M. BERLIET.

REVERSIBLE PETROLEUM AND COMPRESSED AIR MOTOR.

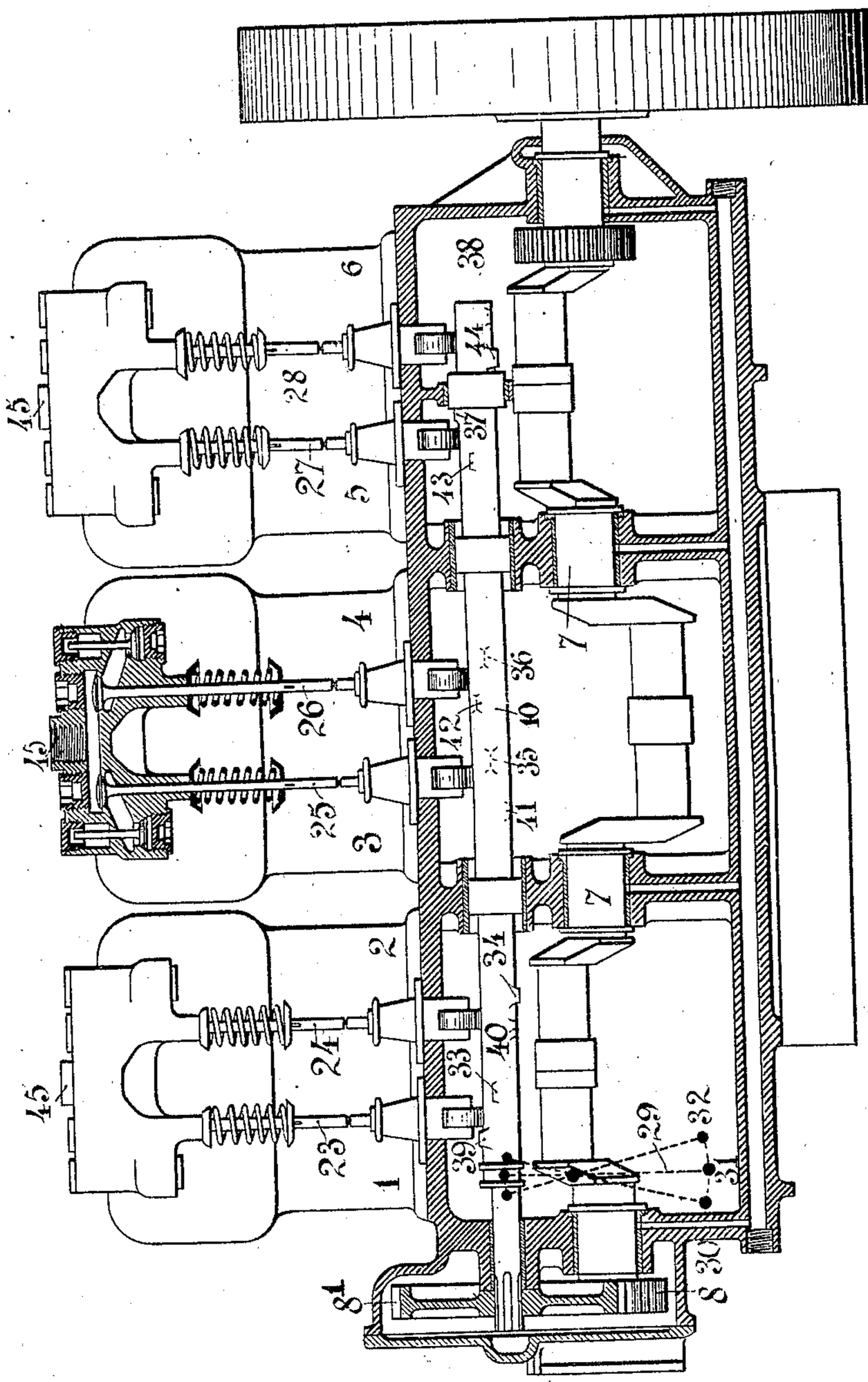
APPLICATION FILED FEB. 24, 1908.

929,540.

Patented July 27, 1909.

3 SHEETS—SHEET 1.

FIG-1



Witnesses:

Jean Germain

Guillaume Pioche

Inventor:

Marius Berliet

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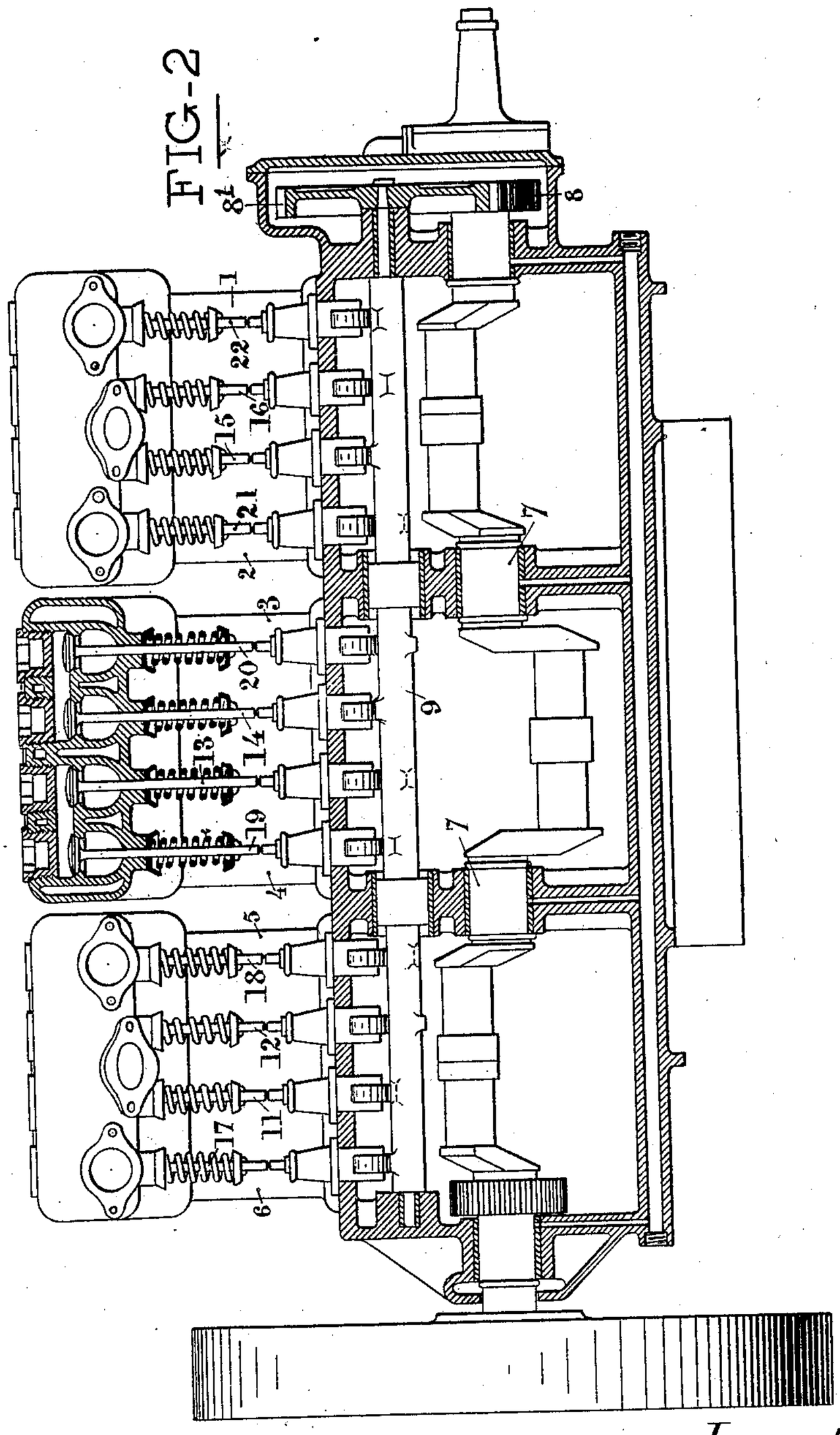
3 SHEETS—SHEET 2.

FIG. 2.



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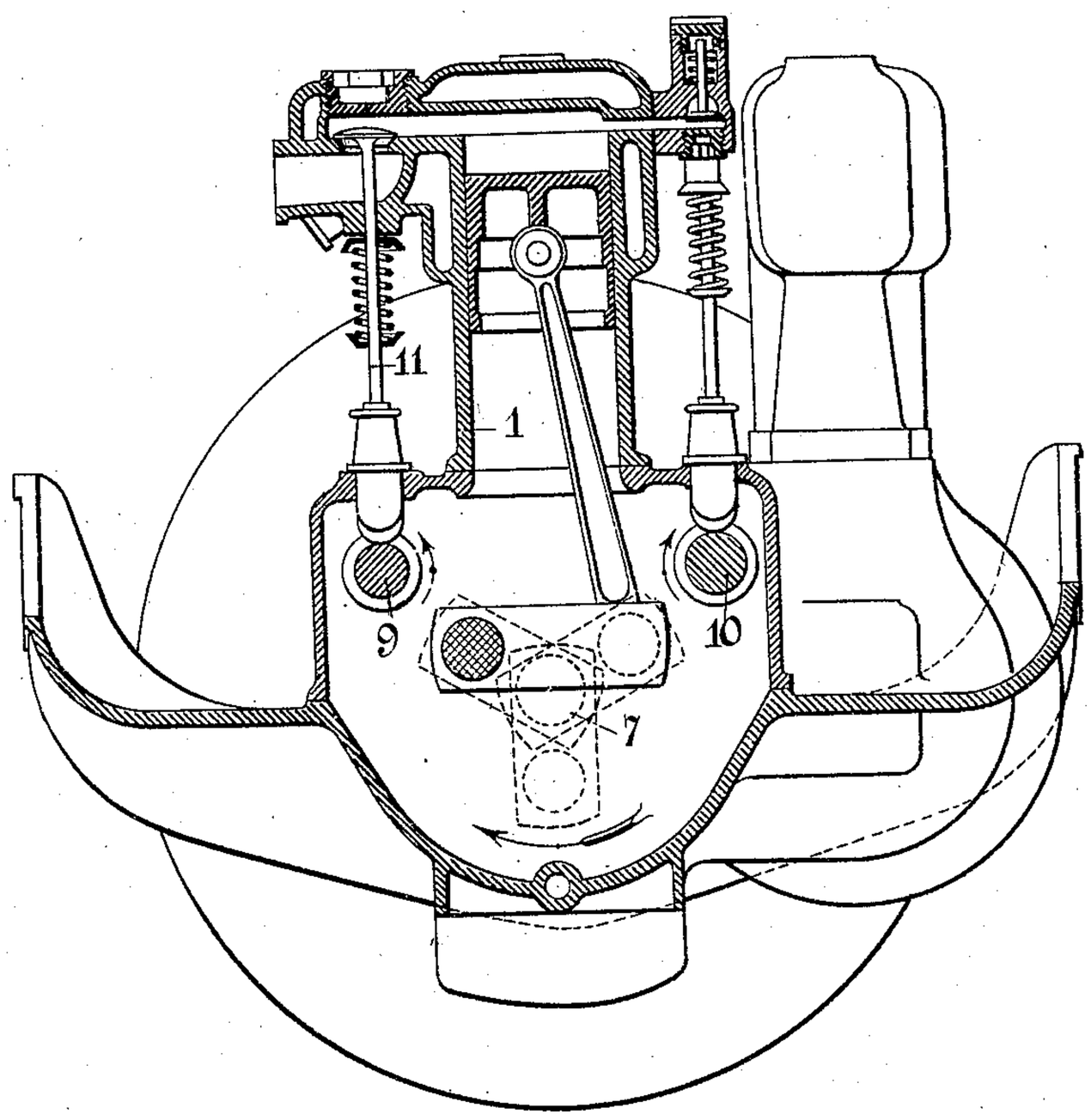
3 SHEETS—SHEET 3.

FIG-3



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UNITED STATES PATENT OFFICE.

MARIUS BERLIET, OF LYON, FRANCE.

REVERSIBLE PETROLEUM AND COMPRESSED-AIR MOTOR.

No. 929,540. Specification of Letters Patent. Patented July 27, 1909.

Application filed February 24, 1908. Serial No. 417,378.

To all whom it may concern:

Be it known that I, MARIUS BERLIET, an engineer and a citizen of the French Republic, residing at Lyon, France, have invented certain new and useful Improvements in Reversible Petroleum and Compressed-Air Motors, of which the following is a specification.

This invention relates to six cylinder motors, in which compressed air can be used in all the cylinders in addition to the usual explosive mixture, and its principal object is to enable the compressed air to be used simultaneously with the combustion of the explosive mixture, by which means a considerable augmentation of the power of the motor may be obtained during a limited time when special occasion arises. In this form of construction, the various phases of running are obtained by the longitudinal displacement of a rotary single cam shaft, which governs the compressed air; as regards the second cam shaft, namely the one which governs the suction and exhaust valves for the explosive mixture, it is not displaced but is revolved only. As the lifting of the valves only takes place every two revolutions of the motor, the compressed air is sent into that cylinder the valves of which are suitably governed.

In the accompanying drawings, a motor comprising the improved arrangements which form the object of the present application is shown, in which—

Figure 1 is a partial longitudinal section along the axes of the air admission valves. Fig. 2 is a partial longitudinal section along the axes of the petrol admission valves; and Fig. 3, a transverse section along the axis of one of the cylinders.

This motor has six cylinders 1, 2, 3, 4, 5 and 6 arranged two by two in pairs, operating by pairs a crank shaft 7 provided with three cranks arranged at 120° relative to one other, two cylinders of the same pair being shut off or disconnected for one revolution for a four stroke movement.

The crank shaft 7 has a pinion 8 which operates two pinions 8^1 keyed on two cam shafts 9 and 10 situated on either side of the crank shaft. The shaft 9 operates the petrol admission valves 11, 12, 13, 14, 15 and 16 and the exhaust valves 17, 18, 19, 20, 21 and 22. The shaft is fixed longitudinally and has only one set of cams producing the operation of the valves as usual.

The shaft 10 operates the compressed air admission valves 23, 24, 25, 26, 27 and 28. This shaft is adapted to be displaced longitudinally assuming three different positions corresponding to running forward, to stopping and to backing. The displacements of this shaft are governed by a forked lever 29 shown in Fig. 1 in dotted lines in its three positions 30, 31 and 32. The position 30 corresponds to backing, the position 31 to the stationary position (this is the position in which the shaft 10 is shown in Fig. 1), and the position 32 to forward running. The shaft 10 has two sets of cams, the one 33, 34, 35, 36, 37 and 38 for forward running, the other 39, 40, 41, 42, 43 and 44 for backing. When the shaft 10 is in the position of repose the rollers of the pushers of the valves travel on cylindrical bearings arranged on the shaft between the cams. The compressed air is under greater pressure than the products of combustion in the cylinders after explosion.

This motor can operate under the following conditions: (*a*) forward running, comprising:—1. Running with compressed air for starting. 2. Mixed running by compressed air and by petrol. 3. Four-stroke running with petrol alone. (*b*) backing with compressed air only.

For starting (forward running) the cam shaft 10 is pushed from right to left by bringing the forked lever 29 into the position 32. By this movement the cams 33, 34, 35, 36, 37 and 38 are brought under the rollers operating the valves and which cams in consequence of their profile, allow an admission greater than 120° and lift one or two valves which give passage to the compressed air arriving at 45, which, penetrating into the cylinders, effects the starting of the motor. The exhaust valves of the expanded air are operated by the cam shaft 9.

The cams for admitting air are arranged so as to reduce gradually and automatically the admission of air up to 80°, so as to diminish its consumption. These cams are also arranged so as only to admit air to the cylinders during one revolution in each two, so that at each revolution, the cylinders 1, 3 and 5 for instance, act as motors and the cylinders 2, 4 and 6 run empty, then in the following revolution, the contrary is the case. During that downward stroke in each cylinder in which compressed air is not being admitted the suction of the carbureted

gas takes place in such cylinder in consequence of the movement of the shaft 9 which operates the admission valves. There is produced therefore, in each cylinder, a four-stroke movement thus defined: 1. Half revolution, descending movement, admission of compressed air. 2. Half revolution, rising movement, exhaust of compressed air. 3. Half revolution, descending movement, suction of carbureted air. 4. Half revolution, rising movement, compression of carbureted air and ignition. The movement thus automatically passes into the mixed running, during which each cylinder works with petrol in a four stroke cycle, compressed air being admitted after the explosion. This admission of compressed air very considerably increases the diagram furnished by the running with petrol, and may be of great utility, because it enables the motor to increase its power in certain cases.

When it is desired to stop the admission of compressed air, it is sufficient to return the shaft 10 to its mean position corresponding to the position 31 of the fork 29; the roller of the air admission valves traveling on the cylindrical parts, the valves 23, 24, 25, 26, 27 and 28 will remain pressed on their seats, and the motor will work with petrol alone during the ordinary four-stroke cycle.

In order to start the motor for backing, it is sufficient to return the shaft 10 to the position 30. The cams 39, 40, 41, 42, 43 and 44 come into action, and in consequence of their position will effect the admission of air under such conditions that the motor will revolve in the reverse direction. The exhaust will be governed by the shaft 9 and will take place by the admission valves in the feed pipe coming from the carbureter. As in running forward with compressed air, the admission of air into each cylinder takes place once in two revolutions.

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

1. In a motor comprising a plurality of cylinders and pistons, two sets of admission valves and a set of exhaust valves to said cylinders, means for supply of carbureted mixture to one set of admission valves, means for supply of compressed air to the other set of admission valves, a rotary cam shaft for controlling the former set of admission and exhaust valves, a rotary cam shaft for controlling the other set of admission valves, means for giving longitudinal movement to the last named cam shaft, and means for synchronizing the rotary movements of said cam shafts, the said cam shafts being set in relative phases so that when in action the two sets of admission valves are operated on alternate strokes of their respective cylinder pistons.

2. In a motor comprising a plurality of cylinders and pistons, two sets of admission valves, and a set of exhaust valves to said cylinders, means for supply of carbureted mixture to one set of admission valves, means for supply of compressed air to the other set of admission valves, a rotary cam shaft controlling the former set of admission and exhaust valves, a rotary cam shaft for controlling the other set of admission valves, the last named cam shaft having cams for operating the valves for forward running, non-operative surfaces for leaving the valves at rest, and other cams for operating the valves, for reverse running, means for giving longitudinal movement to said last mentioned cam shaft, and means for synchronizing the rotary movements of said cam shafts, the said cam shafts being relatively set so that the cams of the said shafts when in action operate the respective sets of admission valves on alternate piston strokes respectively.

In witness whereof I have signed this specification in the presence of two witnesses.

MARIUS BERLIET.

Witnesses:
THOS. N. BROWNE,
GUILLAUME PIOCHE.