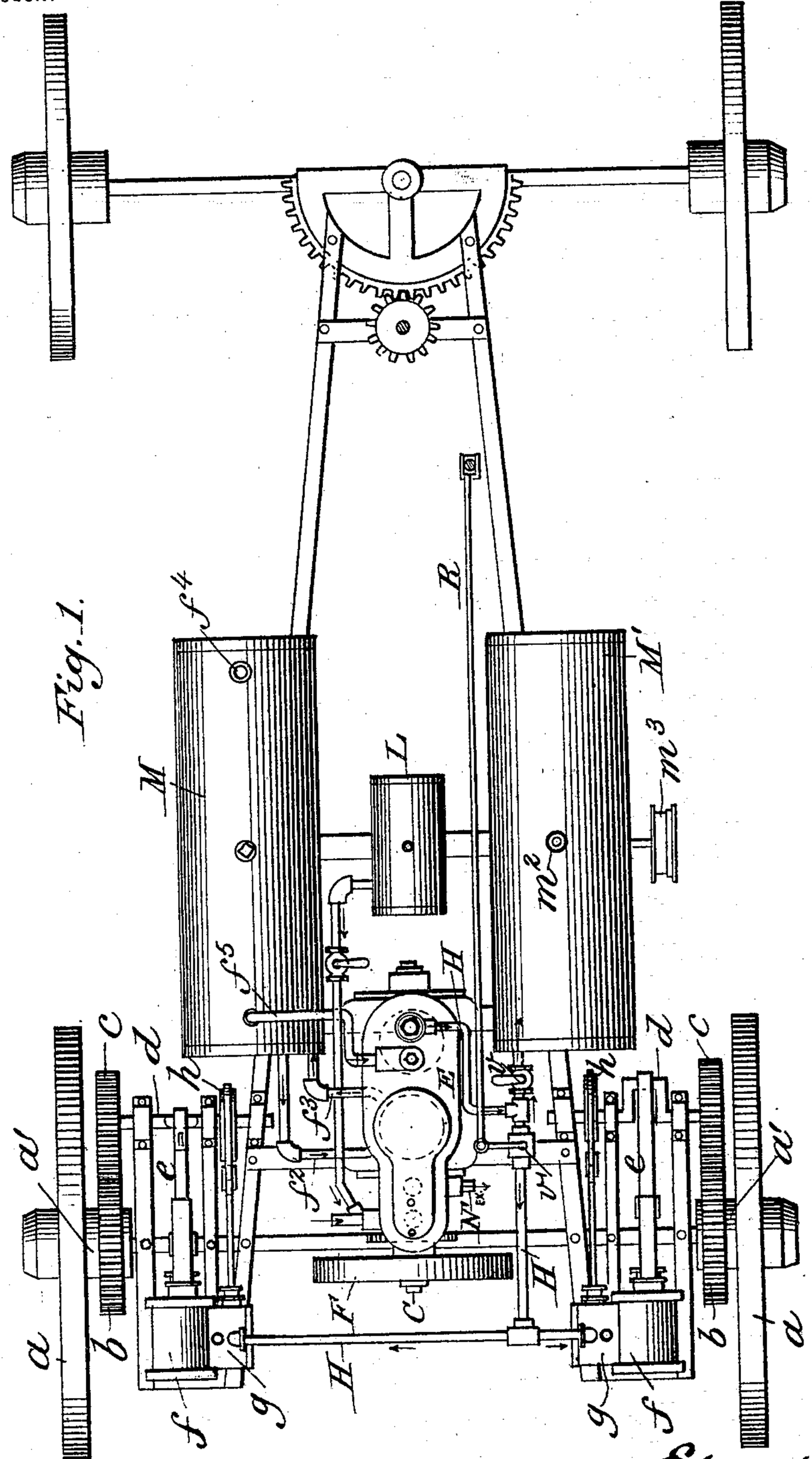


Fig. 1.

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Fig. 2.

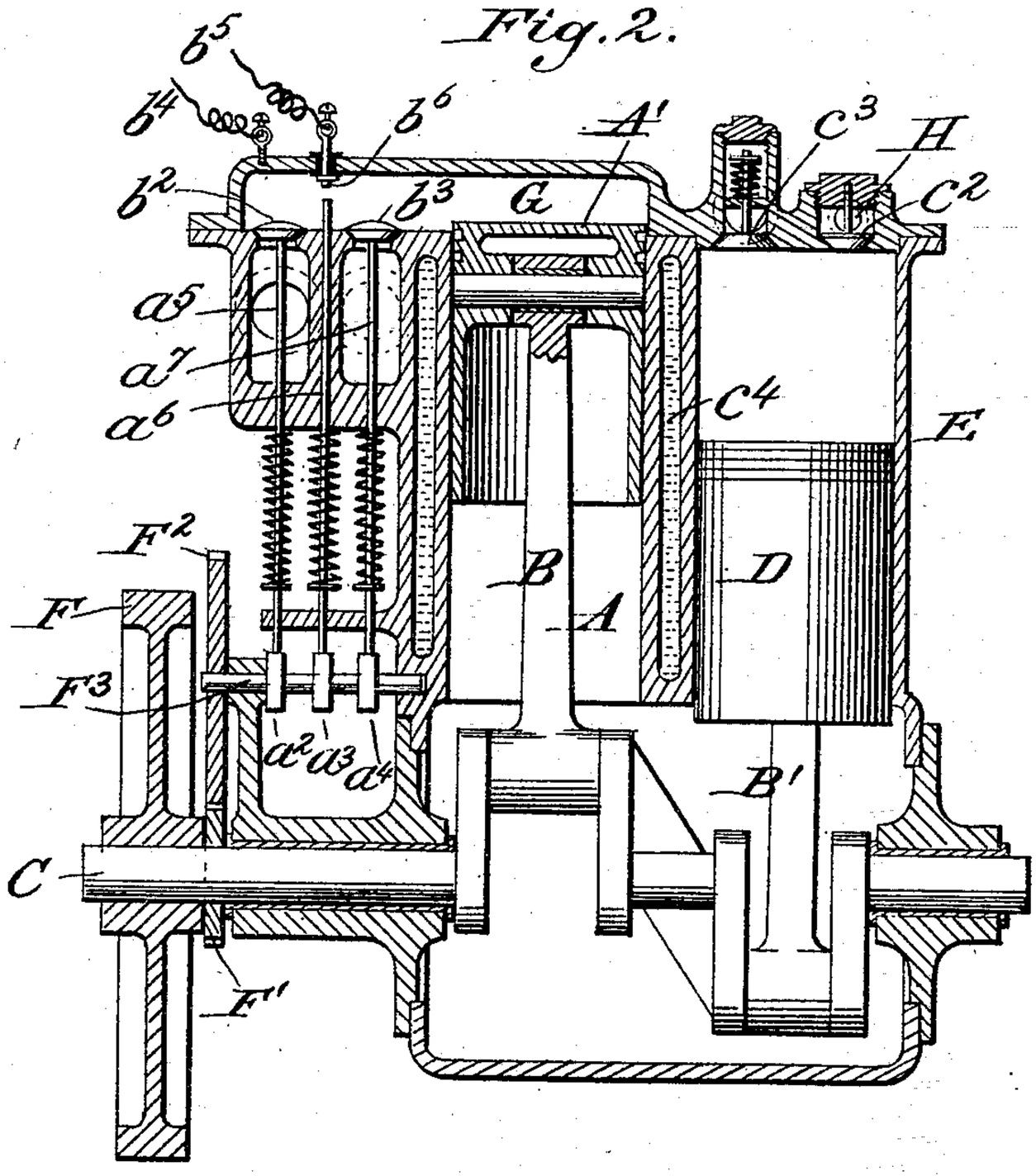
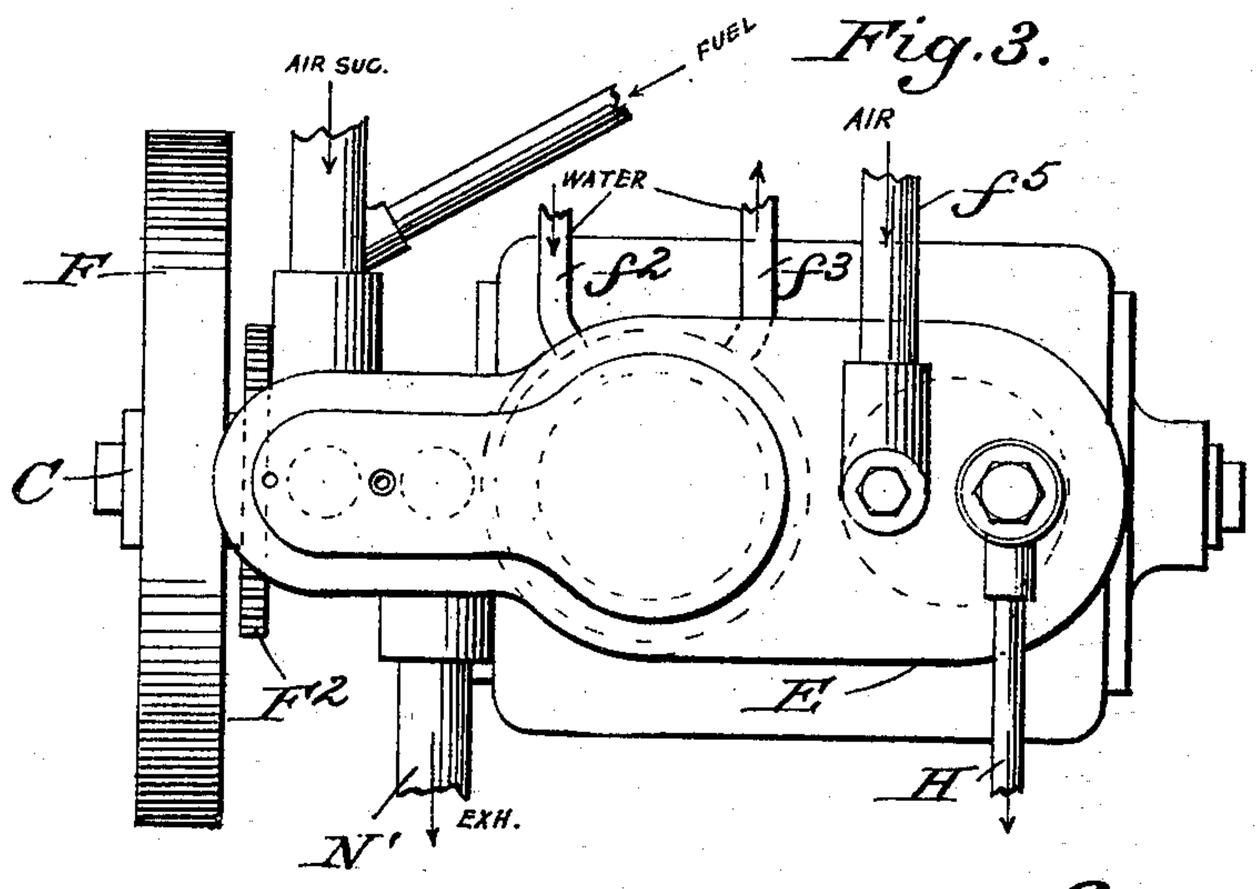



Fig. 3.

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# UNITED STATES PATENT OFFICE.

EDWARD E. PETTEE AND JOHN J. McCUTCHAN, OF NEW YORK, N. Y., ASSIGNORS, BY MESNE ASSIGNMENTS, TO THE AUTOMATIC AIR CARRIAGE COMPANY, OF NEW YORK.

## UTILIZATION OF COMPRESSED AIR FOR MOTIVE PURPOSES.

SPECIFICATION forming part of Letters Patent No. 637,660, dated November 21, 1899.

Application filed March 9, 1899. Serial No. 708,422. (No model.)

*To all whom it may concern:*

Be it known that we, EDWARD E. PETTEE and JOHN J. MCCUTCHAN, citizens of the United States, and residents of the city of New York, county of New York, and State of New York, have invented certain new and useful Improvements in the Utilization of Compressed Air for Motive Purposes; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

Our invention relates to certain new and useful improvements in systems of compressed-air distribution adapted particularly to the propulsion of vehicles and wherein an explosive-engine or like power-generator is employed for the purpose of compressing air, supplying the same to an air motor or motors, and accumulating in a storage-receptacle a reserve portion of the compressed air not required for the operation of the motor when running under a light load, from which storage-receptacle the surplus compressed air may be supplied to the motor whenever the demands of the motor exceed the normal output of the compressor and so as to be used conjunctively with the compressor output. The general arrangement indicated permits the motor to perform extraordinary work for a limited period—as, for instance, in starting the vehicle from a state of rest or when under way to assist it in mounting a steep hill or in carrying abnormal loads.

In the accompanying drawings, Figure 1 represents in plan view the application of our invention to the propulsion of a vehicle. Fig. 2 represents in vertical section a suitable construction of air-compressor appropriate for use in the system, and Fig. 3 represents a plan view thereof.

Similar letters of reference indicate similar parts throughout the several views.

In the drawings, by way of illustration, we have shown the invention as applied to the propulsion of a front-steering rear-driven automobile, although it will of course be understood that it is not confined to that or any other particular type of vehicle, its generic or main characteristic features being manifestly capable of widely-extended use.

The operative parts are supported upon longitudinal and transverse stringers, united, as shown, to form a framework of suitable resiliency entirely independent of the body portion of the vehicle, so that the vibrations of the compressor and air-motors shall not be transmitted to the vehicle-body to the discomfort of the passengers.

In the form illustrated in the drawings the rear wheels $a$ of the vehicle are mounted to revolve freely upon the rear axle and are provided with hubs $a'$, having fixed thereon the pinions $b$, which mesh with pinions $c$ upon the crank-shafts $d$, arranged, as shown, with their cranks at right angles to each other. The crank-shafts are operated by the pitmen $e$ from the cylinders $f$ of any suitable form of air-motor, having the usual slide-valves for controlling the supply and exhaust of the cylinders, said valves being conveniently actuated from eccentrics $h$ on the crank-shafts, as will be understood.

The distributing-chests $g$ of the motors $f$ are supplied with compressed air from a conduit H, leading from an air-compressor cylinder, whose specific construction is illustrated (together with that of the explosive-engine for operating it) in Figs. 2 and 3. Referring particularly to those figures, it will be noted that the piston A′ of the explosive-engine is connected by a piston-rod B with a crank-shaft C, having at its outer end a balance-wheel F mounted thereon. The air-compressor cylinder E is likewise provided with a piston D and is connected to the crank-shaft C by a piston-rod B′ at an angle of one hundred and eighty degrees from the point of attachment of the piston-rod B. Upon the the crank-shaft C is mounted the gear F′, intermeshing with a gear $F^2$ of twice the diameter of the gear F′. The gear $F^2$ is fixed upon a cam-shaft $F^3$, carrying a series of cams $a^2$ $a^3$ $a^4$, upon which rest the lower ends of rods $a^5$ $a^6$ $a^7$, provided with springs for maintaining them in contact with the working surfaces of the cams, as shown. To the rod $a^5$ is attached the valve $b^2$, which governs the inlet

to the engine, and to the rod $a^7$ is attached the valve $b^3$, which governs the exhaust therefrom. The rod $a^6$ terminates at its upper end as a contact, adapted to close an electric circuit through the wires $b^4$ $b^5$ when brought into electrical connection with the insulated contact $b^6$, so that when separated from the contact $b^6$ an electric spark will result, thereby exploding the mixture of gas and air or of oil-vapor and air in the space G. The explosion of this mixture causes the piston A′ to descend and the piston D to rise. As the piston D′ rises in the cylinder E the air within the cylinder is compressed and passes through the exit-valve $c^2$ into the pipe H. On the descent of the piston D air enters through the spring-seated valve $c^3$ to supply the necessary volume of air for a subsequent compression.

To start the explosive-engine, the balance-wheel F is turned one revolution until the piston A′ has descended within its cylinder and drawn therein air and gas or air and oil-vapor in their proper proportion through the valve $b^2$, which has been opened by the cam $a^2$ as the piston descended. When the piston A reaches the end of its stroke, the cam $a^2$ releases the rod $a^5$ and the valve $b^2$ closes. As the piston A′ rises the mixture of air and gas is compressed within the space G, and at the same time the cam $a^3$ raises the rod $a^6$ and closes electric communication with the contact $b^6$. When the piston A′ has reached the upper limit of its stroke, the balance-wheel F carries the shaft C somewhat past the center and the cam $a^2$ releases the rod $a^6$, which immediately drops from the highest point of the cam to the lowest part thereof and breaks the contact made at $b^6$, thereby producing an electric spark which explodes the mixture of gas and air, and thereby forces the piston A′ downwardly, thus raising the compressing-piston D. As the piston A′ returns to its upper position the cam $a^4$ raises the rod $a^7$ and opens the valve $b^3$, thereby allowing the exploded gases or products of combustion to pass to the exhaust N′. When the piston A′ has reached the limit of its upper stroke, the cam $a^4$ releases the rod $a^7$, whereupon said rod drops and closes the valve $b^3$. At the same time the valve $b^2$ is opened and a new supply of gas and air is drawn into the cylinder, as hereinbefore described.

Referring now to Fig. 1, it will be noted that the supply of air to the air-compressor is obtained through a pipe $f^5$ from a tank M, adapted to contain a quantity of water, said water being in communication (by pipes $f^2$ $f^3$, opening below the level of the liquid therein) with the water-jacket $c^4$ of the explosive-engine, whereby a circulation of water is obtained from the water-jacket to the supply-tank and returned, so as to cool the walls of the working cylinder of the explosive-engine. The tank M is provided with an air-inlet $f^4$, and the pipe $f^5$ opens into the tank M above the water-level, so that the air drawn into the compressor is caused to first pass over or into contact with the water in the tank, thereby becoming warmed or preheated and moistened before entering the compression-cylinder. The supply of fuel to the explosive-engine is obtained from a tank L, wherein is contained either oil or compressed gas. At its exit from the air-compressor the compressed moist air is conducted by the pipe H directly to the motors or into a storage-receptacle M′ with a safety-valve $m^2$. This storage-receptacle is designed to receive and store at high pressure a reserve or auxiliary supply of compressed air and may be conveniently filled when the motor is at rest or when it is operating under light load. A cock $v$ permits the storage-tank M′ to be entirely cut off from communication with the pipe H, or a throttle-valve $v'$, operated by the driver by means of a handle and connecting-rod R, governs the flow of the compressed air to the motors when its employment is required.

The operation of the invention will be readily understood. When the explosive-engine is at work and the throttle-valve $v'$ closed, the air-compressor may be employed for storing compressed air at the predetermined pressure within the reservoir M′, thereby accumulating in said reservoir a reserve or surplus at a pressure limited by the safety-valve $M^2$, said pressure being sufficient to start the motors under any load. For the purpose of starting the vehicle or for enabling it when under way to mount a steep hill or for a limited time to carry an abnormal load we have at hand therefore an auxiliary high-pressure supply amply sufficient for the purpose and which may be charged either when the vehicle is at rest or when it is moving under light load, in which latter instance the surplus pressure developed by the air-compressor may be gradually accumulated in the storage-receptacle for future use. It will be evident that with the arrangement shown and described the motors may be operated directly from the reservoir, directly from the compressor, or by the employment of the reservoir and the compressor in conjunction, in which latter case the continued action of the compressor will serve to maintain approximately a uniform pressure in the motors.

Having thus described our invention, what we claim is—

1. The combination with an air-compressor, of a motor, a storage-receptacle, and supply connections from the compressor to the motor and to the storage-receptacle, so arranged as to permit compressed air to be supplied to the motor directly from the compressor and any excess of air not transmitted to the motor to accumulate in the storage-receptacle, and also to permit air to be supplied to the reservoir when the motor is out of service, substantially as described.

2. In a motor-vehicle, the combination with an air-compressor, of an engine for driving the same, a compressed-air storage-reservoir,

a motor, and pipe connections between the air-compressor, reservoir and motor, so arranged that the motor may be driven directly from the air-compressor, directly from the reservoir, or conjointly from the air-compressor and reservoir; substantially as described.

3. In a motor-vehicle, the combination with an air-compressor, of an engine for driving the same, a compressed-air storage-reservoir, a motor, a supply-pipe leading from the air-compressor to the motor and having a branch leading to the storage-reservoir, and a cut-off cock located in said branch; substantially as described.

4. In a motor-vehicle, the combination with an air-compressor, of an engine for driving the same, a compressed-air storage-reservoir, a motor, and a supply-pipe leading from the air-compressor to the motor and having a branch leading to the storage-reservoir, and a throttle-valve in the said supply-pipe between the said branch and the motor; substantially as described.

5. In a motor-vehicle, the combination with an air-compressor, of an engine for driving the same, a compressed-air storage-reservoir, a motor, a supply-pipe leading from the air-compressor to the motor and having a branch leading to the storage-reservoir, a cut-off cock located in said branch, and a throttle-valve in the supply-pipe between the said branch and the motor; substantially as described.

In testimony whereof we affix our signatures in presence of two witnesses.

EDWARD E. PETTEE.
JOHN J. McCUTCHAN.

Witnesses:
JAS. F. WILLIAMSON,
ROBERT R. BLOOD.