(No Model.) 2 Sheets—Sheet 1.

F. A. RIDER & S. VIVIAN.

GAS ENGINE.

No. 533,922. Patented Feb. 12, 1895.

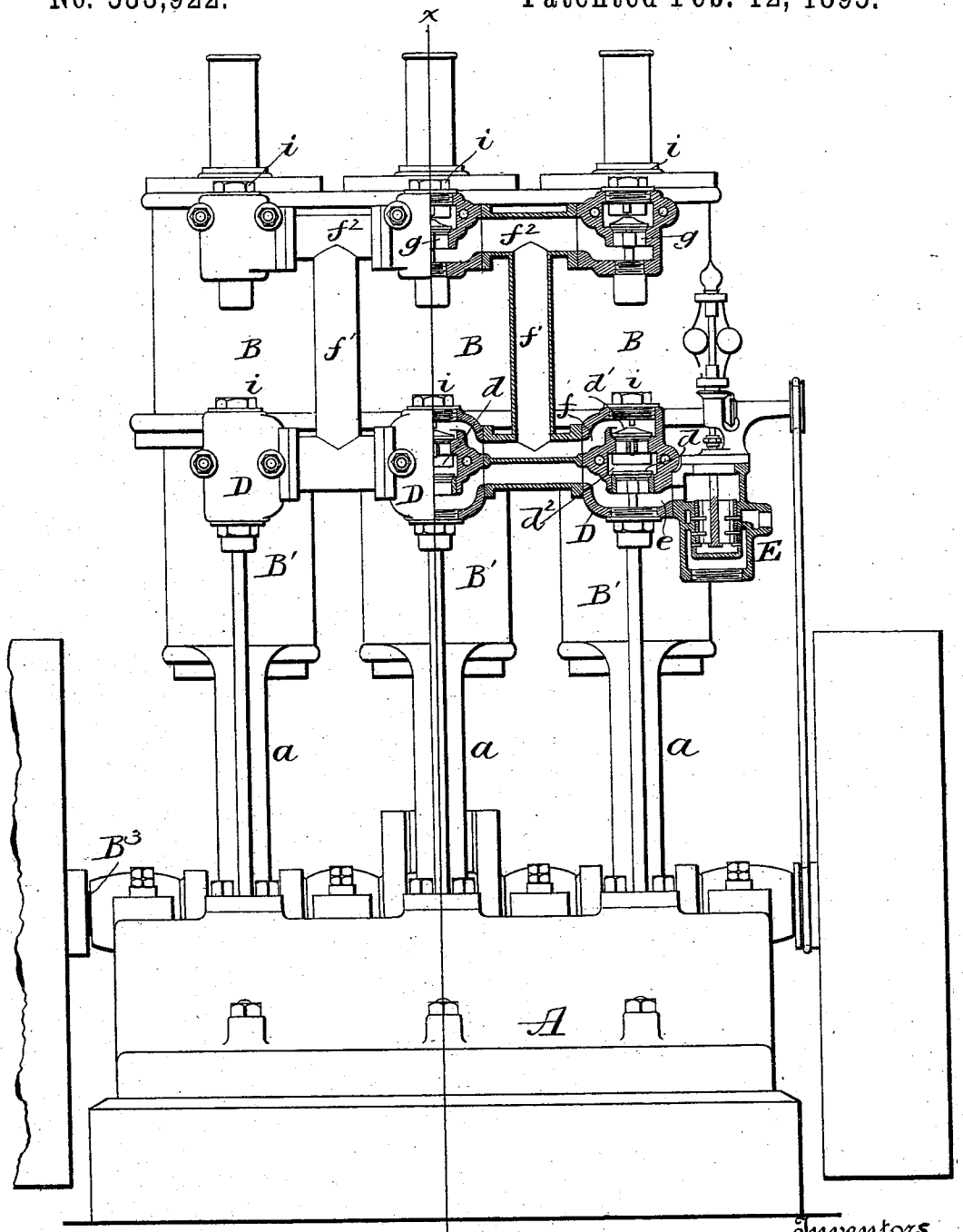

FIG. 1.

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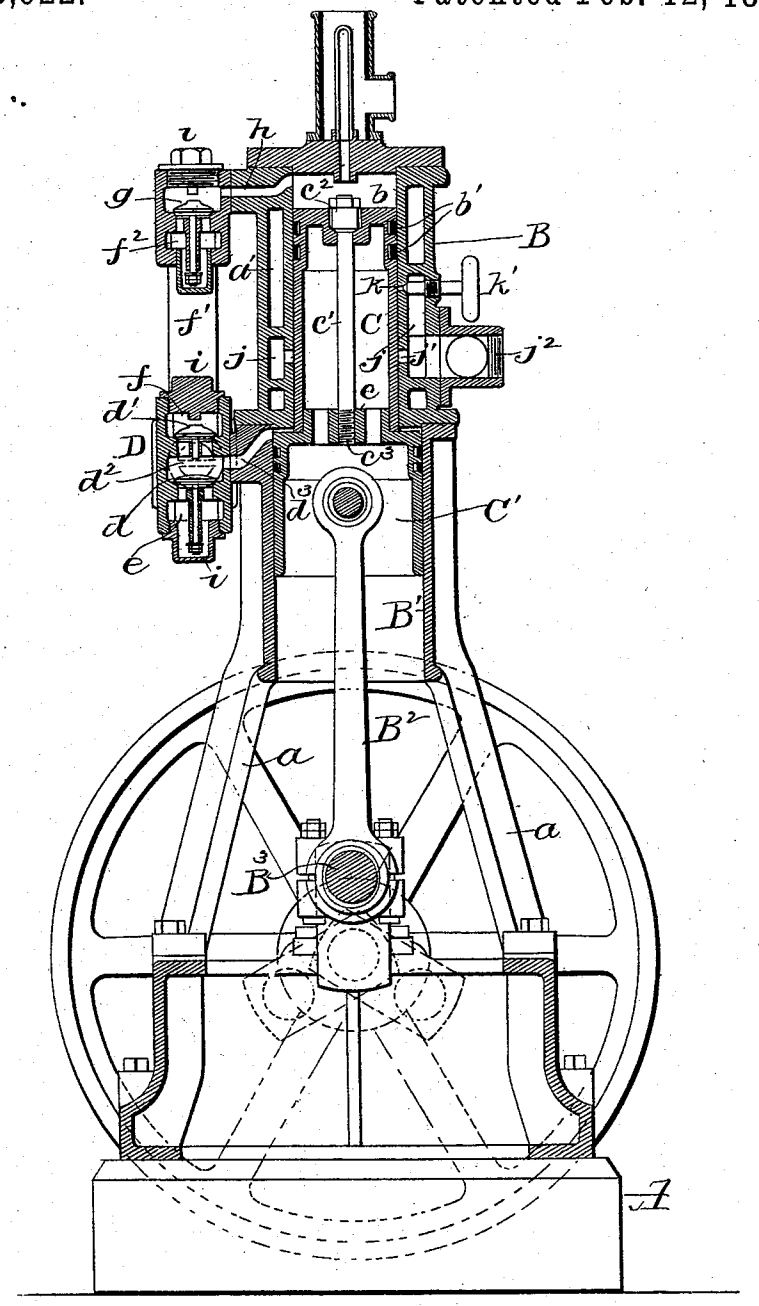

Fig. 2.

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UNITED STATES PATENT OFFICE.

FRANK A. RIDER AND SIMON VIVIAN, OF FORT WAYNE, INDIANA.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 533,922, dated February 12, 1895.

Application filed April 14, 1894. Serial No. 507,583. (No model.)

To all whom it may concern:

Be it known that we, FRANK A. RIDER and SIMON VIVIAN, residents of Fort Wayne, in the county of Allen and State of Indiana, have invented certain new and useful Improvements in Gas-Engines; and we 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.

Our invention relates to an improvement in gas engines and more particularly to such as are known in the art as explosive gas engines,—the object of the invention being to so construct a single acting multiple cylinder explosive gas engine as to insure a continuous and even application of power to the crank shaft of the engine.

A further object is to construct a gas engine of the class specified, in such manner as to establish a natural balance of all the moving parts of the engine.

A further object is to produce a multiple cylinder explosive gas engine which shall be simple in construction and effectual, in all respects, in the performance of its functions.

With these objects in view the invention consists in certain novel features of construction and combinations and arrangements of parts as hereinafter set forth and pointed out in the claims.

In the accompanying drawings: Figure 1 is an elevation partly in section of our improved engine. Fig. 2 is a vertical sectional view on the line x—x of Fig. 1.

A represents a suitable base, above which three (more or less) pairs of cylinders B, B′ are supported by means of legs or standards a, said legs or standards being conveniently made integral with the cylinders B′ and at their lower ends are secured to the base A by means of suitable fastening devices.

The upper cylinder B of each pair (which is the cylinder in which the power to drive the engine is created), is made of smaller bore than the lower cylinder B′ (which constitutes a pump cylinder) and said cylinder B is preferably made with a chamber a' in its wall for the reception of water by means of which to prevent the excessive heating of said cylinder. Within the cylinder B a, preferably hollow, piston C is located and provided at its upper end with a head b and packing rings b'. A piston C′ is located within the cylinder B′ and provided at its upper end with a contracted head c adapted to enter and also constitute the lower head of the piston C. Each piston C′ is connected with a crank of a crank shaft B^3 by means of a pitman B^2. The pistons C, C′ are connected together by means of a rod c' having a head c^2 adapted to enter a recess in the head b and having screw threads c^3 at its lower end to mesh with screw threads in a perforation in the head c.

Adjacent to each cylinder B′ a valve casing D is located and provided with an inlet valve d and an outlet valve d', the chamber d^2 between said valves being adapted to communicate, through a duct or passage d^3, with the upper end of the cylinder B′. Gas and air will be supplied in proper quantities, to the various inlet valves d from a governing or mixing valve E, by means of a common duct or channel e, and from the outlet valves d', the explosive mixture will enter a duct or channel f, from which it will pass, through vertical ducts or channels f', to ducts or channels f^2, by which it will be conducted to charging valves g located coincident with the upper ends of the power cylinders B, and from said charging valves, the explosive mixture will flow through ducts h into the upper ends of the power cylinders B above the piston C. Each valve will preferably be provided with an adjustable nut i, by means of which to afford access to said valves.

In the wall of each cylinder B, a chamber j is made and adapted to communicate with the lower portion of said cylinder through openings j' and with said chamber j an exhaust pipe j^2 communicates. A perforation k is made in the wall of the power cylinder and communicates with the upper portion of the exhaust chamber j, said perforation being adapted to be closed by means of a valve k'. The purpose of this valve is to reduce compression when the engine is being turned over for starting and is termed the "starting valve."

As illustrated in the drawings, the engine has three double cylinders, each fitted with a double headed piston from which the power developed is transmitted to the cranks of the crank shaft of the engine in the usual man-

ner. There being three cranks, one hundred and twenty degrees apart and each stroke of the piston being equal to one hundred and eighty degrees on the crank circle, it is evident that explosive mixture must be continuously flowing through the channel *e* to one of the pump cylinders and it is further evident that one or the other of the pump cylinders will always be discharging into the channel *f* and keeping a constant supply of fresh mixture for charging the power cylinders. Now it will be seen that when the lower or pump cylinder B′ moves downwardly, the explosive mixture, supplied to the duct or passage *e* by the governor or mixing valve E, will be made to pass through the inlet valve *d* and enter the chamber d^2 over said valve, from which it will be drawn by the piston C′, through the duct d^3 into the upper end of the pump cylinder, in which cylinder the mixture will be measured, the quantity of the mixture being commensurate with the space between the top of the cylinder and the upper end of the piston C′ when the latter is at the lower extremity of its throw. When the pistons C, C′ move upwardly the explosive mixture will be made, by the piston C′, to return to the chamber d^2 through the duct or passage d^3, from which chamber it will pass through the valve *d′*, and enter the channel *f*.

In Fig. 2 the piston and cranks are shown in the extreme upper position and the space remaining between the piston C and the charging valve *g* is filled with compressed explosive mixture, which has passed from the channels $f' f^2$ and through the charging valve *g*. Ignition now takes place, resulting in a sudden rise in the pressure of the mixture and the piston is driven downwardly. On reaching the lowest position the piston C uncovers the exhaust ports *j′* in the wall of the cylinder and allows the burned gases to escape through the exhaust ports *j′*, chamber *j*, and pipe j^2 to the atmosphere. Fresh mixture then enters the power cylinder through the valve *g* and displaces any burnt gases which may remain. On the return or up stroke of the piston the exhaust ports are closed and the fresh charge of mixture contained in the power cylinder is compressed until the piston reaches its upper position, when ignition again occurs and the piston is driven downward as before described. It will be seen that the power cylinder is charged with the fresh explosive mixture during the period that the cranks are passing the bottom center and exhaust ports are open. This charge of fresh mixture is not taken from the pump directly under the power cylinder being charged but must be supplied by some other pump piston which is at that time discharging into the space leading to the charging valves. In this case the supply of fresh mixture is driven into the power cylinder, not by the pump directly under it but by the pump piston attached to the crank that is one hundred and twenty degrees in advance of it on the crank circle.

During the downward movement of the piston the pump piston C′ will serve to draw a fresh charge of explosive mixture into the pump cylinder B′, as above explained.

Each double piston is made to give an impulse at each revolution of the crank shaft, making three separate impulses for every revolution of the engine shaft and insuring an absolutely steady development of power.

We do not confine ourselves to the use of three cylinders, as it is evident that more or less might be used to accomplish the desired result, nor do we wish to confine ourselves to the use of the engine with the cylinders placed vertically, but,

Having fully described our invention, what we claim as new, and desire to secure by Letters Patent, is—

1. In a gas engine, the combination with two or more pairs of cylinders, one cylinder of each pair being a power cylinder and the other a pump cylinder and one located in alignment with the other, pistons in each cylinder and connected together in pairs, a crank shaft having cranks an equal number of degrees of a circle from each other, and piston rods connecting the pistons to the cranks, of three ducts for the explosive material, valves controlling the passage between two of these ducts, pipes or channels connecting one of the ducts with the third, and valves for controlling the passages into the power cylinders, substantially as set forth.

2. The combination with several pairs of cylinders, valve chambers in communication with the cylinders of each pair, and valves therein, of channels connecting these chambers in series and pipes connecting two of the channels, substantialiy as set forth.

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

FRANK A. RIDER.
SIMON VIVIAN.

Witnesses:
L. W. HUDREY,
H. WM. MEYER.