(No Model.) 2 Sheets—Sheet 1.

A. G. PURCHAS & J. E. FRIEND.

HYDROCARBON MOTOR.

No. 410,193. Patented Sept. 3, 1889.

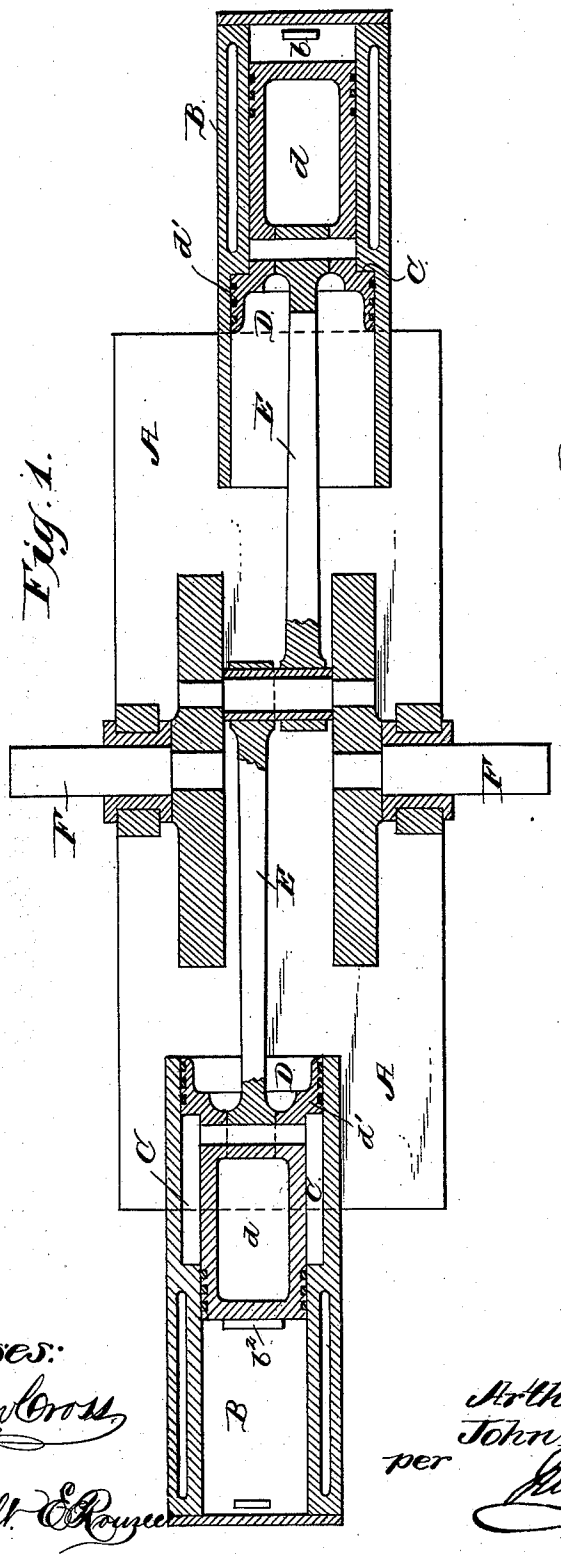


Fig. 4.

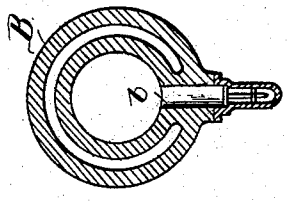
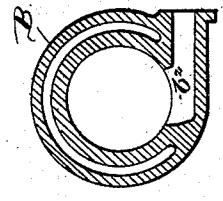


Fig. 3.



Witnesses:
J. Thomson Cross
Milt. E. Rayner

Inventor:
Arthur G. Purchas
John E. Friend
per
Henry Orth
Atty.

(No Model.) 2 Sheets—Sheet 2.

A. G. PURCHAS & J. E. FRIEND.

HYDROCARBON MOTOR.

No. 410,193. Patented Sept. 3, 1889.

Fig. 2.

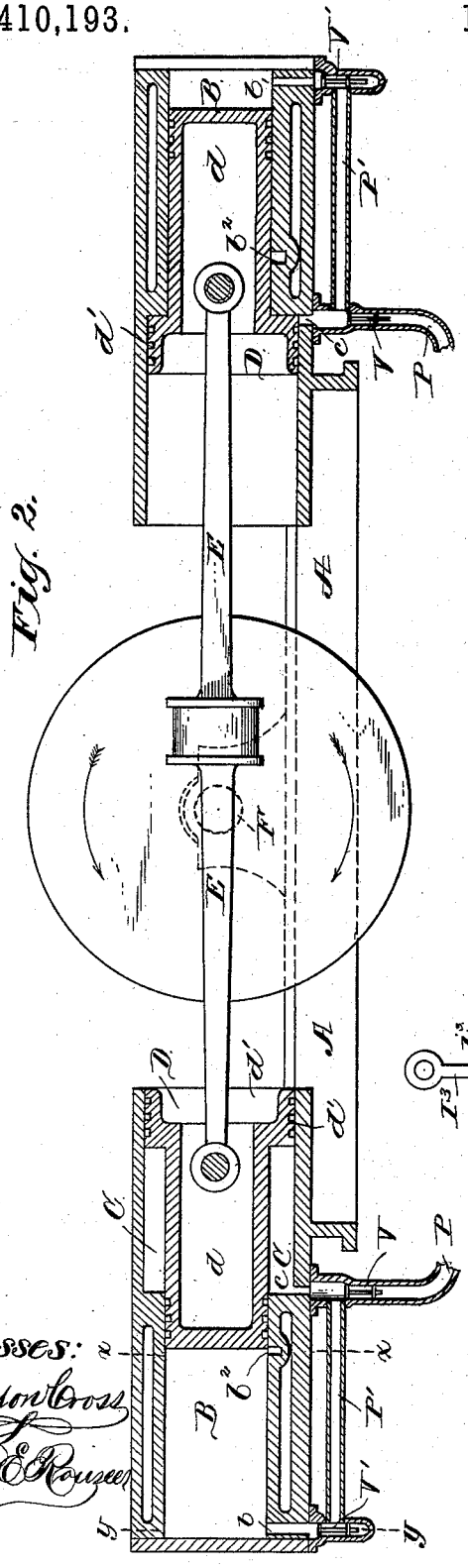


Fig. 5.

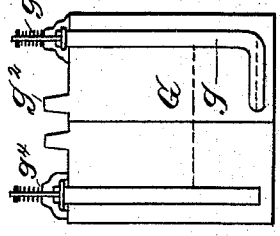
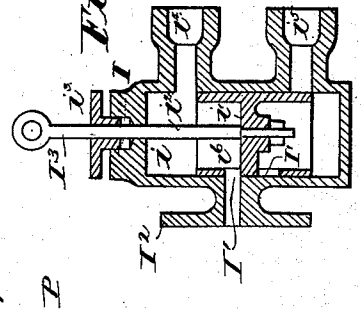


Fig. 6.



Witnesses:
J. Thomson Cross
Milt. E. Rouzer

Inventor:
Arthur G. Purchas.
John E. Friend.
per
Henry Orth
Atty.

UNITED STATES PATENT OFFICE.

ARTHUR GUYON PURCHAS AND JOHN EDWARD FRIEND, OF AUCKLAND, NEW ZEALAND.

HYDROCARBON-MOTOR.

SPECIFICATION forming part of Letters Patent No. 410,193, dated September 3, 1889.

Application filed August 16, 1888. Serial No. 282,935. (No model.)

To all whom it may concern:

Be it known that we, ARTHUR GUYON PURCHAS, surgeon, and JOHN EDWARD FRIEND, engineer, both subjects of the Queen of Great Britain, residing at the city of Auckland, in the British Colony of New Zealand, have invented Improvements in Hydrocarbon-Motors, of which the following is a specification.

Our invention relates to that class of motor in which a mixture of hydrocarbon vapor or gas and air is admitted through suitable openings or ports into a cylinder, where it is ignited in order by its explosion to impart force to a piston working in the said cylinder; and the objects of our invention are to produce a simple and efficient motor of this class and to provide improved means for mixing hydrocarbon vapor or gas with air and for supplying such mixture automatically to the said motor, and for automatically regulating the supply of the mixture to the cylinder of the motor.

In carrying our invention into practice we provide a suitable bed-plate on which we secure a cylinder of special form having suitable inlet and exhaust ports constructed and operating as hereinafter described. The cylinder is made of two diameters, the outer part or working cylinder being the smaller of the two. The larger or inner part acts as the pump and compressor. The piston also is of two diameters, whereof one fits the outer part and is the working portion and the other fits the larger part of the cylinder and by its movement to and fro alternately draws in and compresses the mixture. Inside this cylinder and working freely to and fro is a piston of special construction connected by means of a connecting-rod with the crank of a crank-shaft, whereby the force generated by the ignition of the mixture in the said cylinder may be communicated through a fly-wheel secured on the said crank-shaft to a machine-locomotive or the like.

Arranged in any convenient position adjacent to the cylinder of our improved hydrocarbon-motor is a suitable chamber or vessel, hereinafter referred to as the mixing-chamber, for containing and mixing the hydrocarbon gas or vapor with air, and a pipe is led from this chamber to the suction-valve of the larger part of the cylinder, in order to convey the mixture of vapor or gas and air to the said cylinder, where it is compressed and forced into the working-cylinder through the inlet-pipe, a suitable valve being provided in the said pipe to prevent the mixture being forced back into the pump-cylinder. The mixture being thus compressed into the space between the working-piston and the end of the cylinder, it is ignited at the proper moment by any suitable means, and having driven the piston nearly to the end of its stroke the resultant gases are allowed to escape through an exhaust-port provided for that purpose, which is uncovered by the movement of the piston.

A suitable governor-valve is provided in the feed-pipe leading from the mixing-chamber to the suction-valve of the pump-cylinder, whereby the supply of mixture may be partly or wholly cut off and air substituted therefor. In some cases we prefer to employ two or more motor-cylinders—as, for instance, in a locomotive—as illustrated in the accompanying drawings, in which—

Figure 1 is a horizontal section of a hydrocarbon-motor constructed according to our invention. Fig. 2 is a vertical longitudinal section of the same. Fig. 3 is a vertical transverse section on line $x\,x$, Fig. 2. Fig. 4 is a similar section on line $y\,y$, Fig. 2. Fig. 5 is a vertical section of our mixing-chamber, and Fig. 6 is a vertical section of our governor-valve, hereinbefore mentioned.

The motor illustrated in Figs. 1 and 2 is a twin-cylinder motor, and A represents the bed-plate, to which are secured two combined working and pump cylinders, the working portion B whereof is of less diameter than the pump portion C. The said cylinders are provided with gas-inlet ports b and c, opening, respectively, into the working and pump portions B C at the rear end thereof, and the said working portion B of the cylinders is provided with an exhaust-port b^2 near its forward end.

The inlet-ports $b\,c$ of each cylinder are in communication with each other through a pipe P′, Fig. 2, check or inlet valves V and V′ being provided for each port for obvious purposes, the check-valve V having its seat below the connection of the pipe P′ with the

pipe or passage P, leading to port *c*, and said ports *b c* are in communication with the source of gas-supply through said pipe P. The pistons D are also combined working and pump pistons, their working and pump portions *d d'* respectively fitting the corresponding portions B C of the cylinders.

E E indicate the connecting-rods, and F the crank-shaft.

The pipe P of each cylinder is connected with any suitable source of gas-supply, in which the gas is or may be stored under normal pressure; but where fluid hydrocarbons are used we employ a carburetor G, (shown in Fig. 5,) which carburetor is divided into two chambers, one of which contains the hydrocarbon and has a gas-pipe *g*, the outlet of which is near the bottom of the chamber, its inlet above the same, and has a regulating-valve that is adjustable by means of a spring *g'*, so that the volume of gas entering into the chamber may be regulated. The other chamber is the air-chamber and contains water, the air-pipe g^3 having its outlet also near the bottom of the chamber and its inlet above said chamber. The said air-pipe is also provided with a regulating-valve adjustable by means of a spring g^4. The object of the latter arrangement is to free the air from the impurities before admitting it to the motor.

Each chamber is provided with means for connecting it to the regulating or governor valve I. (Shown in Fig. 6.) The governor-valve I is interposed in pipe P between the carburetor and the working-cylinder; hence two such valves are employed in a twin-cylinder engine, and, if desired, two carburetors may be employed. This valve consists of a cylinder *i*, in which works a hollow piston *i'*, divided centrally by a cross-partition i^6, to which the valve-rod is secured, and has two ports I' I' on opposite sides of the cross-partition and on the same side of the valve, adapted to register with the connection I^2 for pipe P. The valve-casing has two coupling-joints i^4 and i^5, leading into the casing at opposite ends of the valve, the joint i^4 being coupled with the carburetor and the joint i^5 with the air-chamber thereof. The valve-rod is controlled from a moving element of the engine—as, for instance, from the crank-shaft—and after the valve is set to a given speed of said shaft whenever the speed of the motor increases, thereby increasing the speed of the governor-balls, throwing them outward, the valve is lifted, thereby cutting off the communication with the junctions I^2 and the coupling-joint i^4, and establishing communication between the said junction I^2 and coupling-joint i^5, so that at the next forward stroke of the piston air alone will be drawn into the cylinder until the speed of the motor has decreased to return the governor-valve into its normal position. (Shown is Fig. 6.)

We have deemed it unnecessary to show the governor itself, as this mechanism and the manner of connecting the same with the valve-rod I^3 are well known.

Instead of a carburetor any suitable reservoir for storing the combustible gas may be employed, and the gas supplied thereto and stored therein at a normal pressure, or under pressure not exceeding the pressure in the working part of the cylinder. The air-chamber may be dispensed with; but the advantage thereof is obvious, as the air supplied to the cylinders will then be free from all gritty matter liable to speedily wear the cylinder-surfaces when the joint coupling is left open to the atmosphere. Of course a connection with the atmosphere is absolutely necessary; otherwise the motor would become inoperative whenever the supply of gas is cut off by the governor-valve.

The operation of our improved motor is as follows: Assuming the various parts to be in the positions shown in the drawings, in starting the engine the crank-shaft is rotated by hand or otherwise to draw the right-hand piston forward sufficiently to draw combustible gas into the pump portion C and into the working-cylinder B in rear of the piston. Before said piston reaches a point to uncover the exhaust-port it is moved back to force the gas from C into B through pipe P' and compress the charge in B, which is then ignited by means of a suitable or well-known igniting device—as by an electric ignitor, for example. The piston is now driven forward, the pressure of the gases behind it holding the valve V' to its seat, while the valve V will move off its seat and a charge of combustible gas will be drawn into the portion C of the cylinder. When the piston reaches the limit of its forward motion, the exhaust-port b^2 will be uncovered and the products of combustion exhausted from the working-cylinder, thereby relieving the valve V' of pressure, so that on the back-stroke of the piston the charge of gas will first be forced from C into B and will then be compressed in B, the valve V' being again forced to its seat under the pressure, and the charge will be ignited, this operation being then repeated. It will of course be obvious that the motor-cylinder, pump-cylinder piston, and connecting-rod on the left hand of the motor (illustrated in the drawings) will act in a precisely similar manner to the corresponding parts on the right-hand side of the said motor, but at different or opposite times, and as each piston receives an impulse at each revolution of the crank-shaft it follows that with the arrangement illustrated the fly-wheel will receive two impulses at each revolution. When the speed of the motor increases beyond a normal speed, the valve *i* through the governor will be moved to cut off the communication between I^2 and i^4 or the cylinder and source of gas-supply, and the communication between I^2 and i^5 or between the cylinder and the air-chamber will be established, admitting air only to the cylinder until the speed of the motor has

decreased to a normal speed, when the valve *i* will be returned to its normal position, as described.

Although we have described our improved motor as provided with a pair of cylinders, pistons, &c., it is to be understood that for many purposes single motors will suffice.

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

1. In a gas-motor, the combination, with a cylinder and piston constructed to operate as a working cylinder and piston and as a pump, of an air-reservoir connected with the admission-port of the cylinder, said reservoir containing water through which air is caused to pass prior to its admission to the cylinder, substantially as described, for the purposes specified.

2. In a gas-motor, the combination, with a cylinder and piston constructed to operate as a working cylinder and piston and as a pump, a source of gas-supply, and an air-reservoir containing water through which the air admitted thereto is caused to pass, and a connection between the inlet-port of the cylinder and the gas-supply and air-reservoir, respectively, of a regulating-valve interposed in said connection and adapted to cut off the communication between the inlet-port and gas-supply or between said port and air-reservoir, substantially as and for the purposes specified.

3. In a gas-motor, the combination, with a cylinder and piston constructed to operate as a working cylinder and piston and as a pump, a source of gas-supply, and an air-reservoir containing water through which the air admitted thereto is caused to pass, and a connection between the inlet-port of the cylinder and the gas-supply and air-reservoir, respectively, of a regulating-valve interposed in said connection, said valve being controlled by a moving element of the motor—as the governor, for instance—and adapted to cut off the communication between the inlet-port and gas-supply or between said port and air-reservoir, substantially as and for the purposes specified.

4. In a gas-motor, the combination, with a working cylinder and piston constructed to perform the function of a pump, admission-ports *b* and *c*, for the working and pump portions, respectively, of the cylinder, said ports being in communication with each other and with the source of gas-supply, and check-valves in said communications, of a regulating-valve interposed in the connection between the inlet-ports and gas-supply, the valve-casing of which valve is provided with suitable ports in communication with the cylinder and with the gas-supply, respectively, and with said cylinder and the atmosphere, the opening and closing of said ports being controlled by the movements of the valve, for the purposes specified.

5. In a gas-motor, the combination, with a working-cylinder constructed to perform the function of a pump, admission-ports *b c*, for the working and pump portions, respectively, of the cylinder, said ports being in communication with each other and with an air and gas supply pipe, and check-valves V V′ in said communications, of a carburetor and air-reservoir, the latter containing water through which the air admitted is caused to pass, and a regulating-valve *i*, whose casing is provided with a port or passage I^2 in communication with the cylinder through the supply-pipe, a port or passage i^4 in communication with the carburetor, and a port or passage i^5 in communication with the air-reservoir, said communications being controlled by the movements of the valve, substantially as and for the purposes specified.

ARTHUR GUYON PURCHAS.
JOHN EDWARD FRIEND.

Witnesses:
FREDERIC MORRIS PRESTON BROOKFIELD,
Notary Public, Auckland, New Zealand.
ARTHUR HENRY BRABANT,
Articled Clerk, Auckland, N. Z.