

(No Model.)

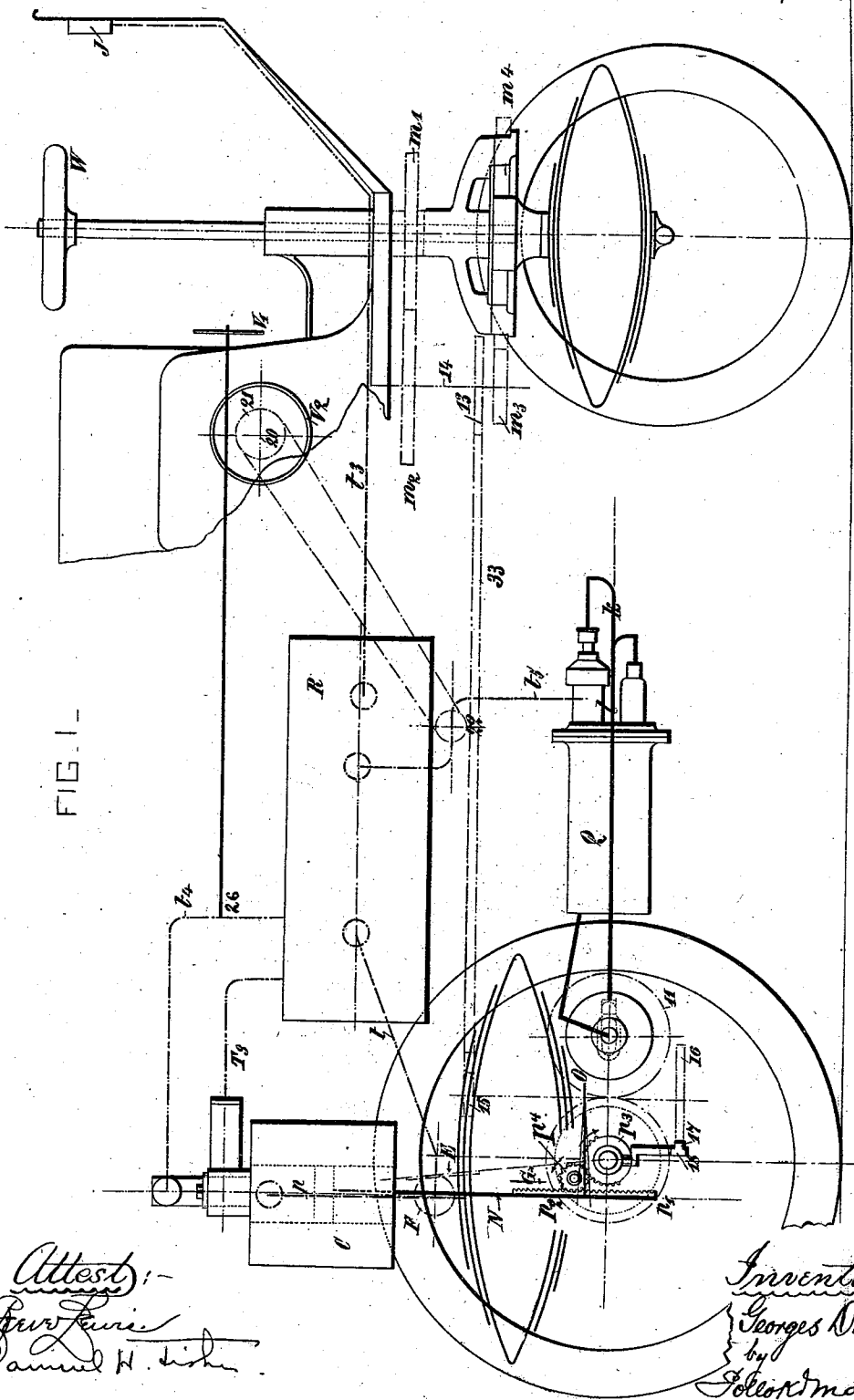
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G. DURAND.
COMPRESSED AIR MOTOR.

No. 550,163.

Patented Nov. 19, 1895.

FIG. 1.



Attest:-
Geo. Lewis
Samuel H. Fisher

Inventor:-
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by
J. J. Mauro
his attorney

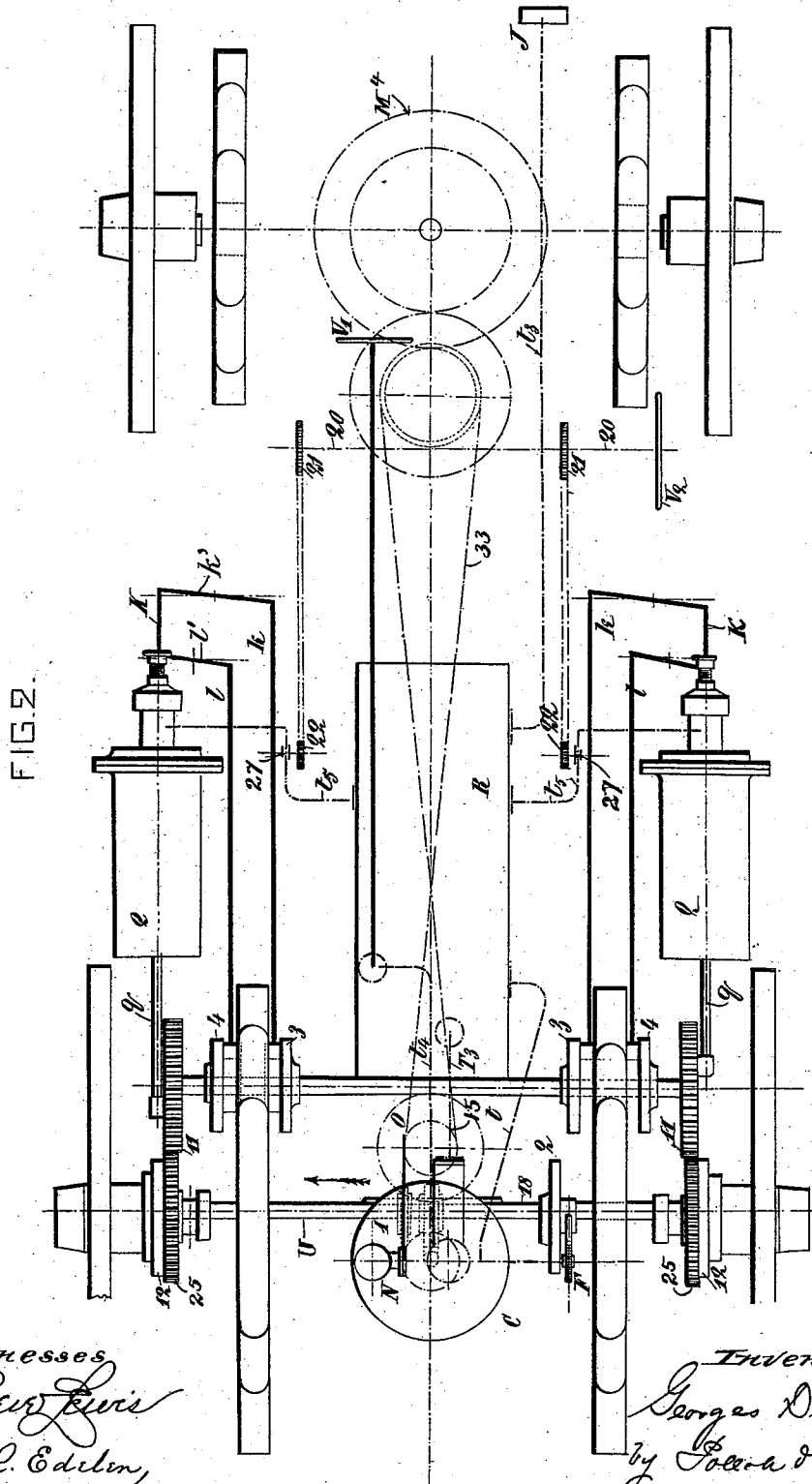
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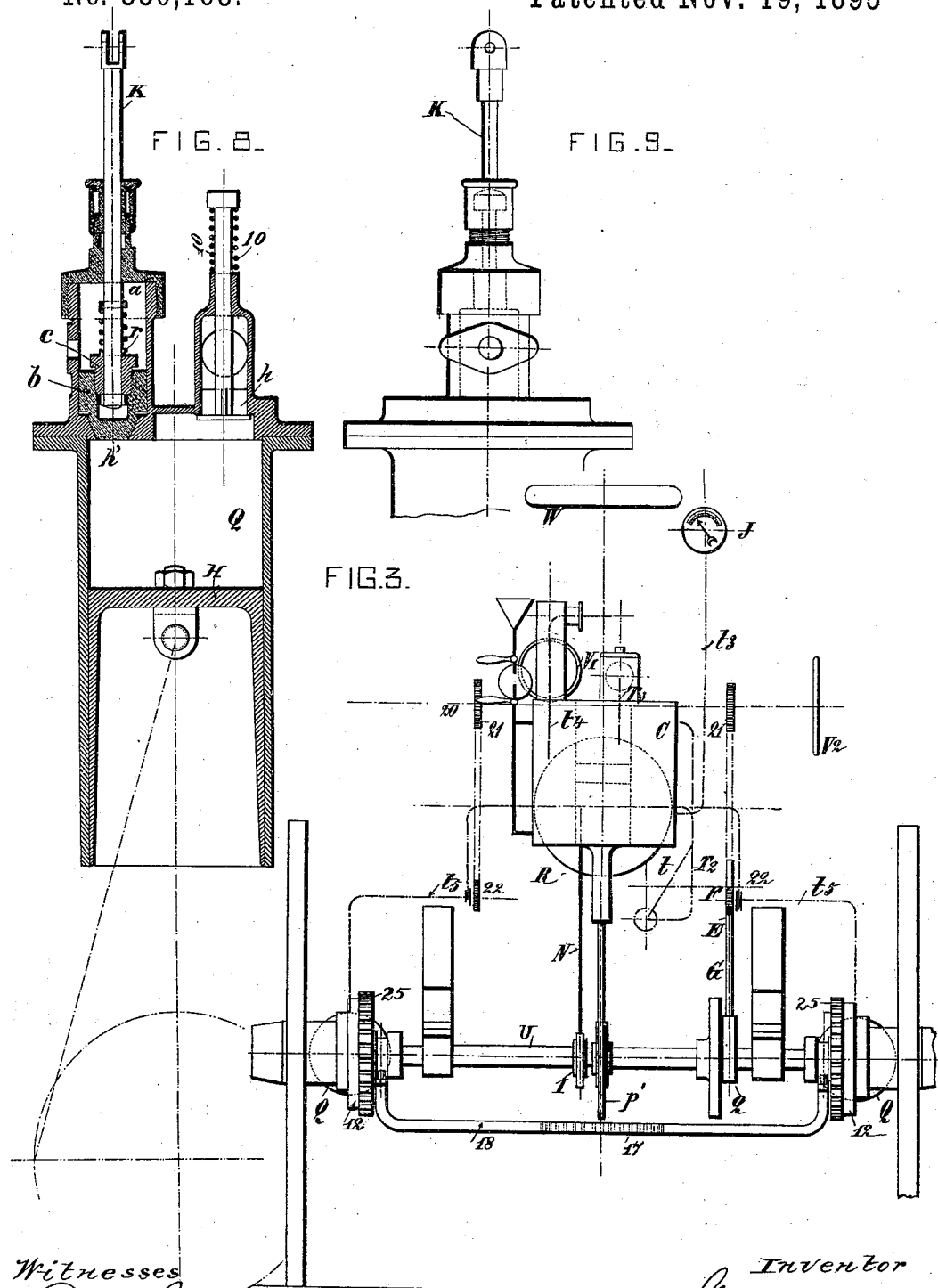
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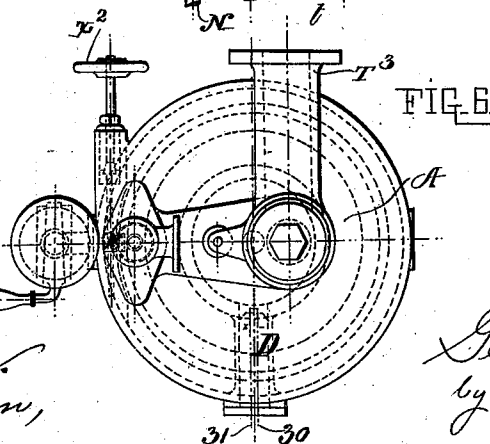
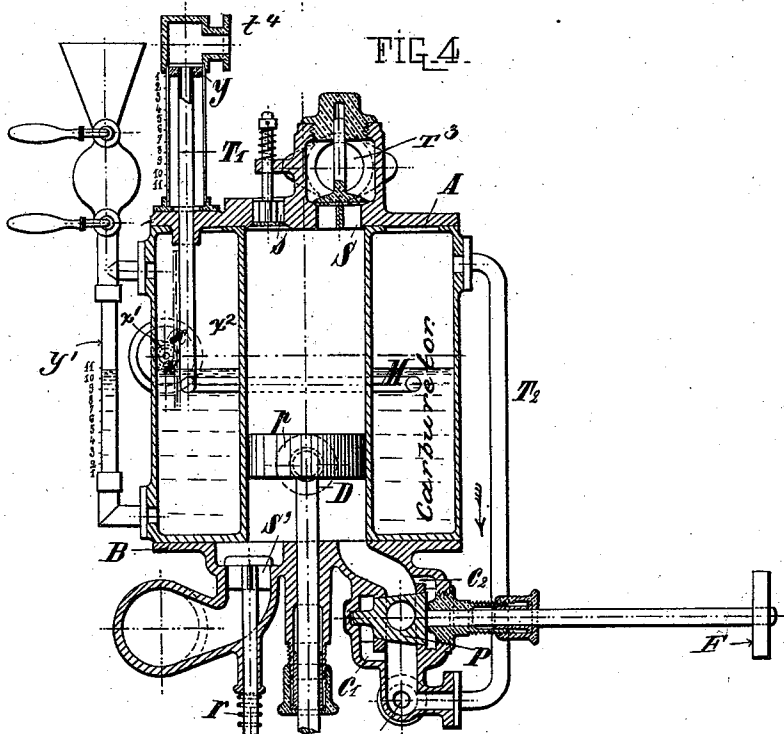
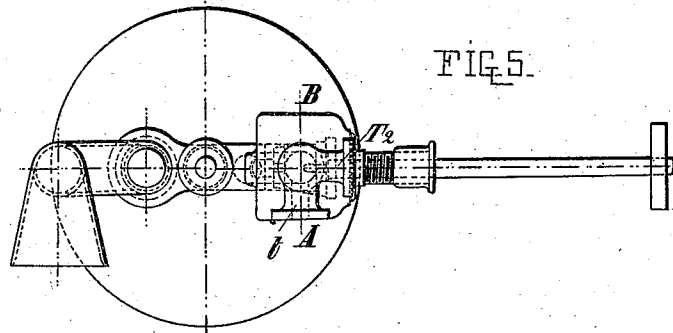
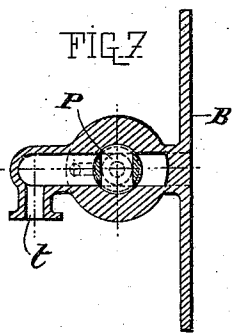
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UNITED STATES PATENT OFFICE.

GEORGES DURAND, OF PARIS, FRANCE.

COMPRESSED-AIR MOTOR.

SPECIFICATION forming part of Letters Patent No. 550,163, dated November 19, 1895.

Application filed January 4, 1894. Serial No. 495,657. (No model.) Patented in France June 17, 1893, No. 230,925.

To all whom it may concern:

Be it known that I, GEORGES DURAND, of Paris, France, have invented certain new and useful Improvements in Compressed-Air Motors, which are fully described in the following specification, and for which I have obtained a patent in France, No. 230,925, dated June 17, 1893.

The object of this invention is to construct a motor suitable especially for traction purposes; and the principle of the invention resides in the employment of two kinds of force or energy, one violent or impulsive energy and the other (into which the first is transformed) quiet, elastic, and easy to store and utilize.

More specifically the invention consists in developing energy by the explosion of a detonating mixture and utilizing the successive intermittent impulses to store in a reservoir a suitable quantity of air under pressure, whose steady and uniform energy is employed in a motor.

The detonating-engine, which is the prime source of power, may be of various types, which are well known; but, preferably, I employ a petroleum-engine, in which the detonating compound is composed of a mixture of air and vapor, the force for propulsion of the current of air being furnished by the air-reservoir. The piston and cylinder of the detonating-engine preferably serve as a pump to store air in the reservoir, from which it is drawn as required for the compressed-air motor. The latter may be constructed in any of the various ways in which the expansion of compressed air produces the movement of a piston, or the dilation of a device constructed on the principle of the bellows.

The compressed air in the reservoir is or may be utilized to effect the tightening of the admission-valve of the detonating-cylinder. The waste gases of the latter can be used to warm the cylinders of the air-motor, and, vice versa, the cold air due to expansion in the latter can be used to lower the temperature of the gas-engine.

The invention includes various improvements of a minor character, which will be explained hereinafter.

The invention being particularly designed for traction purposes is illustrated in the ac-

companying drawings, in connection with a vehicle which it is designed to propel.

In the drawings, Figure 1 is a side elevation, most of the frame and ordinary parts of the vehicle being omitted. Fig. 2 is a plan view. Fig. 3 is a rear elevation. Fig. 4 is a transverse section of the gas-engine in which the explosion is produced to compress the air in the reservoir. Fig. 5 is a plan view of the under side of said engine. Fig. 6 is a plan view of the top of the same. Fig. 7 is a section on line A B of Fig. 5. Fig. 8 is a section of the motor-cylinder and air-valves. Fig. 9 is a plan view of the end of the cylinder and valve-casing.

Inasmuch as many of the parts, such as the valve-operating connections, are of ordinary construction, I have for the sake of clearness and simplicity indicated many of such parts diagrammatically.

It will be assumed that the reservoir R, Fig. 1, is previously filled with air at a pressure of from four to six kilos, and, as I shall hereinafter show, this can be effected by means of elements of the machine itself and does not require the assistance of any auxiliary mechanism.

The carburetor C, Fig. 4, is composed of two concentric cylinders, and in the middle cylinder is the piston *p*. The surrounding annular chamber contains the petroleum, which is heated by contact with the walls of the interior cylinder.

The two concentric cylinders are closed at top and bottom by covers A B. The former A carries the compressed-air-distributing valves. The cover B carries the distributing mechanism of the detonating compound.

Assuming the piston to be at the top of its course and descending, the air-inlet valve S will open by suction, allowing the air to enter. The valve S remains closed during the descent of the piston, being held upon its seat by the pressure from the compressed-air reservoir R, with which it is in communication by pipe T³. When piston *p* arrives at the end of its course, the cock P turns a quarter of a rotation, and the bottom of the cylinder is then put in communication with the reservoir R by the tube *t*, Figs. 1 and 2, and also with the upper part of the carburetor C through the tube T². Thus two conduits bring

air to the cylinder at a pressure superior to that which is under the piston. Through pipe *t* will pass the pure air from the compressed-air reservoir R; but the air from pipe *T*² is charged with vapor from carburetor C, to which it was conducted from the reservoir by pipe *t'*, which is connected with pipe *T'*. Pipe *T'* terminates in the carburetor in a ring M, perforated with small holes and submerged in the petroleum. The air, being agitated by passing through these holes, becomes saturated with vapor. Beneath the piston, therefore, will be, first, pure air from the reservoir R, and, second, air charged with petroleum-vapor coming by pipe *T*².

In order that ring M may always be submerged in the petroleum, whose level falls as it is used, this ring, with its upright pipe *T'*, is vertically adjustable, the head of pipe *T'* being fitted to slide in a sleeve *y*. The pipe has a rack *x*, engaged by a pinion *x'*, which can be turned by a hand-wheel *x*² to adjust the position of ring M. A glass gage-tube *y'* shows the level of the liquid in the carburetor, and this tube is provided with a graduated scale. A corresponding scale on sleeve *y* enables the operator to make an accurate adjustment.

The detonating mixture is introduced under the piston at a pressure of five kilos, which is sufficient to lift the piston, and the entrance of the mixture continues up to the time when cock P closes. This takes place just before the igniting-chamber D, Figs. 4 and 6, is uncovered by the piston. The mixture then ignites by an electric spark and the explosion takes place. The air stored above the piston being compressed by the movement of the piston will lift the valve S and enter the reservoir R through tube *T*³.

When the piston returns to the top of its course the escape-valve S' will open and allow the descent of the piston, driving out the gases. Valve S' and cock P may be actuated by any positive actuating mechanism. As shown, valve S' is actuated from the axle of the vehicle from a cam 1, Figs. 2 and 3, which in turning lifts a horizontal lever whose axis of oscillation is at O. Its end lifts rod N of the valve. A spring *r* returns the valve S' to its seat. Cock P is actuated by rack E, Figs. 1, 3, and 4, operating a pinion F on the spindle of the cock, and the movement is obtained from an eccentric 2 through connecting-rod G, which carries the rack E.

To prevent cock P from wedging, a pipe *c'* connects the rear side of the cock with reservoir R and another pipe *c*² connects the other side with the cylinder below the piston. When the explosion takes place, the pressure, being far greater than that in the reservoir, forces the cock firmly into its seat and the closure is hermetic. At this moment the cock is immovable. On the other hand, when the escape takes place, and when the cock is about to turn to admit of an introduction of air and vapor, there is at the back of the cock

a pressure of five atmospheres, while opposite to it will be only a pressure of one atmosphere. The cock may move freely. At each rotation of the wheel of the vehicle an explosion is produced which causes the introduction into the reservoir R of a volume of compressed air. On the other hand, each revolution of the mechanism of distribution will permit the entrance into the motor-cylinders Q, Fig. 1, of a cylinder full of air from the reservoir R, which drives the piston H, Fig. 8, and is then expelled by the valve *h*, which opens at the proper time. The air from reservoir R is conducted to cylinders Q by pipes *t*² and enters the cylinder by valve *h'*. This valve derives its movement in the following manner: To open it, rod K is actuated by a connecting-rod *k*, connected to valve-rod K by a lever *k'*. Rod K receives its movement from an eccentric 3, Fig. 2, being moved thereby to the right, Fig. 8, and in that movement the piece *b* is carried outward by nut *c* opening the valve *h'*, to which it is connected. To close the valve, rod K moves inward and ring *a* compresses spring *r*, which in turn pushes nut *c* and valve *h'*. Valve *h* is actuated by lever *l* and connecting-rod *l* from an eccentric or cam 4. The opening of the discharge-valve takes place when the rod is pushed to the left. It closes by the action of spring 10.

The connecting-rods *g*, attached to the motor-pistons H, operate each a gear 11, Fig. 2, mounted on an auxiliary shaft and engaging with the gears 25 on the driving-axle U. The wheels 25 are capable of moving lengthwise of the shaft to connect and disconnect therewith.

When the forward wheels are parallel with or in the same direction as the rear wheels—i. e., when the vehicle is going in a straight line—the coupling-sleeves 12 unite the wheels and the motor-gears. In that case both the gears 25 act as motor-gears. When the forward wheels incline to the right, wheel 13, Fig. 1, which is mounted on an upright shaft 14, turns, by a chain 33, the wheel 15, Fig. 1, and consequently the wheel 16, mounted on the same shaft. This latter acts upon the rack 17, Figs. 1 and 3, carried by the bar 18, whose ends are engaged in grooves of the couplers 12, and thus disengage the right wheel, allowing it to turn independently. The left wheel remains then the only driving-wheel. The right wheel becomes, in its turn, the sole driver when the vehicle turns to the left.

For the purpose of starting and stopping the vehicle three cocks are provided. One of them is placed at 26 on tube *t'*, Fig. 1, and permits or cuts off the access of compressed air from reservoir R to the carburetor C. It is worked by hand-wheel V', placed forward, so as to be accessible to the driver. The other cocks 27 are placed one in each of tubes *t*², Fig. 2, and are operated simultaneously by means of a wheel V², whose shaft 20 carries

sprocket-wheels 21, connected by chains with wheels 22, Figs. 1 and 2, on the spindles of the valves or cocks 27.

By turning wheel V^2 in one direction the motor is stopped, since compressed air is cut off from cylinders Q. The starting is effected by turning wheel V^2 in the opposite direction.

In order that the movement of piston p may be regular, its rod carries a rack $p' p^2$, Fig. 1, which engages a pinion p^4 , meshing with wheel p^3 on the axle. At the point corresponding to the moment of explosion the teeth of the wheel are omitted, and the piston-rod is thus free to rise quickly under the expansion of the gases. On the other hand, when the piston reaches the upper limit of its movement the teeth of the pinion p^4 encounter those of the wheel p^3 , which thus causes the piston-rod to descend and insures the regularity of the cycle.

The guiding of the vehicle is effected by a steering-wheel W, which, through gears m' on the same shaft as wheel W, $m^2 m^3$ on shaft 14, and m^4 turns the forward truck in the desired direction.

The igniting of the detonating mixture is effected in any suitable way, preferably by an electric igniter, supplied by a generator of any convenient description. The conductors 30 31 of the igniter are shown in Fig. 6. The air-reservoir R is connected by pipe t^3 with a pressure-gage J, Figs. 2 and 3. The advantages of this combination of two kinds of motors or, rather, of two kinds of energy are, first, it permits utilization of the elastic force of compressed air without the necessity of accumulating it in great volume at a low pressure, which is inconvenient, or in small volumes at high pressure, which is dangerous; second, it permits the employment of a practical motor, such as the petroleum-motor, without necessitating the use of a heavy fly-wheel to give it a regular and uniform movement, the use of a fly-wheel being always inconvenient in a vehicle; third, the pressure of compressed air being used to charge the cylinder with the explosive compound admits of an explosion at each revolution of the petroleum-motor and consequently does away with unnecessary weight, and, fourth, the compressed air acting as a motor permits the au-

tomatic starting of the vehicle—that is, the starting without the aid of the petroleum-engine.

If the compressed air should fail in the reservoir R, it would be possible, after having lifted valve S' , Fig. 4, to reciprocate the piston-rod p by means of hand-levers carried for the purpose. It would thus act as a pump and force air into the reservoir R.

Various modifications may be made in the construction and arrangement of the parts without departing from the spirit of the invention.

Having now described my invention, what I claim is—

1. The combination with the cylinder, piston and valves of a detonating air-pump and with a reservoir supplied with air by said pump, of a cock controlling the admission of the explosive mixture to the detonating chamber, the space in front of the cock being in communication with the detonating chamber, and the space behind it with the air-reservoir, so that the cock is wedged tightly in its seat by the force of the explosion, and relaxed by the pressure of the air when the force of the gases of explosion is expended, substantially as described.

2. The combination in a detonating air-pump comprising a cylinder and its piston, said cylinder having air inlet and outlet valves therein on one side of the piston, and connections for supplying an explosive mixture to the cylinder on the other side of the piston, of a piston-rod connected with the piston, and gearing for connecting the end of the piston rod with a working part of the machine during the return or discharging stroke of the piston and for releasing said piston rod during a working stroke of the piston, the impelling force for the latter stroke being produced by the explosion of the gaseous charge in the cylinder, substantially as described.

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

GEORGES DURAND.

Witnesses:

CLYDE SHROPSHIRE,
JOSEPH LECORTE.