

A. P. BRUSH.
EXPLOSION ENGINE.
APPLICATION FILED JULY 3, 1907.

1,012,323.

Patented Dec. 19, 1911.

3 SHEETS—SHEET 1.

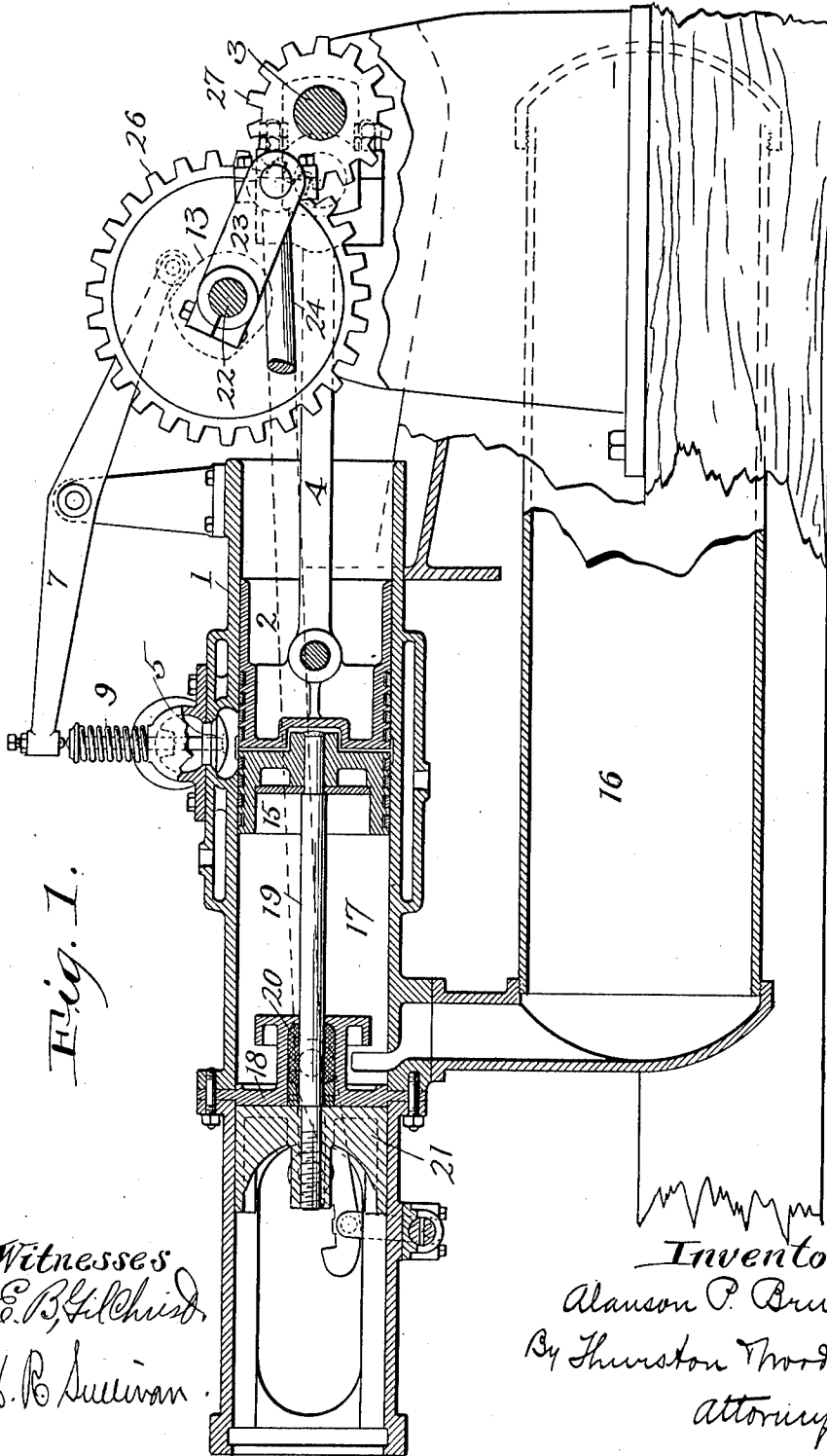


Fig. 1.

Witnesses
E. B. Christ
H. B. Sullivan.

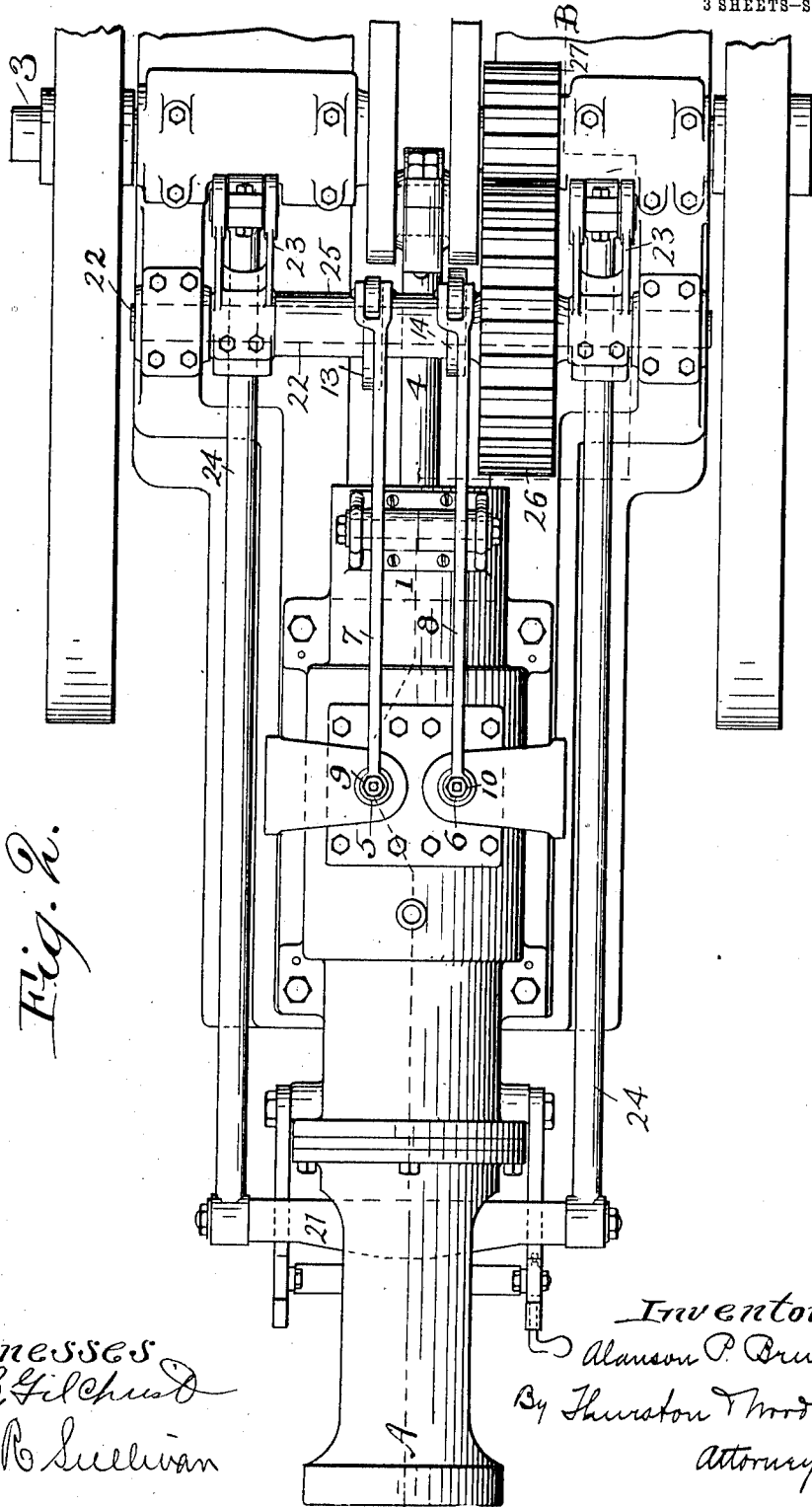
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E. B. Gilchrist
H. B. Sullivan

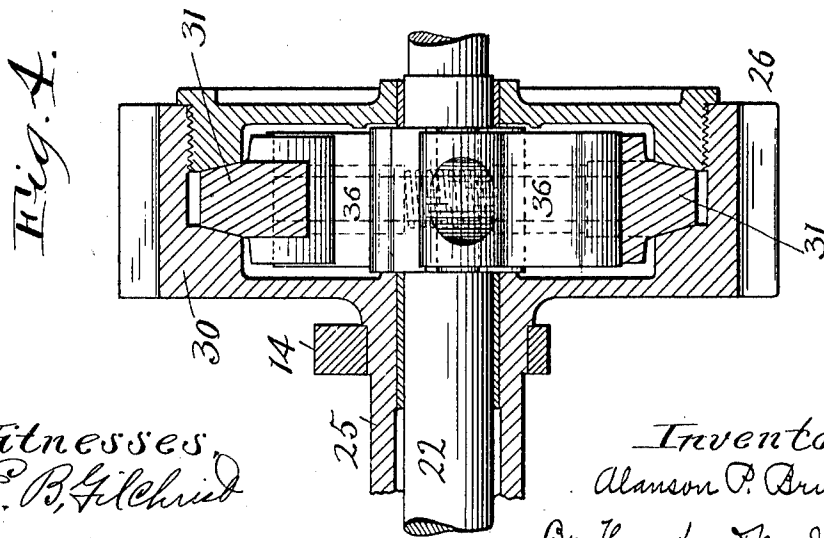
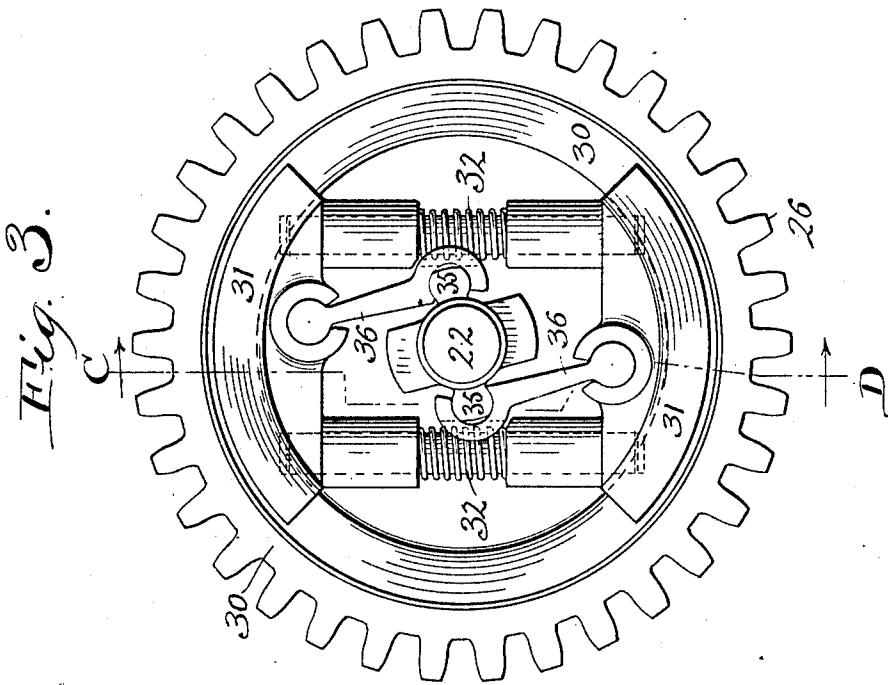
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UNITED STATES PATENT OFFICE.

ALANSON P. BRUSH, OF DETROIT, MICHIGAN.

EXPLOSION-ENGINE.

1,012,323.

Specification of Letters Patent.

Patented Dec. 19, 1911.

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To all whom it may concern:

Be it known that I, ALANSON P. BRUSH, a citizen of the United States, residing at Detroit, in the county of Wayne and State of Michigan, have invented a certain new and useful Improvement in Explosion-Engines, of which the following is a full, clear, and exact description.

The object of the invention is to increase the efficiency of explosion engines.

Among the beneficial results produced by the invention are the following, viz., the gas produced by the explosion of the charge is permitted to expand and do its work almost instantly instead of being retarded, and its efficiency thereby greatly reduced by the speed of the crank shaft, as is the case in most of the explosion engines in common use, in which the charge is compressed in the explosive chamber. The compression of the explosive mixture will be of substantially the same value irrespective of the volume of the charge. It is therefore unnecessary to employ electric igniting-devices or any form of igniting devices capable of being exactly timed as to their action relative to the position of the piston. Premature explosions do not materially reduce the efficiency of the explosion, and do not shock the mechanism as they do in engines of the ordinary type. Moreover, the losses in efficiency due to heat losses are greatly reduced, and the energy of the explosions is utilized without substantial loss for nearly one half of the cycle of the engine, or nearly a full revolution of its crank shaft.

The invention will be described in connection with the accompanying drawings, in which—

Figure 1 is a sectional side elevation of an engine embodying the invention, the section being in the plane indicated by line A—B of Fig. 2. Fig. 2 is a plan view of said engine. Fig. 3 is a side elevation of a friction ratchet mechanism which may be employed with advantage in connection with the described engine; and Fig. 4 is a sectional view on line C—D of Fig. 3.

Referring to the parts by numerals, 1 represents the cylinder of an explosion engine; 2 the piston therefor; 3 the crank shaft; 4 the connecting rod; 5 the inlet valve; and 6 the outlet valve. These valves are held closed by springs 9 and 10 respectively, and may be opened by levers 7 and 8

operated by cams 13 and 14 on the sleeve 25. The parts mentioned are or may be of any approved form, except that the cylinder has no fixed head opposed to the piston 2 as is the usual construction; but, on the contrary, the head opposed to piston 2 is in the form of a forwardly yielding piston 15,—the cylinder being prolonged in a forward direction for the accommodation of piston 15.

The forward yielding of the piston head 15 is to be resisted by a yielding resistant of some sort, the tension of which is increased by the forward movement of said piston-head. Mechanism is also provided and arranged to be moved as the yielding resistant returns the piston-head 15 to its normal position, which mechanism is organized so as to transmit that movement to the driven member of the engine.

I have deemed it advisable to employ compressed air as the yielding resistant, but this is a matter of preference only.

16 represents a tank containing compressed air; and this tank is in open communication with the piston chamber 17 in the cylinder between the piston-head 15 and the fixed head 18 of the cylinder. The piston-head 15 has a rod 19 which extends forward out of the cylinder through a stuffing box 20 in the fixed head 18; and the projecting end of this piston rod is fixed to a cross head 21.

A rock shaft 22 is suitably mounted adjacent to the crank shaft 3 of the engine. On this rock shaft are two arms 23 which are connected with the cross head by the connecting rods or links 24. On the rock shaft 22 a sleeve 25 is loosely mounted. The gear 26 is rigid with said sleeve and meshes with a gear 27 on the crank shaft. A clutch contrivance of some suitable form must be provided and arranged so that it will connect this sleeve with the rock shaft when the latter is being rocked by the compressed air induced movement of the piston head 15 through the described mechanism but which permits the sleeve to rotate freely on the rock shaft under all other conditions.

Now, in using the described engine, the resistant associated with the piston head is put under the required tension;—that is to say, that in the construction illustrated the air is compressed to the required degree. The crank shaft is then turned over and the

engine set in operation. When the piston 2 moves out, it draws into the cylinder in the space between it and the piston-head 15 a charge of the explosive mixture in the usual way, the valve 5 being opened to permit this. When said piston 2 reverses its movement and goes toward the piston head 15 the explosive charge is compressed to the required degree which will correspond with the force of the resistance to the forward movement of the piston-head 15. As soon as there is a balance between the compression of the charge between the piston 2 and piston head 15, on the one hand, and the pressure of the air resisting the forward movement of the piston head 15, on the other hand, a further movement of the piston 2 will cause a forward movement of the piston-head 15. It is evident, therefore, that the compression of the charge to be exploded will always balance the force resisting the forward yielding of the piston 15. Therefore, it follows that whether the charge drawn in be of large or small volume, it will always be compressed to substantially the same degree. The compression will, of course, be slightly greater when a large charge is taken than when a small charge is taken, but the difference will be slight because of the described yielding of the piston-head 15. At the proper time the compressed charge is ignited. It has not been thought necessary to show any means for so igniting the charge. Any familiar means may be employed; or, as above stated, the mechanism may be so organized as to spontaneously ignite the charge when it is compressed to a predetermined degree. The immediate expansion of the hot gas produced by the explosion thrusts in both directions,—that is to say, against both of the pistons 2 and 15. Some part of the force drives the piston 2 out at such speed as is possible in view of its described connection with the crank shaft, and the permissible speed of the crank shaft in view of its load. That is to say, so much of the explosive force as is expended in the movement of this piston 2 is utilized in the usual way and through well understood mechanism to produce the usual result—that is to say a rotation of the crank shaft. But what I consider as a very important result produced by the explosion is the immediate movement forward of the piston-head 15. This movement is practically unrestrained as to time, and has no relation whatever to the speed of the crank shaft of the engine. This movement will be resisted by the compressed-air and will increase the tension of that air. That is to say, a large part of the useful energy of the explosion will, through the movement of the piston 15, be stored in the air which resists that movement. When the available energy of the exploded charge has

been absorbed by the resisting air the forward movement of the piston head 15 ceases. In moving forward the piston head, it has through the described mechanism, rocked the rock shaft 22 idly backward. When the pressure in the cylinder between the piston 2 and the piston head 15 is sufficiently reduced, which will, for the most part, be after the exhaust valve 6 has been opened and after the piston 2 has begun its forward scavenging stroke, the compressed air will exert its stored energy upon the piston head 15 and will return it to its initial position. As soon as this return movement is begun, it will, of course, reverse the movement of the shaft 22. As soon as this movement is reversed the clutch referred to will connect said shaft with sleeve 25, so that that sleeve must turn in unison with said shaft. The time within which the air-induced action of the piston head 15 and the attached parts may act will, of course, be governed by the speed and inertia of the crank shaft and its load; but this delay does not entail any loss of energy by loss of heat, as does the corresponding delay in the action of an ordinary piston in an engine of the ordinary construction. The exploded charge does its work instantly in moving the piston 15 forward, and before it has time to lose much, if any, of its efficiency. The energy thereby stored in the air acts efficiently and without material loss during such period of time as may be required, in view of the load on the crank shaft, to restore the piston 15 to its normal position. It will, of course, be understood that the turning of sleeve 25 by reason of its connection with shaft 22 transmits power to the crank shaft of the engine through the intermeshing gears secured to said sleeve and crank shaft, and that this power is exerted to turn the crank shaft in the same direction in which it is turned by the piston 2. In as much as the piston head 15 is being returned to its normal position and the power of the stored energy of the air is being utilized while the piston 2 is making its scavenging stroke, and therefore after it has transmitted its quota of the energy of the explosion to the crank shaft, it is evident that the crank shaft is being impelled to rotate, for nearly one-half of the cycle of the engine instead of only one-fourth of its cycle, as is the case with the ordinary four-cycle explosion engines. It is evident, therefore that the shocks and strains upon the machinery are lessened. Moreover, premature explosions do no serious harm, because their force will be expended for the most part in moving forward the yielding piston head 15, and thereby storing in its yielding resistant that energy or nearly all of the energy which would otherwise oppose the completion of the forward movement of piston 2. and

thereby check, and sometimes stop the engine and injuriously rack the working parts thereof.

The clutch contrivance for connecting the sleeve 25 with the rock shaft 22, which I prefer, is shown in Figs. 3 and 4. It is a friction clutch including the following parts, to wit: a cylindrical casing 30 attached to the sleeve 25, two friction shoes 31 within said casing and adapted to be moved outward into contact with said casing or to be withdrawn from said contact according to circumstances. Springs 32 act to force these two shoes outward into contact with the casing. On the rock shaft 22 are two diametrically disposed arms 35 which are connected by links 36 with the two friction shoes respectively. When the rock shaft is rocked by the forward movement of the piston 15, due to the explosion, this shaft is turned more rapidly than sleeve 25, so that through the links 36 the shoes are withdrawn from engagement with the casing. When, however, the shaft is turned in the opposite direction, it acts through the links 36 to thrust said shoes outward into contact with the casing and thereby to frictionally connect the shaft with the casing, which it will be remembered is a part of the sleeve 25, and thereby said sleeve and the gear, which it carries, are driven with shaft 22 and at the same speed and with practically no lost motion, as there might be if the clutch were of some other form than a quick acting friction clutch as shown.

It will be understood that this invention may be embodied in engines which employ widely different forms of yielding resistants opposing the forward movement of the piston 15 and employing widely different forms of mechanism for transmitting energy stored in that yielding resistant to a driven member of the engine.

When the piston 2 returns on the exhaust stroke it comes much closer to the piston-head 15 than is the case with the ordinary explosion engines, and therefore there is a more complete expulsion of the exploded gases.

Having described my invention, I claim:

1. In an explosion engine, the combination of the cylinder, two pistons therein, a crank shaft, suitable connections between one of said pistons and said crank shaft, a yielding resistant which opposes the explosion-induced movement of the other piston and which returns said piston to its normal position, an oscillating crank, mechanism connecting said crank with the last named piston whereby the piston in moving oscillates the crank, a rotatable member concentric with said oscillating crank, transmitting

mechanism intermediate of said concentric rotatable member and the first named crank shaft, an automatic clutch intermediate of the crank and the said concentric rotatable member, which clutch acts automatically to disconnect said oscillating crank and concentric rotatable member when the last named piston begins its explosion-induced stroke and to automatically connect them when the piston begins its return stroke to its initial position, and means for periodically exploding an explosive gas within the cylinder between said pistons.

2. In an explosion engine, the combination of a cylinder, two pistons therein, means for introducing the explosive mixture between them, a crank shaft, and suitable connections between said crank shaft and one of said pistons, a piston rod attached to the other piston and extending out of the cylinder, a cross head secured to said piston rod, a rock shaft having crank arms, links connecting said arms with said cross head, a member concentric with said rock shaft and normally rotatable independently thereof, means for constant rotatable connection of said member to the crank shaft, an automatic clutch adapted to connect said rock shaft to said rotatable member for transmitting motion in one direction only from said rock shaft to said rotatable member during the return movement of the piston to which said rock shaft is connected, and a yielding resistant which opposes the explosion-induced motion of the last named piston and acts to return it to its normal position.

3. In an explosion engine, the combination of a cylinder, two pistons therein, means for admitting the explosive mixture between them, a crank shaft, suitable connections between said crank shaft and one of said pistons, a pivoted rocking member, mechanism connecting said member with the other piston, a yielding resistant to the explosive induced movement of the second piston, which resistant acts to move said piston back to its normal position, two meshing gears, one driven by the crank shaft and one mounted on an axis concentric with the axis of said rocking member, and an automatic clutch by which the latter gear is connected with the rocking member when the latter is moving in one direction and is disconnected therefrom when it is moving in the other direction.

In testimony whereof, I hereunto affix my signature in the presence of two witnesses.

ALANSON P. BRUSH.

Witnesses:

E. L. THURSTON,
E. B. GILCHRIST.