

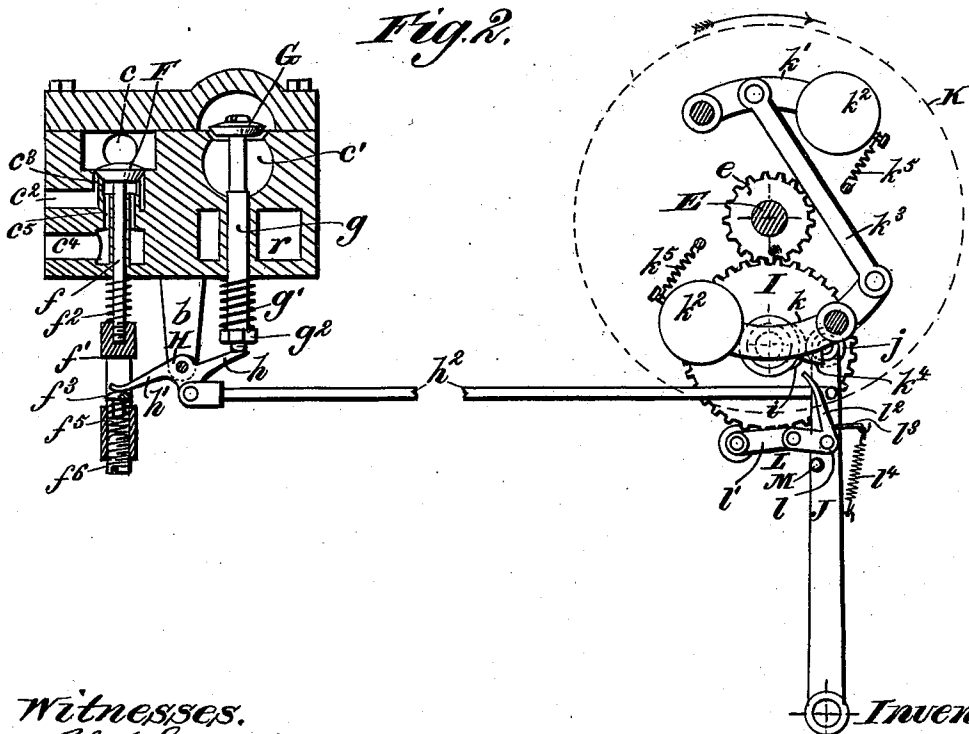
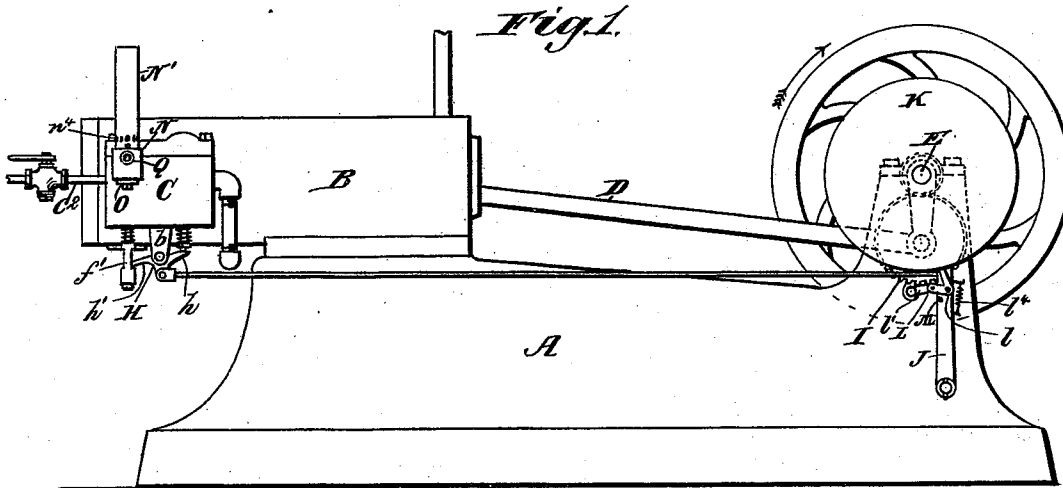
(No Model.)

2 Sheets—Sheet 1.

F. P. MILLER.
GAS ENGINE.

No. 532,980.

Patented Jan. 22, 1895.



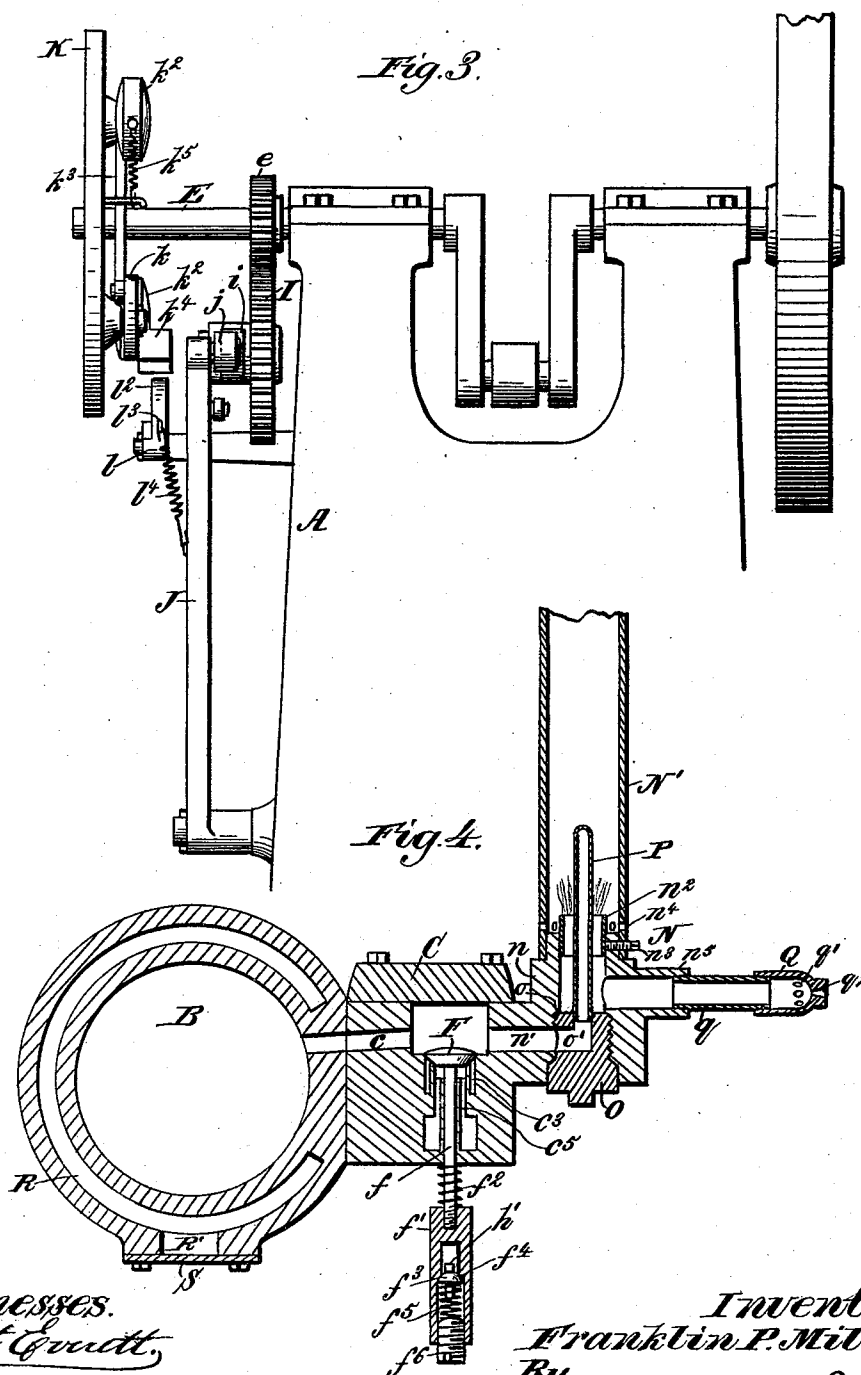
Witnesses.
Robert Grout.
G. W. Rea.


 Inventor:
 Franklin P. Miller.
 By James L. Norris, *Atty.*

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UNITED STATES PATENT OFFICE.

FRANKLIN P. MILLER, OF BLOOMFIELD, NEW JERSEY.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 532,980, dated January 22, 1895.

Application filed February 12, 1894. Serial No. 499,948. (No model.)

To all whom it may concern:

Be it known that I, FRANKLIN P. MILLER, a citizen of the United States, residing at Bloomfield, in the county of Essex and State of New Jersey, have invented new and useful Improvements in Gas-Engines, of which the following is a specification.

My invention relates to that class of gas engines commonly known as "four cycle" engines, wherein a complete working cycle is composed of four strokes of the piston, a mixture of gas and air being drawn into the cylinder by suction, compressed, ignited, and the waste products of combustion finally expelled. In engines of this class these operations take place in the manner and order following: The first outward stroke of the piston draws into the cylinder a charge of air and gas mixed in the proper proportions to be highly explosive. The second or inward movement of the piston compresses the mixture of gas and air, and at the end of this stroke, while the compression is greatest, the mixture is ignited, and the piston propelled outward on its third stroke. On the fourth or inward stroke of the piston the waste products of combustion are expelled from the cylinder into a suitable receptacle.

The objects of the present invention are to provide an improved governor and valve connections for regulating the speed of the engine and to provide an improved igniting device.

To these ends my invention consists in the novel construction, combination, and arrangement of parts hereinafter fully described and afterward definitely pointed out in the claims following the description, due reference being had to the accompanying drawings forming a part of this specification, wherein—

Figure 1 is a side elevation of my improved engine. Fig. 2 is an enlarged view showing a longitudinal, vertical section through the valve chest, and a side elevation of the governor, the disk supporting the governor balls being removed for the sake of clearness. Fig. 3 is an end elevation of the governor. Fig. 4 is a sectional view of the cylinder, valve chest and igniting device.

Referring to the drawings the letter A indicates the bed of the engine; B, the cylin-

der; C, the valve chest; D, the piston rod, and E the crank shaft.

The valve chest C is located at one side of and near the rear end of the cylinder B, as shown, and communicates with said cylinder by the inlet port *c* and exhaust port *c'*. A gas inlet *c²* communicates with the port *c* by means of an annular passage *c³*, and an air inlet *c⁴* also communicates with said port by means of an annular passage *c⁵*, concentric with the passage *c³*. The passages *c³* and *c⁵* are closed by valve F provided with a stem *f* which projects downwardly through the valve chest, and at its lower end is provided with a stirrup *f'*, for the purpose hereinafter described. About said stem and between the top of said stirrup and the bottom of the valve chest is arranged a coiled spring *f²* which operates to close the valve F. The exhaust port *c'* is also controlled by a valve G provided with a stem *g* which projects downwardly through the valve chest and at its lower end is encircled by a coiled spring *g'* which bears against the bottom of the valve chest and against an adjusting nut *g²*, and operates to close said valve. To a hanger *b* is pivoted a double bell crank lever H, one arm *h* of which bears against the under side of the stem *g* of the exhaust valve, and the other arm *h'* is adapted to rest within the stirrup *f'*. The lower end of said stirrup is provided with a cylindrical aperture within which is seated a button *f³* held up against a shoulder *f⁴* by a coiled spring *f⁵*, the tension of said spring being adjusted by a screw-plug *f⁶* fitted in the lower end of the stirrup. The arm *h'* of the bell crank H bears against said button, and by rocking said bell crank about its pivot the valves F and G are alternately operated in the manner presently to be described. Upon the crank shaft E is keyed a gear wheel *e* which meshes with a gear wheel I journaled to the engine frame, the ratio of said wheels being as one to two. Upon the hub of the wheel I is formed a cam *i* which is adapted to engage a roller *j* journaled to the upper end of a rock arm J. A connecting rod *h²* is pivoted at one end to said rock-arm and at its other end is pivoted to the bell-crank H. To the end of the crank-shaft E is secured a disk or plate K, to which, at opposite points, are

pivoted arms k, k' , carrying governor balls k^2 . The arm k is pivoted to said disk at a point between its ends, as shown, while the arm k' is pivoted at its extreme end, said arms being
 5 connected as shown by a link k^3 to cause them to move in unison. One of the arms, as k , is provided upon its outer side with a cam k^4 , for the purpose to be presently made appar-
 10 ent. To each of the governor balls is connected one end of a coiled spring k^5 , the other ends of said springs being attached to the plate or disk K. The springs serve to draw the governor balls toward the center of the
 15 disk K in the well known manner. To the rock arm J is pivoted a bell-crank lever l which is pivotally secured to one end of a lever l' , which at its other end is pivoted to the engine frame, the levers l, l' , forming a
 20 toggle-lever L^2 . From the upper arm l^2 of the lever l projects an arm l^3 , to the end of which is attached one end of a coiled spring l^4 , the other end of said spring being secured to the rock arm J.

As thus described the operation of the de-
 25 vice is as follows: Upon the first or outward stroke of the piston, a partial vacuum is formed behind the piston, raising what I de-
 30 nominate the mixing valve F and drawing in a charge of mixed gas and air. Upon the return stroke of the piston the valve F closes by the combined action of gravity, the spring
 35 f^2 and the pressure exerted by the piston, and the mixture is compressed. At the extreme end of the stroke the mixture is ignited, as will hereinafter be described, propelling the
 40 piston outward. During these three strokes of the piston the crank-shaft has made one and one-half revolutions thus revolving the
 45 gear wheel I three quarters of a revolution. At this point the piston starts inward upon its fourth stroke, and at the same moment the
 50 cam i abuts against the roller j journaled in the upper end of the rock arm J and forces said arm to one side, which, through the me-
 55 dium of the rod h^2 , rocks the bell crank lever H upon its pivot and causes the arm h to raise the exhaust valve G. The cam i forming one-
 60 fourth of the periphery of the wheel I, and said wheel making one revolution to every two revolutions of the wheel e , or four strokes
 65 of the piston, it will be seen that the exhaust valve G is held open during the entire period of the fourth stroke of the piston, thus per-
 mitting the waste products of combustion to be expelled from the cylinder into a suitable
 exhaust chamber or receptacle. At the completion of the fourth stroke of the piston the
 cam i leaves the roller j , when the spring g'
 will immediately close the exhaust valve G
 and simultaneously rock the bell-crank H and
 draw back the rock arm J to its original po-
 sition. Should the momentum of the engine
 become too great the governor balls k^2 will be
 thrown outward by centrifugal force, causing
 the cam k^4 , on the governor arm k , to strike
 the upper end of the arm l^2 of the toggle lever
 L, forcing said toggle lever over to the oppo-

site side of its center, and before the spring
 l^4 can draw it back to its former position the
 cam i will have left the roller j and the spring
 70 g' will start to close the exhaust valve G. This
 action of the spring g' , however, will draw the
 rock-arm J toward the hub of the wheel I, thus
 forcing the lower arm of bell-crank, arm l of
 75 which forms one arm of the toggle lever L
 against a pin M on the rock arm, arresting the
 further movement of the latter and prevent-
 ing the closing of the exhaust valve G. Al-
 though the spring l^4 tends to return the parts
 80 to normal position, it will be understood that
 the pressure of the spring g' acting through
 the medium of the bell-crank H, the rod h^2 ,
 the rock-arm J, and the toggle-lever L, will
 maintain the said toggle-lever in its locking
 85 position, thereby holding the exhaust-valve
 open during excessive speed of the engine;
 for, in order to close the exhaust-valve, when
 the toggle rests against the pin M, it will be
 necessary to force the toggle against the pres-
 90 sure of the spring g' to the other side of the
 center, thus forcing the rock-arm from the
 hub of the gear I to a distance equal to the
 distance it is forced by the cam i , the spring
 l^4 having only tension enough to draw the to-
 95 ggle-lever L past the center when released from
 its locked position by reason of the cam i forc-
 ing the rock-arm J away from the hub of the
 gear I. The pin M is so situated as to allow
 the rock-arm J to move a short distance to-
 100 ward the hub of the gear I after the cam i
 has left the roller j . The exhaust valve is thus
 held open and at the same time the arm h' of
 the bell crank H holds down the mixing valve
 F to its seat. The piston will now, on its out-
 105 ward stroke, draw into the cylinder through
 the exhaust valve the burned or waste gases,
 upon its next stroke will expel the same
 through the exhaust, upon its next outward
 stroke will again draw in the burned or waste
 110 gases, and will again expel them, the mixing
 valve F being all this time held closed and
 the exhaust valve G held open. The valves
 will be held in this position until released by
 the cam i again rocking the arm J away from
 the hub of the wheel I, upon which the spring
 115 l^4 will immediately swing the toggle lever L
 back past its center to its original position,
 and if the speed of the engine has slackened
 sufficiently to permit the governor balls be-
 ing drawn inward by their springs so that the
 120 cam k^4 will clear the arm l^2 of the toggle le-
 ver, the piston will upon its next stroke again
 draw in through the mixing valve F a fresh
 charge of gas and air.

It will be understood that when the exhaust
 125 valve is held closed by its spring the arm l^2
 of the toggle lever will be held away from and
 out of the path of the cam k^4 , and this is es-
 sential, as the exhaust valve must open but
 once during every two revolutions of the disk
 130 carrying the governor balls.

In practice the pivot connecting the levers
 l and l' of the toggle L will be allowed a little
 play so as to allow the toggle to pass from one

side of the center to a corresponding distance to the other side without raising the roll from the cam i , so that the cam k^4 will by slight pressure force the toggle L into its lower position, and said cam k^4 is made long enough to hold it in this position until the cam i has left the roller j , when the arm l of the toggle will settle against the pin M, as before described.

N indicates the igniting device, constructed as follows: To the side and near the rear end of the valve chest C is formed a casing n which communicates by means of a passage n' with the gas and air inlet of the cylinder. Said casing is cored out centrally, as shown, and is internally screw-threaded for the reception of a screw-threaded plug O which seats itself against a shoulder o at its top, and at its bottom tightly fits the cored out casing, thus forming gas tight joints at these points. Said plug is provided with a port o' which registers with the passage n' in the casing n when the plug O is screwed up in place. In said port is fitted a vertical tube P which is closed at its upper end, and in the upper end of the cored out casing n is fitted a vertically adjustable sleeve n^2 , held in its adjusted position by means of a set-screw n^3 tapped through the upper end of the casing. Fitted over the upper end of the casing n is a chimney N' which projects for a suitable distance above the top of the igniting tube P. The chimney N', at a point just above the top of the casing n , is provided with a series of perforations n^4 , which serve as air inlets to support combustion, as hereinafter made apparent. The casing n is provided with a nipple n^5 within which is fitted a tube q having at its end a cap Q which is provided with air inlets q' and an inlet q^2 for the admission of gas in the same manner as a Bunsen burner.

The operation of the igniting device is as follows: Gas and air are supplied to the burner through the tube q and pass up about the igniting tube until the top of the sleeve n^2 is reached at which point ignition takes place and heats the igniting tube. Before reaching this point the supply of air is insufficient to support combustion, which cannot occur until the mixed gas and air escape from the sleeve n^2 , at which point air is supplied through the perforations n^4 in the base of the chimney N'. Upon starting the engine the tube P is filled with air or the burned gases of a previous charge. The first stroke of the piston fills the cylinder with a combustible mixture of gas and air. The second or inward stroke compresses the charge so as to occupy, say, one-third of its volume at atmospheric pressure when the piston has reached the end of its stroke. The old gas in the tube will now be forced to occupy one-third the space, and being followed up by the combustible mixture the junction of the burned and combustible gas will just reach the heated part of the tube causing the ignition of the combustible gas. The point at

which the ignition takes place may be regulated by raising or lowering the sleeve n^2 , so as to cause the ignition to take place at the moment the piston reaches the end of its inward stroke. By this arrangement valves for regulating the time of admission of gas to the igniting tube are dispensed with. By making the plug O removable and fitting the igniting tube removably therein, the plug may be quickly taken out in case the igniting tube burns out, and another plug fitted with an igniting tube substituted, when the damaged tube may be removed from the plug at leisure.

The cylinder and valve chest, as usual, are provided with water jackets R, r , to prevent overheating. Heretofore much trouble has been experienced from the water in the jackets freezing in very cold weather, often resulting in bursting the jackets. To prevent this I cut an aperture through the jacket, as at R' and secure over said aperture, by bolts or other suitable fastenings, a metallic plate S which is thinner or weaker than the jacket R, so that in the event of the water in the jacket freezing the plate will break and permit the escape of the water. As shown the aperture is made in the bottom of the cylinder. Should it be made in the top the water would freeze on the top first and become firmly wedged to the sides of the cylinder, and as the remaining water froze it would be apt to burst the bottom of the cylinder.

Having described my invention, what I claim is—

1. In a gas engine, the combination with the inlet and exhaust valves and springs for closing them, of a double bell crank operating to open the exhaust valve and hold the inlet valve closed, a rock-arm, a connection between said bell crank and rock arm, mechanism for periodically vibrating said rock arm, a toggle lever fixed at one end and at its other end pivoted to the rock arm, a spring for throwing said toggle lever in one direction, a pin on the rock arm to arrest the motion of the toggle lever in the opposite direction, and a speed governor provided with means for throwing the toggle lever against said pin, substantially as described, and for the purpose specified.

2. In a gas engine, the combination with the inlet and exhaust valves and springs for closing them, of a double bell crank operating to open the exhaust valve and hold the inlet valve closed, a rock arm, a connection between said bell crank and rock arm, a cam wheel for vibrating the rock arm, a governor comprising pivoted, weighted arms, a cam carried by one of said arms, a toggle-lever fixed at one end and at its other end pivoted to the rock-arm and provided with an arm adapted to be engaged by said cam, a spring for moving the toggle lever in one direction, and a pin on the rock arm for arresting the movement of the toggle lever in the other direction, substantially as described.

3. In a gas engine, the combination with the

inlet and exhaust valves and springs for closing them, of the stirrup f' carried by the inlet valve, said stirrup being centrally apertured as shown and provided with a shoulder f^4 , the
5 button f^3 arranged in said aperture and abutting against said shoulder, a spring arranged below said button, a screw plug f^6 for adjusting the tension of said spring, a double bell
10 crank one arm of which is adapted to bear against said button and the other end against the under side of the exhaust valve, and means for automatically rocking said bell
crank to open the exhaust valve and close the inlet valve, substantially as described.

15 4. An igniting device for gas engines, comprising a hollow casing having arranged therein a tube closed at one end and communicating at its other end with the cylinder, a gas supply for said casing, and a vertically
20 adjustable sleeve surrounding said tube, substantially as described and for the purpose specified.

5. An igniting device for gas engines, comprising a hollow casing having arranged therein a tube closed at one end and communicating
25 at its other end with the cylinder, a gas supply for said casing, a vertically adjustable sleeve surrounding said tube, and a chimney

perforated near its base and fitted over said tube and sleeve, substantially as described. 30

6. An igniting device for gas engines, comprising a hollow casing having removably fitted therein a plug carrying a detachable igniting tube closed at one end and at its other
35 end communicating with the cylinder, an adjustable sleeve surrounding said tube, and a gas supply for said casing, substantially as described.

7. In an igniting device for gas engines, the combination with a casing n provided with
40 the passage n' , of the screw-plug O fitted in the bottom of said casing and seated against a shoulder o , the port o' in said plug registering with the passage n' , the igniting tube P closed at its upper end and removably fitted
45 in said plug, an adjustable sleeve n^2 surrounding said tube, and a gas supply g , substantially as shown and described and for the purpose specified.

In testimony whereof I have hereunto set
50 my hand and affixed my seal in presence of two subscribing witnesses.

FRANKLIN P. MILLER. [L. S.]

Witnesses:

BENJ. F. MILLER,

ADELAIDE L. MILLER.