No. 670,966. Patented Apr. 2, 1901.

J. PENDER.

EXPLOSIVE MOTOR FOR VEHICLES.

(Application filed Oct. 18, 1898.)

(No Model.) 4 Sheets—Sheet 1.

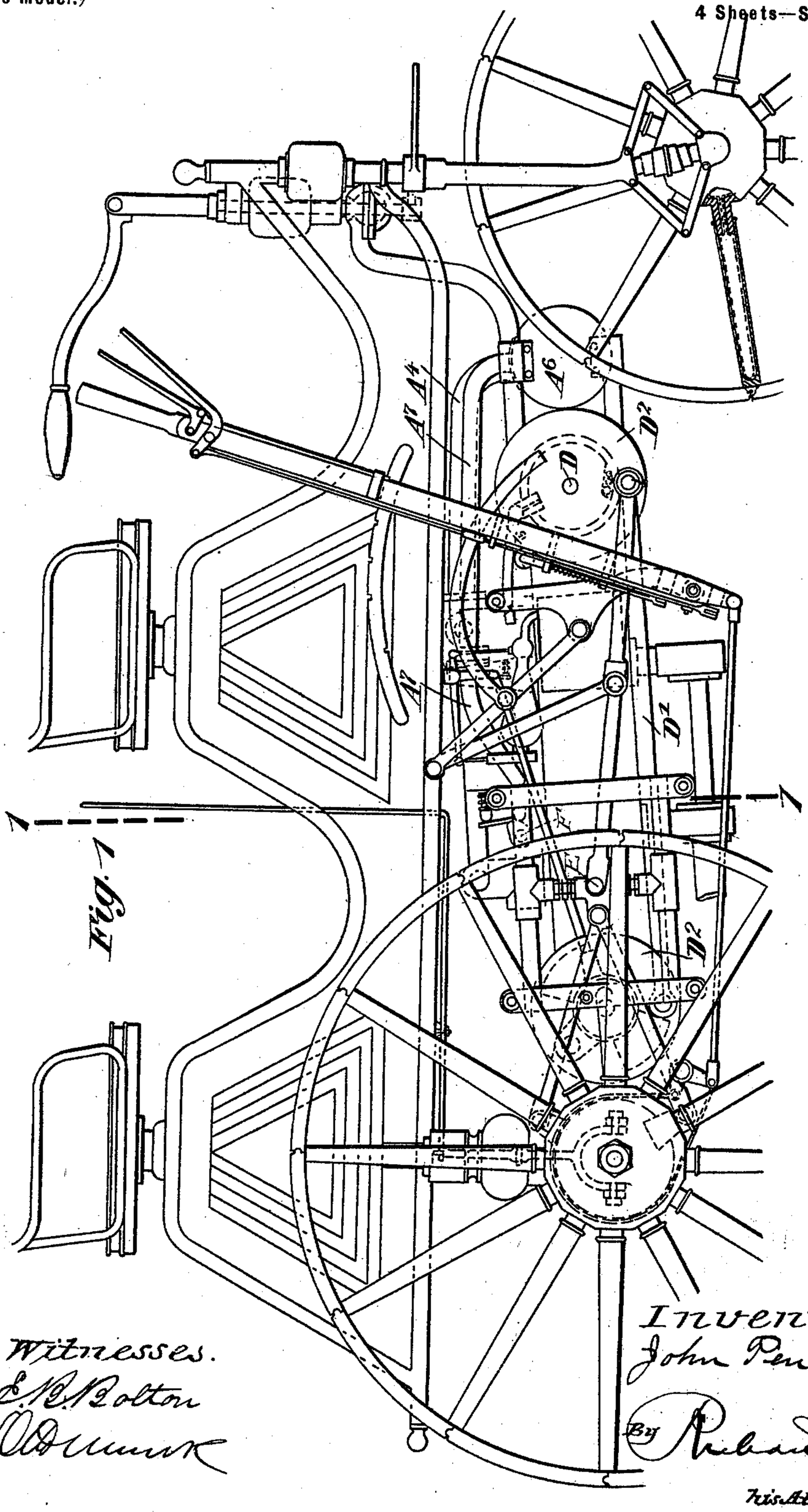

Fig. 1.

Witnesses.
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(No Model.) 4 Sheets—Sheet 2.

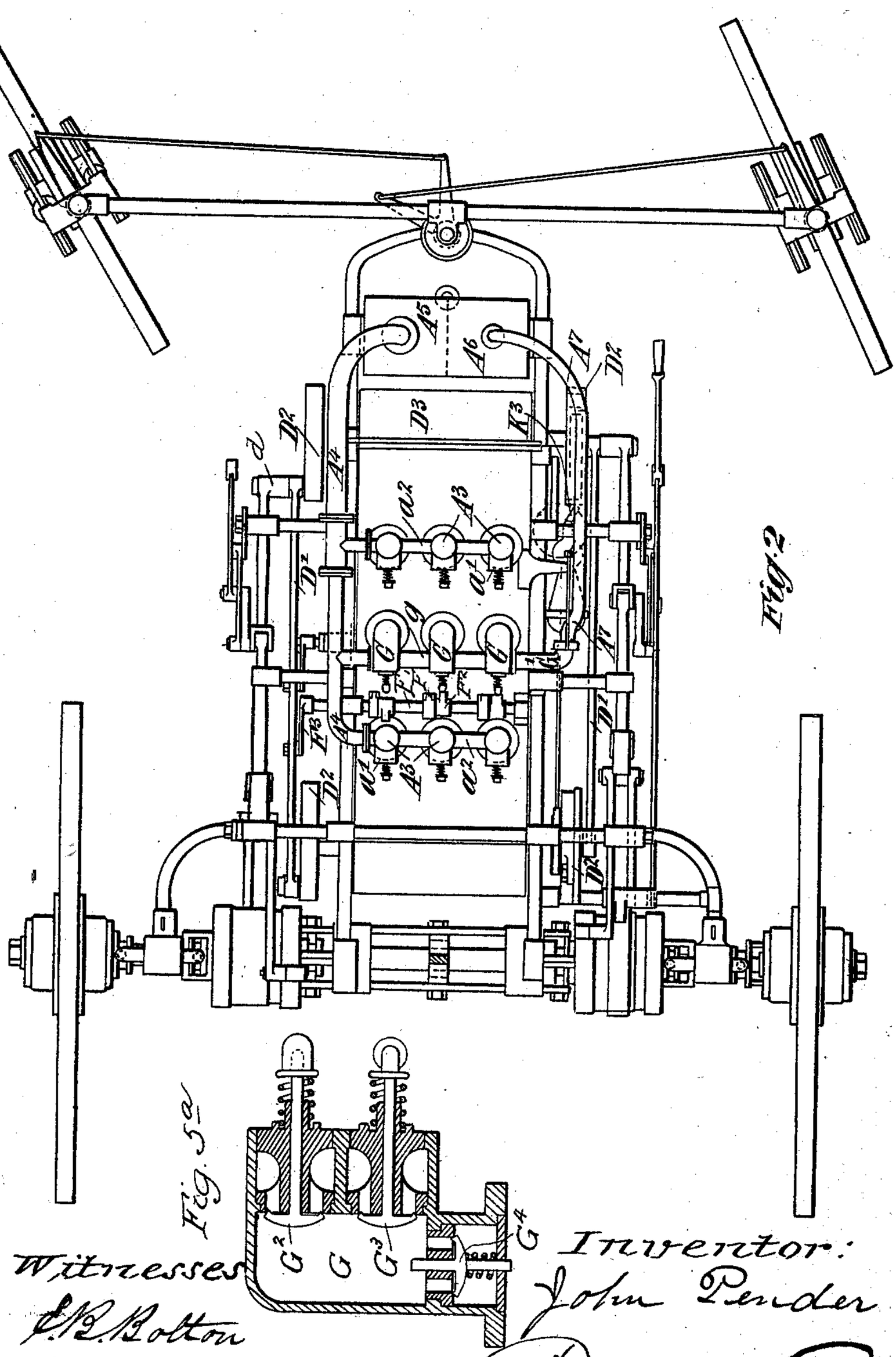

Fig. 2.

Fig. 5a.

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(No Model.) 4 Sheets—Sheet 3.

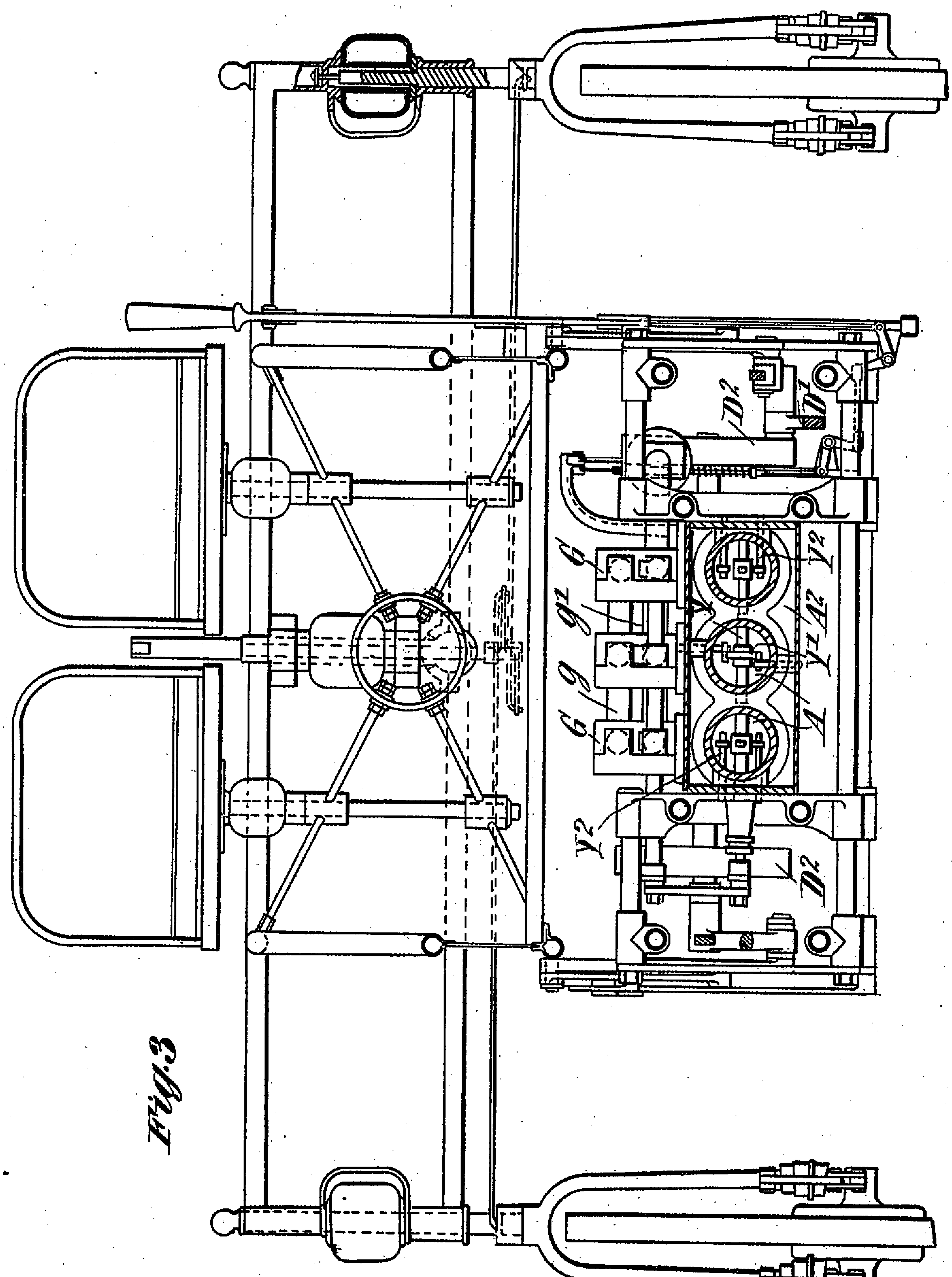

Fig. 3

Witnesses:
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[illegible]

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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 670,966. Patented Apr. 2, 1901.

J. PENDER.

EXPLOSIVE MOTOR FOR VEHICLES.

(Application filed Oct. 18, 1898.)

(No Model.) 4 Sheets—Sheet 4.

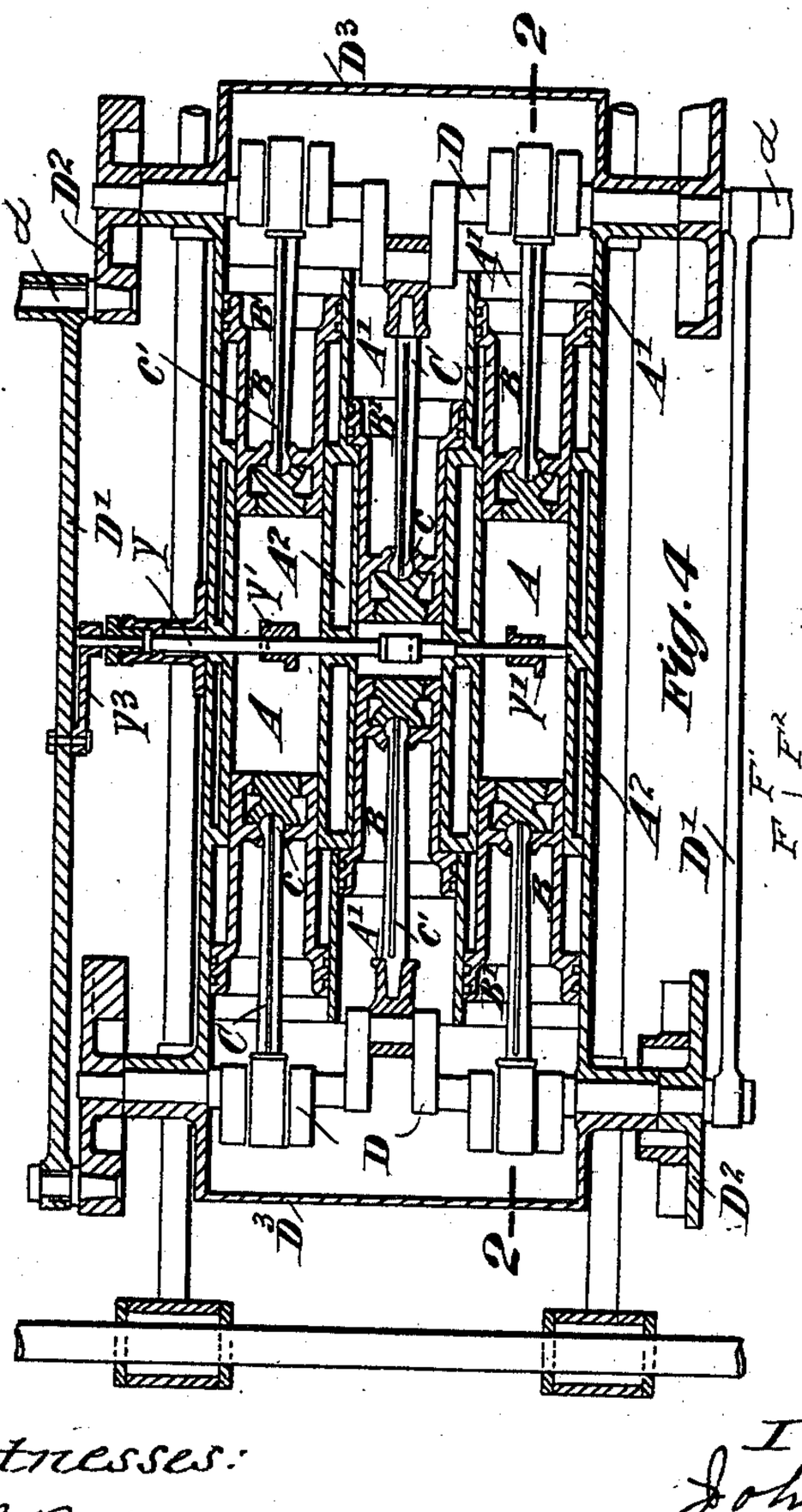

Fig. 4

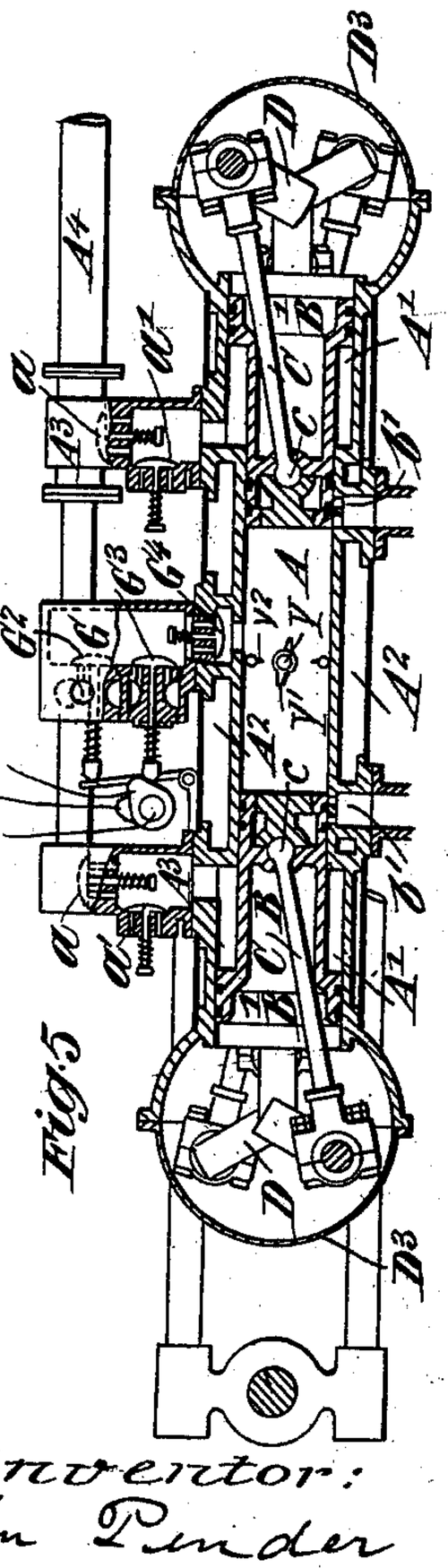

Fig. 5

Witnesses:
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Inventor:
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UNITED STATES PATENT OFFICE.

JOHN PENDER, OF BRUNSWICK, VICTORIA.

EXPLOSIVE-MOTOR FOR VEHICLES.

SPECIFICATION forming part of Letters Patent No. 670,966, dated April 2, 1901.

Application filed October 18, 1898. Serial No. 693,910. (No model.)

To all whom it may concern:

Be it known that I, JOHN PENDER, horse-shoe-nail manufacturer, a subject of the Queen of Great Britain and Ireland, and a resident of Tinning street, Brunswick, in the Colony of Victoria, have invented a certain new and useful Improvement in Motors for Vehicles, of which the following is a specification.

This invention relates to improvements in explosion-motors designed more particularly for power-propelled vehicles.

The improvements in the motor are specially applicable to the type of engine which is driven by the explosive force of carbureted air or oil-vapor or gas produced on the vehicle, said motor consisting of a novel triple-cylinder engine, each cylinder of which is designed to have an explosion at every rotation of the coupled crank-shafts. Each of said cylinders has two trunk-pistons, and each piston is attached by a connecting-rod to a crank on a three-throw crank-shaft, one of which is mounted at each end of said cylinders. Said cranks are so set or assembled in relation to the pistons that when either pair of the cranks are passing their dead-centers another pair is receiving the full force of an explosion while the third pair is making its return stroke. Hence the effect of dead-centers is practically obviated. Each of said trunk-pistons is also double—that is to say, it accomplishes the work of two pistons, the larger and outer one acting as an air or gas-pump or compressor to supply the charge for the explosion within the cylinder, while the inner and smaller piston receives the force of the explosion, which takes place between each pair of pistons in each cylinder once during each revolution of the crank-shafts and just after the pistons have begun their outward stroke.

The invention will now be described, aided by a reference to the attached drawings, in which—

Figure 1 is a side view of a power-propelled vehicle constructed according to my invention; Fig. 2, a plan with the carriage-body removed; Fig. 3, a transverse sectional view looking forward from line 1 1, Fig. 1; Fig. 4, a horizontal sectional plan through the cylinders, showing the pistons, connecting-rods, three-throw cranks, and their coupling-rods and the ignition-gear shaft; Fig. 5, a sectional view taken on line 2 2, Fig. 4; and Fig. 5ª, a central section of the air and gas admission valves.

The motor-cylinders A are three in number, each furnished with two trunk-pistons, (marked B B,) and said cylinders have an enlarged part A′ at each end, which, together with the enlarged part B′ of pistons, act as a pump for the purpose of compressing and forcing air or gas through valves *a* in valve-chests A^3, and through pipes A^4 into a receiver A^5 A^6 fixed, preferably, in the fore part of the motor-frame. Said receiver A^5 A^6 has a partition at about its center provided with a non-return valve in order that air may be taken from A^6 through pipe A^7 and the carbureter into the cylinders, while A^5 retains a supply of air to scavenge the cylinders.

a′ represents inlet-valves in valve-chests A^3, and a^2, Fig. 2, pipes connecting the valve-chests together. The receiver A^6 is connected by pipe A^7 with the branch pipe G′, which leads to valve-chests G, and which latter are connected together by the upper and lower intermediate pipes *g* and *g′*, Fig. 3, respectively. Pipe A^7 also leads to the carbureter through branch K^3, Fig. 7. Each of said chests G has a valve G^2 in it which regulates the admission of the explosive mixture and a valve G^3 to regulate the admission of air for scavenging the cylinders. Also a check-valve G^4 is provided, which prevents the return of vapor from and confines the explosion within the cylinders. Each pair of said pistons B travels to and from each other and they are each attached by a ball-joint *c* to a connecting-rod C, the other end of which is connected to the main crank-shaft D, one of said shafts being, as shown, at each end of the cylinders and inclosed in splash-casings D^3. The inner ends of the pistons B receive the force of the explosion. Each connecting-rod C has a groove *c′* at its top to lead oil to the bearing *c*, the oil being retained in the splash-casing D^3 to lubricate all the working parts by the cranks in their rotation dipping into the oil and splashing it about therein. The said crank-shafts D are connected by coupling-rods D′, working on crank-pins fixed in the disks or fly-wheels D^2 and so arranged that one is following the other past the cen-

ters, the forward crank-pins *d* carrying the transmission-gear jointed pitman E. By having two pistons in each cylinder working to and from each other, with three explosions during one revolution of the coupled crank-shafts, the effect of dead-centers is obviated, the motor derives a greater proportion of the energy from the explosion than can possibly be obtained when only one piston is used, the rapid expansion and moderate piston speed contributing to this end, and, further, there is a minimum of vibration imparted to the vehicle and less heat is absorbed by the cylinders. This method of combining and arranging the cylinders, air-pumps, and pistons with their connecting-rods and crank-shafts is very compact and occupies a small space on the vehicle. The explosion between the pistons B B is brought about by the means shown in Figs. 2, 3, 4, and 5, the inlet gas-valves G^2 and air-valves G^3 being each worked by means of cams F′ and F^2, arranged on a transverse spindle F, which is revolved by an arm F^3 on it being worked from the coupling-rod D′ of the motor. The cams F′ and F^2 are so timed that when the piston is passing the exhaust-ports *b*′ on its outward stroke a puff of air is admitted through the valves G^3 and G^4 from reservoir A^5 to blow out the products of the previous explosion, and when the piston has returned to cover the exhaust-ports the gas-valve G^2 is opened sufficiently long to again fill the cylinder with the compressed explosive mixture and proceed to compress it still further before it is ignited on the pistons beginning their outward stroke.

A^2 represents water-jackets about cylinders A.

For some power-propelled vehicles a motor of less weight and power will suffice, and in such a case I may provide single-piston triple engines of the type herein described by constructing the cylinders with an end or cover which would lie just beyond the spark-producing cams Y′.

The ignition-gear (shown in Figs. 2, 3, 4, and 5) consists of a stepped spindle Y, passing through the cylinders at about their center and having upon it within each cylinder insulated contact pieces or cams Y′, which are designed to make contact with the circuit-pieces Y^2, leading from a dynamo or battery (not shown) at the moment it is desired the gas between the pistons is to be exploded. Said spindle Y is carried in suitable bearings and worked by a crank-arm Y^3 from the coupling-rod D′.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is—

1. In a motor for power-propelled vehicles, cylinders A provided with inlet and exhaust branches, and with an enlarged air-compressor part at each end, crank-shafts at opposite ends of said cylinders, and piston-rods C connecting the pistons of the cylinders with their respective crank-shafts, substantially as described.

2. In combination, the cylinders A provided with inlet and exhaust branches and having enlarged air-compressing parts at opposite ends thereof, oppositely-acting pistons in said cylinders, crank-shafts at opposite ends of said cylinders, piston-rods connecting the respective pistons and crank-shafts, and a pitman connecting the two crank-shafts, substantially as described.

3. In combination, the cylinders A arranged side by side, and having inlet and exhaust branches, crank-shafts at opposite ends thereof, oppositely-acting pistons in each cylinder connected with the respective crank-shafts, a pitman connecting said crank-shafts, an igniting-shaft extending centrally through said cylinders, and a crank on the end of said igniting-shaft connected with said pitman, substantially as described.

4. In combination, the cylinder A having inlet and outlet ports, and having oppositely-acting pistons, an igniter located between said pistons, a valve-chest G having a gas-valve G^2 and an inlet-valve G^3, a cam F′ for operating the gas-valve and a cam F^2 for operating the air-valve, and a spring-pressed valve G^4 controlling the passage from the valve-chest to the cylinder, substantially as described.

5. A motor for power-propelled vehicles composed of triple cylinders A having enlarged air or gas compressing parts A′ at each end and two trunk-pistons as B B′ working in said cylinders, rods C connecting the pistons at both ends with a three-throw crank-shaft having crank-disks D^2 at their ends coupled by rods D′ one of which latter imparts motion by an arm Y^3 to shaft Y operating the ignition-gear Y′ Y^2 combined with valve-chest G having valves G^2 and G^3 operated by cams F′ and F^2 on shaft F worked by arm F^3 from coupling-rod D′ and valve-chests A^3 provided with valves *a*, *a*′ substantially as described and shown.

6. In a power-propelled vehicle the combination in a motor having three cylinders, that is three explosive-chambers with enlarged gas or air compressing parts at each end, six pistons, one piston at each end being common to the explosion and air or gas compressing chambers, connecting-rods, with oil-grooves cut in them, splash-tanks at each end containing oil into which the crank-shafts dip at every revolution thereby splashing oil in every direction and so lubricating all the working parts substantially as described.

7. In a power-propelled vehicle the combination in a motor having three cylinders with enlarged air or gas compressing parts, pistons, common to the explosive and compressing chambers, connecting-rods with oil-grooves, crank-shafts, splash-tank at each end for holding oil to lubricate the crank-shaft and connecting-rod bearings and cylinder-surface,

coupling-rods with projections for revolving igniting-gear, revolving cam-shaft, cams for operating valves, valves for admitting air to scavenge the cylinder, valves for admitting gas for the explosions and the exhaust-ports all arranged and assembled substantially as described and shown.

In witness whereof I have hereunto set my hand in presence of two witnesses.

JOHN PENDER.

Witnesses:
BEDLINGTON BODYCOMB,
W. J. S. THOMPSON.