C. J. HAUTIER.

SELF PROPELLED VEHICLE.

APPLICATION FILED OCT. 25, 1909.

992,661. **Patented May 16, 1911.**

2 SHEETS—SHEET 1.

Fig. 1

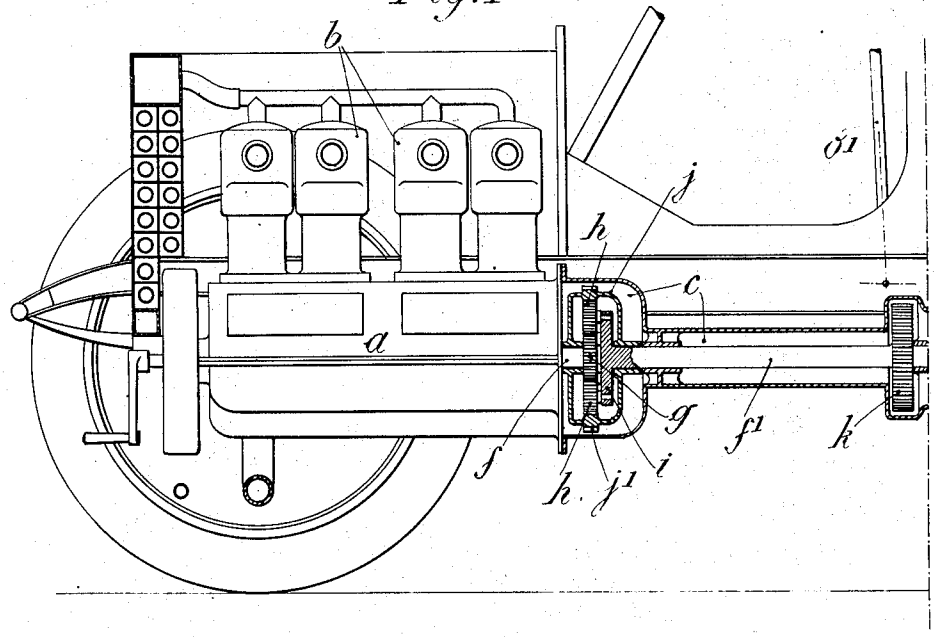
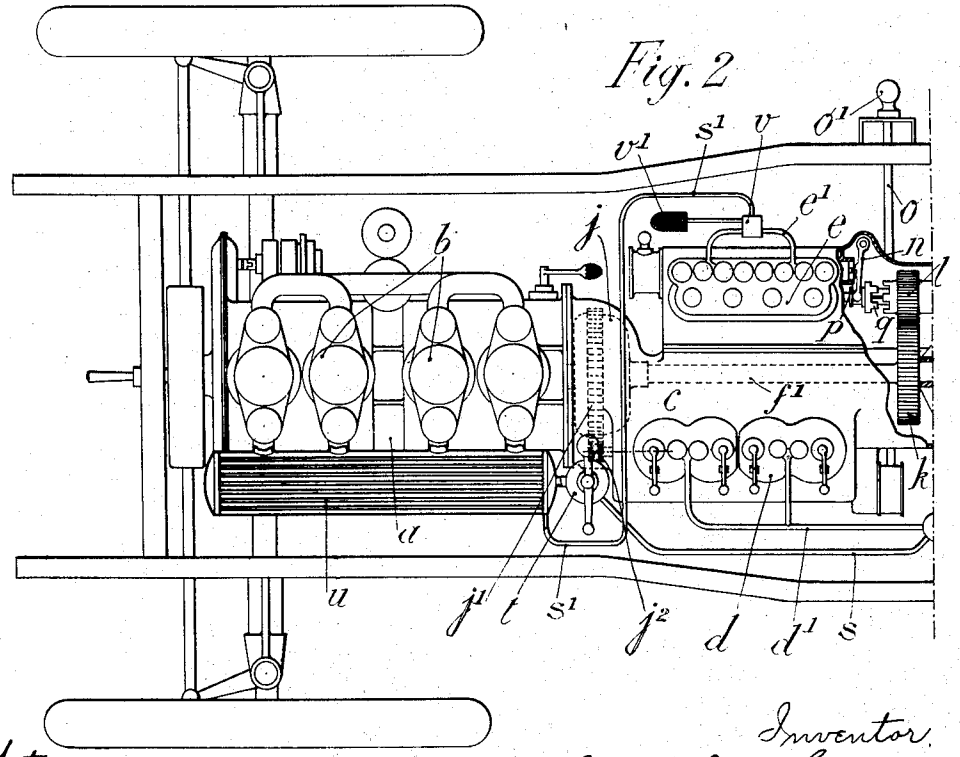


Fig. 2



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2 SHEETS—SHEET 2.

Fig. 1ª

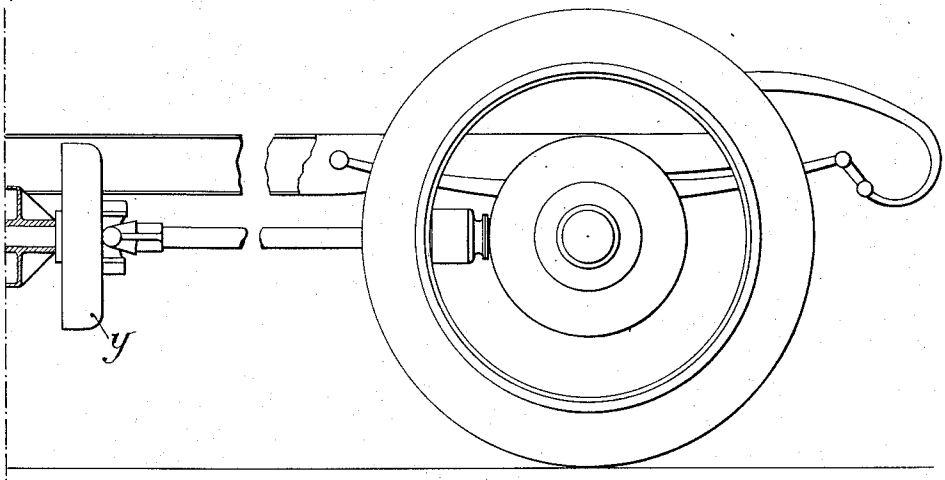
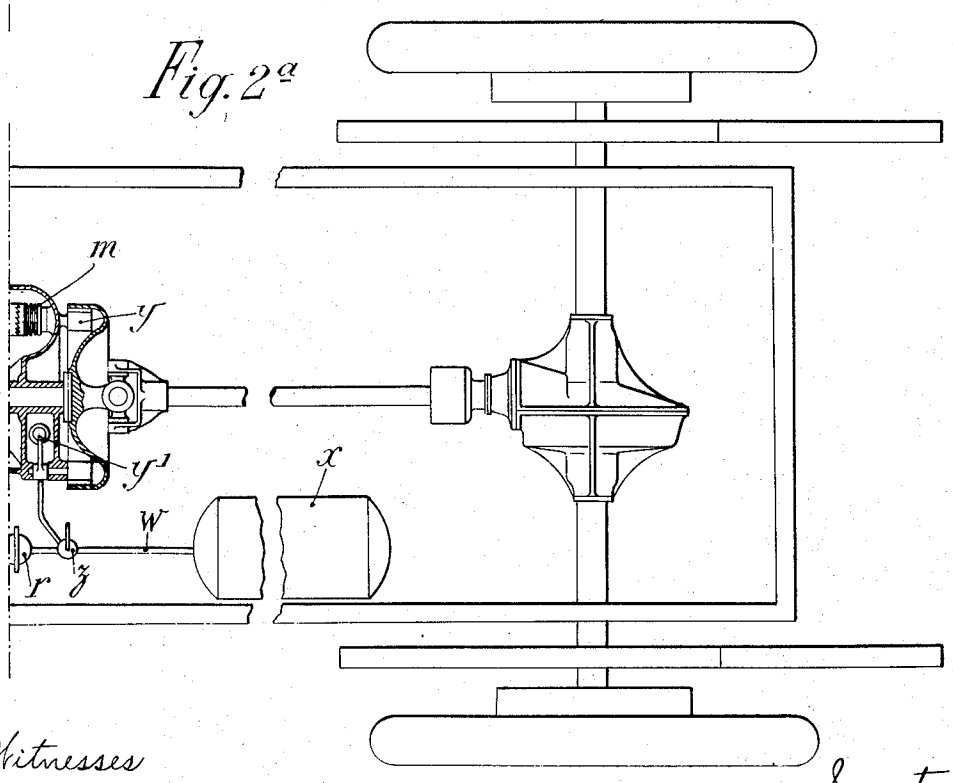


Fig. 2ª



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SELF-PROPELLED VEHICLE.

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To all whom it may concern:

Be it known that I, CAMILLE JEAN HAUTIER, citizen of the Republic of France, and residing at 60bis Grande-Rue, Boulogne, Seine, in the said Republic, engineer, have invented certain new and useful Improvements in Self-Propelled Vehicles; and I 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, reference being had to the accompanying drawings, and to letters or figures of reference marked thereon, which form a part of this specification.

There already exist vehicles which are propelled by the combined use of a compressed air motor and an ordinary primary motor, which may be a petrol engine or any other suitable motor. In vehicles of this kind a compressor, which may be driven at any required moment by the primary motor, pumps air into storage reservoirs from which the air may be allowed to issue at a pressure determined by a reducing valve for driving the compressed air motor suitably coupled with the driving shaft; the latter can thus be started at a desired speed according to the pressure of the compressed air.

The present invention relates to an improved vehicle of this kind which comprises in combination a primary heat engine, a compressor and a compressed air motor, but in which the heat engine is coupled with the propeller shaft through an epicyclic train, the crown wheel of which is braked directly by the compressor, the compressed air of this latter being used directly in the compressed air motor which also drives the propeller shaft. This new combination produces a complete equilibrium between the heat engine, compressed air motor and the compressor, which equilibrium corresponds to the sum of the variable power requirements of the engine, motor and compressor so that the whole of the power of the driving shaft f will be utilized. According to the value of the said pressure of the compressor on which the output of the compressed air motor depends there will be obtained progressively different speeds up to the maximum which corresponds with the stoppage of the compressor, that is to say the crown wheel of the epicyclic train. The progressive starting or stopping of the compressor and in consequence of the compressed air motor is thus brought about automatically according to the power required and on the other hand starting occurs under the effect of the pressure of the air as soon as the compressor is put into action. A small auxiliary reservoir of compressed air combined with a reducing valve also serves for automatic starting of the heat engine by the compressed air motor and affords an opportunity, when this is desirable, for applying an increase of power to the main shaft by putting, if necessary, an excess of work upon the compressed air motor.

The accompanying drawings show the preferred application of the invention to an automobile having as a primary motor a four cylinder petrol engine.

Figures 1 and 1a are the two parts of a vertical section along the axis of the frame of the vehicle. Figs. 2 and 2a are corresponding plans. To the frame a of the internal combustion engine b is fixed a casing c on which is mounted on one side the compressor d and on the other side a compressed air motor e. In the example shown both the compressor and the compressed air motor are provided with four vertical cylinders.

The engine shaft f where it enters the casing c carries a pinion g engaging with pinions h carried on a plate i fixed on the end of the propeller shaft f'. The pinions h gear with the internal teeth of a crown wheel or box j free to turn with respect to the two shafts f, f' and having external teeth j' gearing with a toothed wheel j^2 carried by the shaft of the compressor d. At the rear end of the casing c shaft f' carries a gear wheel k engaging with a pinion l free to turn on the shaft of the compressed air motor e and adapted to be clutched to the shaft by a ratchet toothed coupling m, the engagement of the two parts whereof is insured by a spring. A lever n controlled by a horizontal shaft o adapted to be turned by a lever o' can displace the distribution shaft p of the compressed air motor e in such a manner as to vary the output or power of the latter in order to modify the delivery pressure of the compressor and consequently the speed of the vehicle. This same lever n controls, by means of a fork, a claw coupling q which allows of the compressed air motor e driving directly the propeller shaft f' for backward travel of the vehicle, the rotation

of the motor *e* being at such time produced at the end of the stroke of the lever *n* by suitable shifting of the distributing cams of this motor.

The delivery pipe *d'* of the compressor *d* communicates through a valve *r* with a pipe *s* leading to the reducing valve *t* which is in communication with a heat exchanger *u* traversed by the exhaust gases of the motor *b* by which means the compressed air is heated by the exhaust. From this heat exchanger the compressed air passes by a pipe *s'* to the admission ducts *e'* of the compressed air motor *e;* a valve *v* controlled by a pedal *v'* opens or closes these admission ducts. A third way in the valve *r* is connected with a pipe *w* leading to an accumulator or air reservoir *x*. In the drawing there is also shown a pneumatic brake *y* operated by a small cylinder *y'* controlled by the operation of a valve *z*.

The system works as follows:—To start the internal combustion engine *b* when the vehicle is at rest, the valve *r* is turned into the position making communication between the reservoir *x* and the compressed air motor through pipes *w* and *s*, the reducing valve *t*, the heat exchanger *u* and pipe *s'*. Pedal *v'* is then actuated to open valve *v*. The coupling *q* being disengaged and the valve *v* open, the compressed air motor drives the propeller and motor shafts *f'* and *f* through gearing *l*, *k* and coupling *m*, thus starting the motor *b* and the car. The motor *b* will revolve without driving the vehicle if care has been taken to lift the valves of the compressor so that it runs light. When the motor *b* has been started the valve *r* is turned into the position for cutting off the reservoir *x* and for making communication between the pipes *d'* and *e'* through pipes *s* and *s'* and the heat exchanger *u*. The valve *v* being still open and the compressor valves free to act, the pressure of the air from the air compressor is immediately exerted in the system of pipes which are already full of air and the vehicle is started at once at a speed which increases automatically under the effect of the progressive retardation exerted by the compressor on the rotation of the crown wheel *j* of the epicyclic or planet train. The speed of the vehicle then increases automatically and gradually up to a predetermined speed at which equilibrium is established between the internal combustion engine, the compressor and the compressed air motor, the shafts *f f'* being then driven both by the internal combustion engine and the compressed air motor. For increasing the speed the lever *o'* is turned; this moves the lever *n* and displaces a cam shaft *p* of the compressed air motor, thus diminishing the output or work of the latter and immediately increasing the delivery pressure of the compressor. The effect of this is to still further brake the crown wheel *j* and increase progressively the speed of the vehicle. The maximum speed is attained by shutting the valve *v* or the valve *r* so as to stop the compressor and lock the crown wheel *j*. Evidently the output of the compressed air motor may not only be cut off but also diminished by gradual operation of the pedal *v'* controlling the valve *v*. When it is desired to increase temporarily the power on the motor shaft, such as when climbing a hill or when starting on difficult ground, it is possible by adjusting the valve *r* and the reducing valve *t* to surcharge the compressed air motor *e* with compressed air from the reservoir *x*, the valve *v* being at this moment open. When, owing to successive withdrawals of air from reservoir *x*, the pressure in the latter has fallen to a certain extent valve *r* may be turned into the necessary position and the reservoir re-charged by the compressor *d*. For traveling backward the lever *o'* is turned into its end position so as to engage the coupling *q* whereupon the compressed air motor, the cams of which have been simultaneously shifted by the lever *n*, drives the motor shafts *f f'* in the reverse direction. When the vehicle is to be stopped, the valves of the compressor may be lifted from their seats so that the compressor runs light and the crown wheel *j* becomes practically free and incapable of transmitting rotary movement to the part *f'* of the motor shaft. It will be seen that this improved system of mixed propulsion is considerably superior to the known systems from the point of view of output, since on the one hand owing to the advantageous use of the compression and the heating of the air and on the other hand to a constant equilibrium which is normally established between the three elements of the motor mechanism, all losses of power are reduced to a minimum and practically suppressed.

Having thus described my invention and the best means I know of carrying the same into practical effect, I claim:

1. In a self propelled vehicle, the combination of a motor mechanism composed of an engine, a compressor and a compressed air motor, an epicyclic train of gears, an externally toothed crown wheel to the said train, a toothed wheel mounted on the compressor shaft and in gear with the said externally toothed crown wheel, a propeller shaft, and means carried by the said shaft for carrying the intermediate wheels of the said epicyclic train.

2. In a self propelled vehicle, the combination of an engine, an epicyclic train of gears driven thereby, and including an externally toothed crown wheel, a propeller shaft driven by said train of gears, a compressor driven by the said externally toothed crown wheel, a compressed air motor actu-

ated from the compressor, gearing between the compressed air motor and the propeller shaft, and a coupling adapted to connect the said compressed air motor with the gearing in such a manner that the propeller shaft is driven in the direction of forward travel by the compressed air motor.

3. In a self propelled vehicle, the combination of an engine, an air compressor, a compressed air motor, a propeller shaft, an epicyclic train between the engine and the shaft, gearing between the said shaft and the compressed air motor, a coupling in the said gearing adapted to allow the motor shaft being driven in the direction of forward travel by the compressed air motor, means for shifting the valve gear of the compressed air motor and a coupling adapted to cause the compressed air motor to drive the motor shaft in the direction for rearward travel.

4. In a self propelled vehicle, the combination of a heat engine, an air compressor, a compressed air motor, a heat exchanger adapted for circulation of the exhaust gases of the heat engine and of the compressed air proceeding from the air compressor to the compressed air motor, a reducing valve between the said compressor and the heat exchanger and a throttling valve between the heat exchanger and the compressed air motor.

5. In a self propelled vehicle, the combination of a heat engine, an air compressor, a compressed air motor, a reservoir of compressed air, pipes connecting the said reservoir with the said compressor, and the said compressed air motor, cut-off valves in the said pipes, a heat exchanger interposed between the said reservoir and the compressed air motor and a reducing valve between the said heat exchanger and the said reservoir.

6. In a self propelled vehicle the combination with an engine, of a propeller shaft and planet mechanism thereon driven from the engine, a compressor driven from said mechanism, a compressed air motor driven by air from the compressor and mechanism to drive the propeller shaft from the motor.

7. In a self propelled vehicle the combination with an engine, of a propeller shaft and planet mechanism thereon driven from the engine, a compressor driven from said mechanism, a compressed air motor driven by air from the compressor and mechanism to drive the propeller shaft from the motor including reversing means.

8. In a self propelled vehicle the combination with an engine, of a propeller shaft and planet mechanism thereon driven from the engine, a compressor driven from said mechanism, a compressed air motor driven by air from the compressor, means to heat the compressed air by the engine exhaust before reaching the motor.

9. In a self propelled vehicle the combination with an engine, of a propeller shaft and planet mechanism thereon driven from the engine, a compressor driven from said mechanism, a compressed air motor driven by air from the compressor means to drive the propeller shaft from the motor, and means to control the supply of air to the motor and thereby control the speed imparted to the propeller shaft by the engine through said mechanism.

10. In a self propelled vehicle the combination with an engine, of a propeller shaft and planet mechanism thereon driven from the engine, a compressor driven from the planet mechanism, a compressed air motor to drive the propeller shaft and a compressed air reservoir to supply starting air to the motor to start said shaft and thereby the engine.

11. In a self propelled vehicle the combination with an engine, of a propeller shaft and planet mechanism thereon driven by the engine, a compressor driven by the mechanism, a compressed air motor to drive propeller shaft and supplied by the compressor, an air reservoir and means to supply air from the reservoir to the motor independently or simultaneously with that from the compressor.

In testimony that I claim the foregoing as my invention, I have signed my name in presence of two subscribing witnesses.

CAMILLE JEAN HAUTIER.

Witnesses:

DEAN B. MASON,

ALCIDE FABE.