No. 735,964. PATENTED AUG. 11, 1903.

F. H. GILE.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED JULY 9, 1902.

NO MODEL.

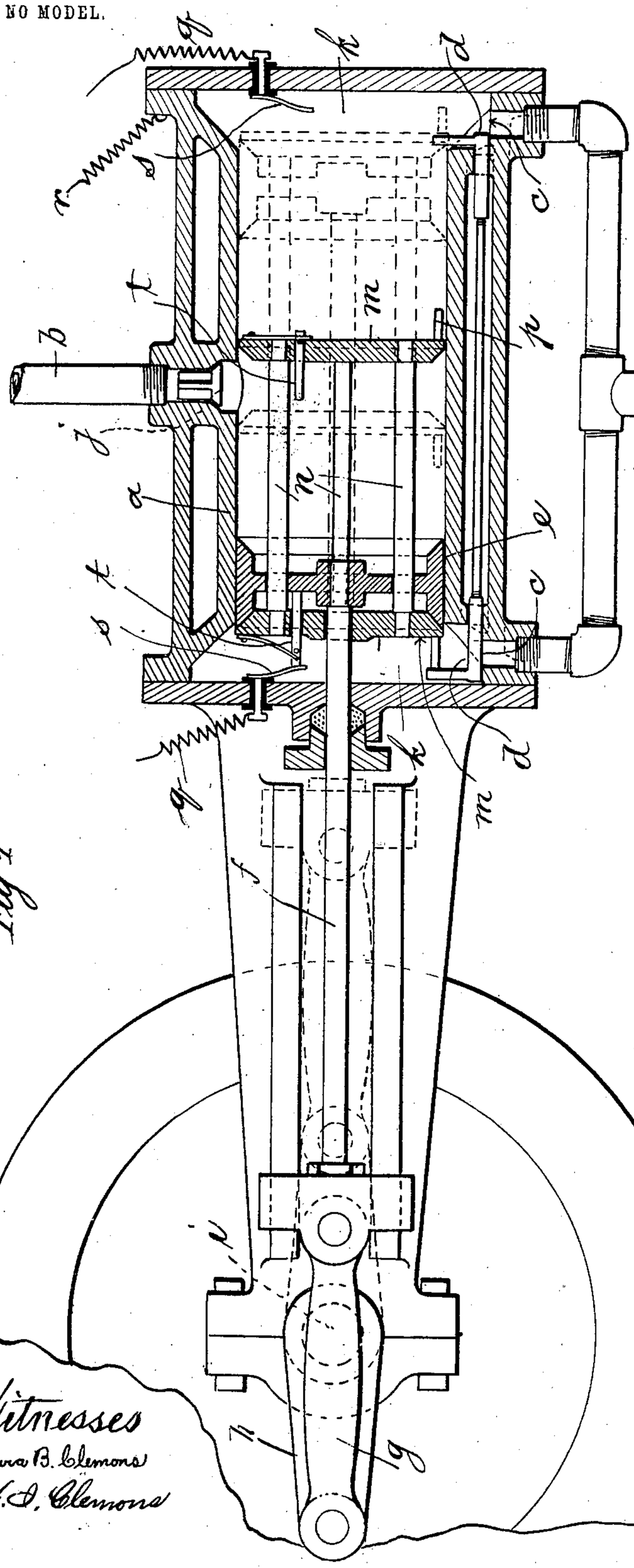


Fig 1

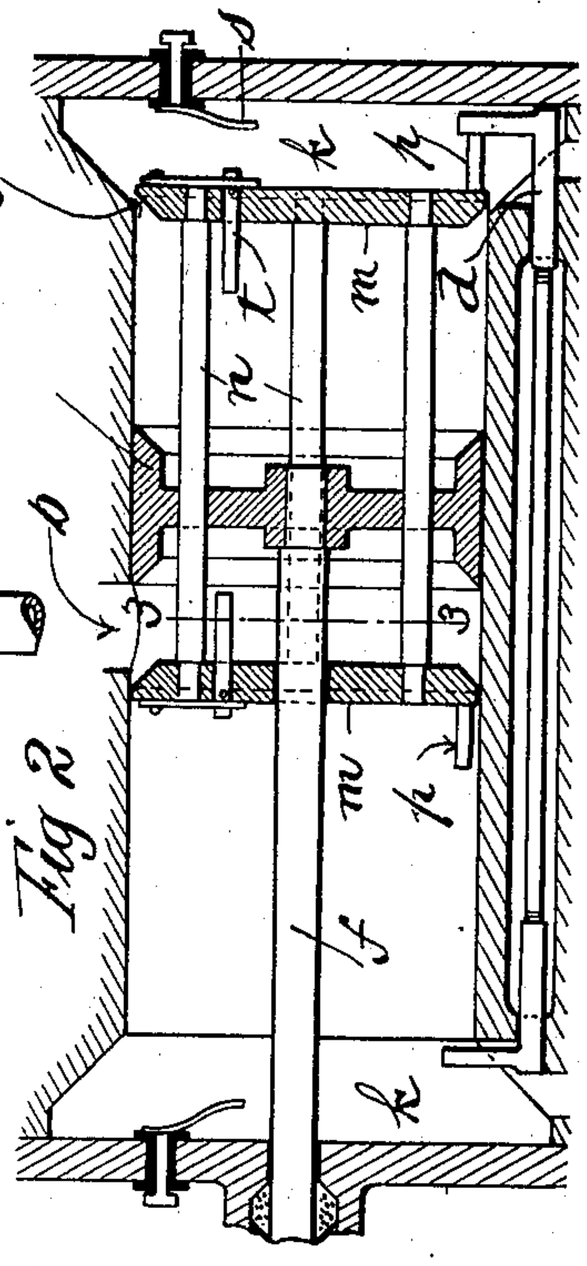
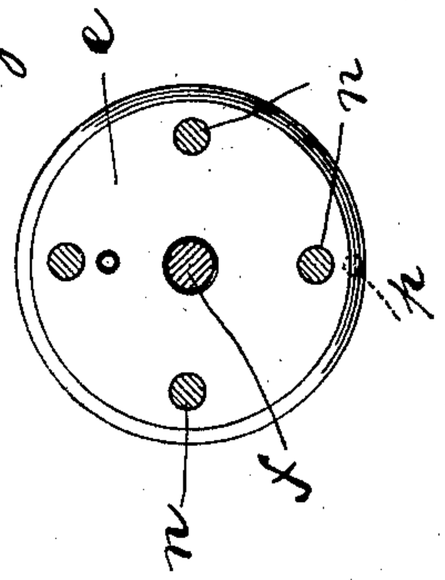


Fig 2

Fig 3



Witnesses
Laura B. Clemons
H. D. Clemons

Inventor
Fred H. Gile
By Chapin & Co
Attys

No. 735,964. Patented August 11, 1903.

UNITED STATES PATENT OFFICE.

FRED H. GILE, OF GREENFIELD, MASSACHUSETTS, ASSIGNOR OF ONE-HALF TO FREDERIC E. WELLS, OF GREENFIELD, MASSACHUSETTS.

INTERNAL-COMBUSTION ENGINE.

SPECIFICATION forming part of Letters Patent No. 735,964, dated August 11, 1903.

Application filed July 9, 1902. Serial No. 114,937. (No model.)

To all whom it may concern:

Be it known that I, FRED H. GILE, a citizen of the United States of America, residing at Greenfield, in the county of Franklin and State of Massachusetts, have invented new and useful Improvements in Internal-Combustion Engines, of which the following is a specification.

This invention relates to internal-combustion engines; and it has for its object certain improvements in motors of this type whereby a volume of combustible may be compressed and exploded at each end of the cylinder alternately without skipping a stroke, as in the present constructions of this type of motor; and a further object of the invention consists in the provision of means whereby the products of combustion in the cylinder may be expelled or practically expelled therefrom without being intermingled with the fresh charge of combustible; and the invention consists in the construction to be described in the following specification and clearly pointed out in the claims.

The invention is illustrated in the accompanying drawings, in which—

Figure 1 is a longitudinal sectional view of a motor-cylinder having my improvements applied thereto. Fig. 2 is a similar view of the interior of the cylinder, showing the parts therein in a different position. Fig. 3 is a sectional view on line 3 3, Fig. 2.

Referring to the drawings, the cylinder *a*, provided with the usual water-jacket, has an inlet-pipe *b*, located at a point substantially midway between its ends and is provided with an exhaust-port *c* at each end thereof. Over these exhaust-ports slide-valves *d* are fitted, which are operated by the movements of the piston-head *e* in a manner presently to be described. This piston-head *e* is provided with the usual piston-rod *f* and a connecting-rod *g*, which engages a crank *h* to rotate a driving-shaft *i*.

The arrangement and construction of the exhaust-valves and the construction of the motor generally form no part of the present invention, and these parts may serve simply as typical of the necessary elements of a reciprocating motor, the essence of the invention consisting in the method of introducing and compressing a gaseous or atomized combustible into the cylinder and exhausting the same therefrom after its combustion preparatory to the introduction of the new charge of combustible therein. Having these ends in view, the inlet-pipe *b* is located at a point substantially midway between the two ends of the cylinder, and located at the inner end of this pipe or inlet *b* is a check-valve *j*, acting to close the pipe *b* against pressure in the cylinder. The pipe *b* may extend to and be connected with a carbureter of any desired construction, the piston *e* of the cylinder serving as a pump whereby combustible may be drawn into the cylinder, or the pipe *b* may be connected to some suitable atomizing device or vaporizing device, as desired, it being immaterial in what form the combustible is introduced into the cylinder, save that it should have such an admixture of air as to cause it to explode properly when ignited.

At each end of the cylinder the latter is somewhat enlarged to form a combustion-chamber *k*. Within the cylinder is a flying piston consisting of the two heads *m*, one located on each side of the piston-head *e*, this piston-rod passing axially through one of said heads. These two heads are rigidly united by rods *n*, passing freely through the piston *e*, the distance between the heads being somewhat greater than half the length of the cylinder, to the end that the heads may be moved alternately one toward each end of said cylinder sufficiently to permit said heads to pass out of the cylindrically-bored portion of the cylinder and into the combustion-chamber, as shown in Fig. 2, without permitting the other head either to pass over or cover in any degree the inlet-port *b*, the heads of the flying piston being connected together by the rods *n*, which pass through the piston *e*. Either one of these heads may be moved out of the cylindrically-bored portion of the cylinder and yet be supported in axial alinement therewith. The object in having this head *m* moved into the combustion-chamber *k* is to provide a passage *o* around the edge of the head *m*, through which combustible may pass from between said head and one side of the piston *e* into the explosion-chamber *k*. It will be observed that the two heads *m* are in-

wardly beveled from their outer edges and that the opposite sides of the piston *e* are similarly beveled, to the end that when the piston *e* moves against one of the heads *m* a tight joint may be formed between the two. This position of the parts is shown in Fig. 1 at the left-hand end of the cylinder.

On the flying piston pins *p* may be located which at or near each end of the stroke of said flying piston will come in contact with the valves *d*, which cover the exhaust-ports and operate said valves to open and close them at the proper time. On each head of the cylinder there is a suitable electrical connection *q*, and connected with the cylinder is another electrical connection *r*, in circuit with which connections is a battery and the usual induction-coil, (neither of which is shown,) whereby when a contact is made within the combustion-chamber of two points representing the terminals of this circuit a spark will be produced when said terminals are separated, which will serve as means for igniting the charge of combustible. This igniting device is shown in a purely conventional manner, and any other may be substituted therefor. The two terminals thereof are indicated by the fingers *s* and the plunger *t*, the latter being secured in the head of the flying piston loosely and being forced out toward the finger *s* by contact with the piston *e* as the latter approaches the end of its stroke. The opposite end of the cylinder is similarly equipped.

Assuming the parts to be in the position shown in Fig. 1, which is at the time at which the piston *e* has completed its stroke in one direction—viz., to the left—and assuming a charge of explosive combustible to be confined in the chamber *k* at the left-hand end of the cylinder it will be observed that the head *m* of the flying piston, lying approximately at the center of the cylinder, forms one movable partition therein and the piston *e* the other movable partition, between which combustible may enter or be introduced from the pipe *b*, which, it must be remembered, has a check-valve *j* therein closing outwardly. The ignition now taking place will drive the piston *e* and the flying piston simultaneously toward the opposite end of the chamber, carrying through the latter the volume of combustible referred to. When the said forward head of the piston *m* reaches the position shown in dotted lines in Fig. 1 at the extreme right-hand end of said cylinder, it passes into the combustion-chamber *k*, thus leaving open an annular passage *o* around the edge thereof. When this advancing head *m* of the flying piston nears the end of its stroke, the pin *p* strikes against a projection on the slide-valve *d* and covers the exhaust-port *c* at that end of the cylinder toward which the pistons are advancing. Thus the movement of the head of the flying piston tends to drive out of the cylinder practically all of the burned gases which may remain in one end of the cylinder after an explosion and before the passage *o* is opened, whereby the volume of combustible contained between one end of the flying piston and the piston *e* is discharged into said combustion-chamber by the continued advance of the piston *e* from the position shown in Fig. 1 in full lines to a contact with the opposite head thereof, as shown in dotted lines on the opposite end of the cylinder. When the end of the flying piston reaches the position shown in Fig. 2, it comes to a standstill by reason of the contact therewith with the slide-valve *d* or any other suitable abutment, and the piston *e*, then continuing its movement, having passed the inlet *b*, forces the volume of gas confined between it and the forward head of the flying piston through the passage *o* and into the combustion-chamber *k*, said piston *e* continuing its movement until the beveled edge bears on the inner side of the head of the flying piston, thus effectually closing the passage *o*. At a proper time this piston *e* strikes the pin *t*, which is thus made to contact with the finger *s*, whereby the ignition of the combustible is effected. It is thus seen that each charge of combustible is first received between one of the heads *m* of the flying piston and one side of the piston *e*, and this charge is carried toward one end of the cylinder and there discharged into one of the chambers *k*, wherein it is compressed by the continued movement of the piston *e*, and this chamber then closed by the arrival of the latter, and the charge is then fired, thus driving the flying piston and the crank-connected piston in an opposite direction to that in which they last moved. Each explosion takes place against the outer side of the head of the flying piston, which is backed up by the arrival of the piston *e*, which moves into contact therewith just prior to the explosion of the combustible.

Having thus described my invention, what I claim, and desire to secure by Letters Patent of the United States, is—

1. The combination with a cylinder, of a flying piston consisting of two heads rigidly united, the distance between which is greater than half the length of said cylinder; an inlet-opening in the cylinder located between said heads, a crank-connected piston-head located between the two heads of said flying piston, the space between the opposite sides of the crank-connected piston and the heads of the flying piston alternately constituting combustible-receiving chambers, there being a passage around each head of the flying piston, at or near each end of the cylinder, adapted to be closed by the movement of the crank-connected piston, and there being exhaust-ports near each end of the cylinder; together with a sparking device at each end of the cylinder, and a valve mechanism for periodically opening and closing said exhaust-ports.

2. An internal-combustion engine consisting of a cylinder having an inlet-opening located substantially midway between its ends, suitable exhaust-openings at each end there-

of, valves and valve-operating mechanism, and a combustion-chamber at each end of the cylinder; a flying piston consisting of two rigidly-united heads, the distance between which is greater than half the length of the cylinder; whereby at the end of a stroke explosive mixture may enter the space in the cylinder between its heads; a second piston connected to a suitable crank located between said heads of the flying piston, said mixture serving as a cushion to move the flying piston toward the combustion-chamber, there being a passage from the cylinder into the combustion-chambers opened by the movement of the flying piston, and adapted to be closed by the crank-connected piston prior to the movement of ignition.

3. An internal-combustion-engine cylinder having an inlet-opening substantially midway between its ends, a flying piston therein consisting of two rigidly-united heads between which a volume of combustible mixture is contained, a combustion-chamber at each end of the cylinder into which said volume is discharged at the end of the stroke of the flying piston; a crank-connected piston-head located between the heads of said flying piston, whereby said volume of mixture is forced into said combustion-chambers, there being a passage around the heads of the flying piston into the combustion-chambers.

4. The combination with the cylinder of an internal-combustion engine having an inlet-opening midway between its ends, of a flying piston consisting of two rigidly-united heads between which a volume of combustible is received, there being a passage around each head of the flying piston at opposite ends of the cylinder for conducting the combustible alternately, at or near the end of the stroke, to the outside of each of said heads prior to the moment of ignition, together with a crank-connected piston located between the heads of the flying piston, and movable against said heads alternately, prior to the moment of ignition.

FRED H. GILE.

Witnesses:
H. A. CHAPIN,
WM. H. CHAPIN.