No. 799,537. PATENTED SEPT. 12, 1905.

W. E. COLLIER.

EXPLOSIVE ENGINE.

APPLICATION FILED SEPT. 16, 1904.

2 SHEETS—SHEET 1.

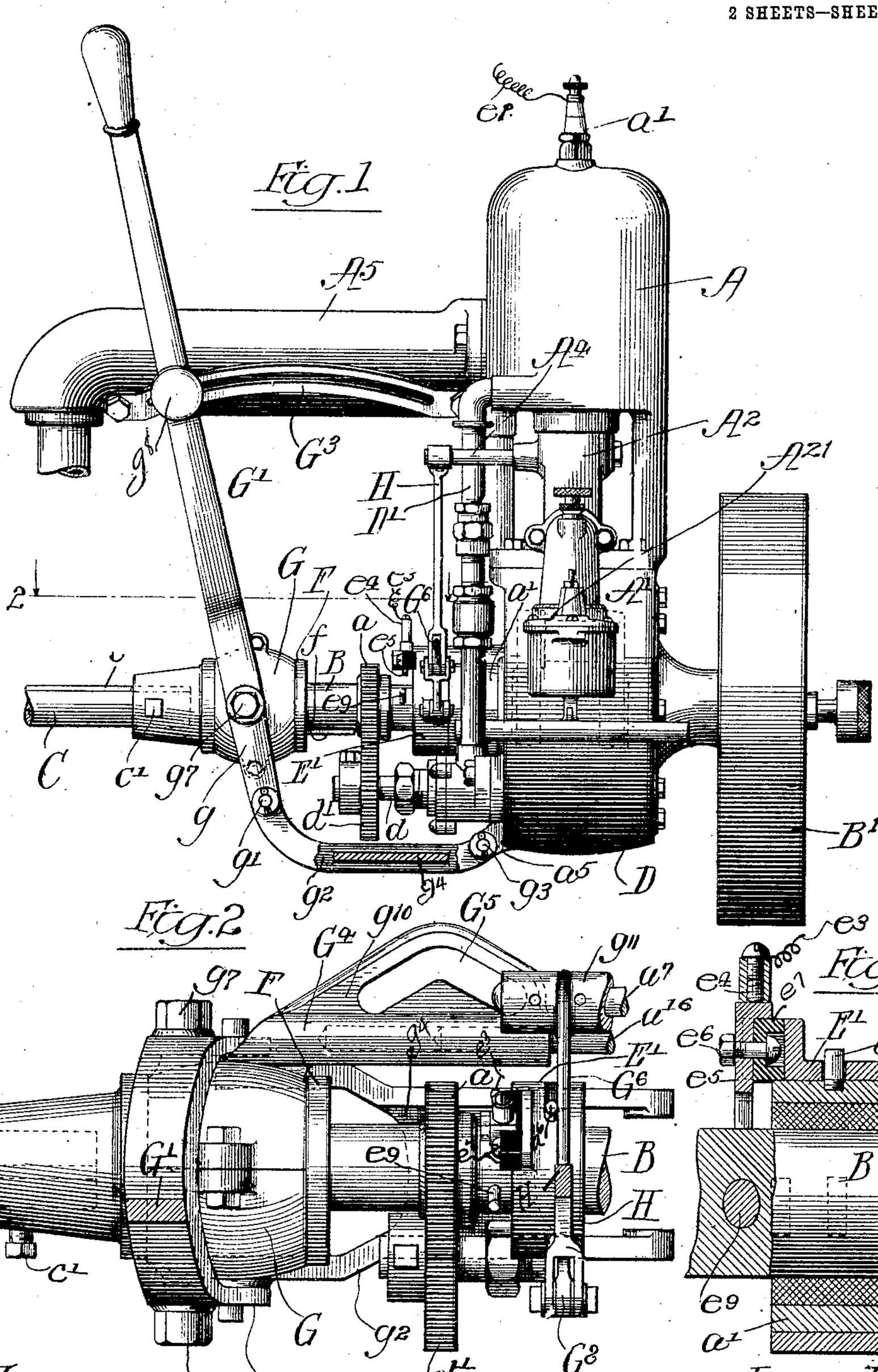

Fig. 1

Fig. 2

Fig. 3

Witnesses:-

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his Attys

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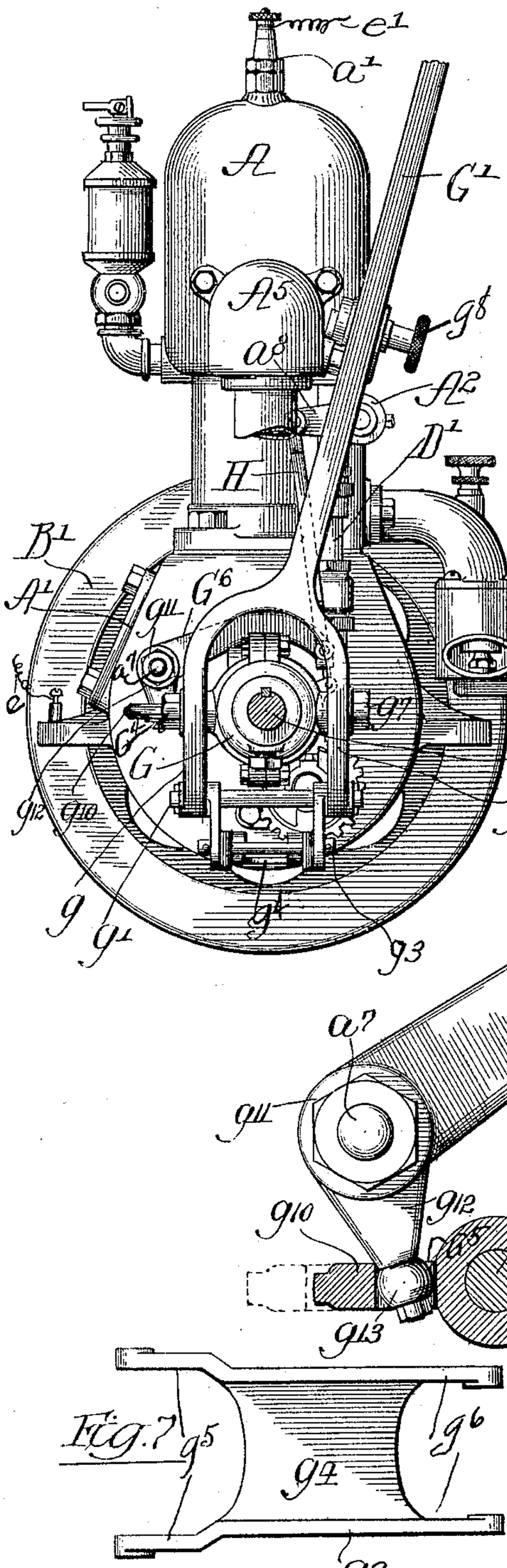

Fig. 4

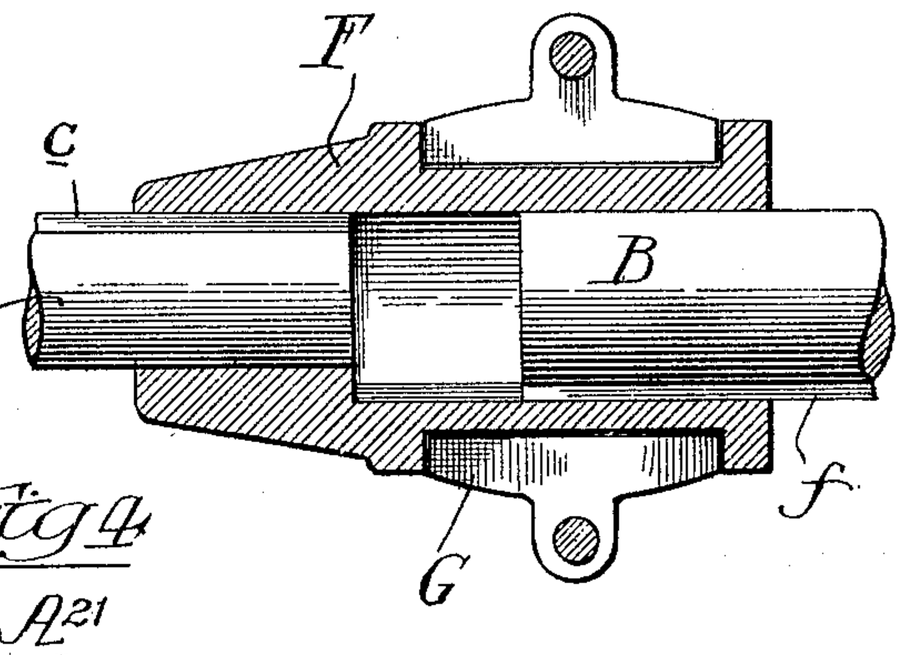

Fig. 5

Fig. 6

Fig. 7

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EXPLOSIVE-ENGINE.

No. 799,537. Specification of Letters Patent. Patented Sept. 12, 1905.

Application filed September 16, 1904. Serial No. 224,686.

To all whom it may concern:

Be it known that I, WILLIAM E. COLLIER, of Muskegon, in the county of Muskegon and State of Michigan, have invented certain new and useful Improvements in Explosive-Engines; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention relates to improvements in explosive-engines, and refers more specifically to improvements in means for regulating the speed and power of the engine, which regulation is effected by so connecting the ignition mechanism of the engine with the valve or valves for controlling the admission of the explosive mixture to the cylinder that said valve-controlling and ignition mechanisms act in unison with each other in such manner that as the explosive charge delivered to the cylinder is decreased the ignition-spark occurs later in the stroke of the piston, and vice versa, thereby maintaining a constant relation between the volume of the explosive charge delivered to the cylinder and the sparking-period of the ignition mechanism.

Among the objects of the invention is to simplify and render certain the unison operation of an ignition and valve mechanism connected as thus described, the two regulating factors being operated for regulation by a single manually-operable part.

A further object of the invention is to render its ready application as an attachment to explosive-engines of different kinds or makes.

A still further object of the invention is to produce a combination of the character set forth which is readily applicable to gasolene-propelled launches in such manner that the regulation of the engine is effected and its effective power varied in unison with variations of the load on the propeller.

In the drawings, Figure 1 is a side elevation of an explosive-engine provided with my improvements. Fig. 2 is a partial horizontal section and partial plan view taken on line 2 2 of Fig. 1. Fig. 3 is a fragmentary vertical section taken through the make-and-break device of the ignition mechanism. Fig. 4 is an end view of the engine. Fig. 5 is a detail section taken through the coupling for connecting the shaft of the engine with the shaft which it drives, showing said shafts in elevation. Fig. 6 is an enlarged fragmentary detail showing the make-and-break device of the ignition mechanism and the connection between the same and the valve-controlling rod and the cam for operating said parts. Fig. 7 is a detail view of a link by which the operating-lever of the device is hinged to the engine-frame, said link having also the form of a drip-pan.

As shown in the drawings, A designates the cylinder of an explosive-engine; A′, the crank-chamber; B, the crank-shaft thereof, and B′ the balance-wheel of the crank-shaft.

The ignition mechanism herein shown is of that class known as the "three-wire induction type," the leading wires of the primary and secondary coils being connected, respectively, with a stationary part of the make-and-break devices and the arcing ignition-plug and a single return-wire for both coils being grounded to the engine-frame.

A^{21} designates as a whole the carbureter, and A^2 the inlet-valve for the explosive mixture received from said carbureter and provided with a rocking stem A^4, projecting laterally therefrom. The exhaust-valve of the engine (not shown) discharges through a muffler A^5.

D designates a casing of a rotary pump located at the base of the crank-chamber, and the rotative shaft *d* of said pump is shown as provided with a gear-wheel *d′*, which meshes with a gear-wheel *a* on the crank-shaft, whereby said pump is driven.

D′ designates a pipe leading from the pump-chamber to the water-jacket of the cylinder.

The parts described may be made of any desired construction and need not be more fully shown or described.

The engine herein shown is of that type known as a "two-cycle" engine, and the charge of the explosive mixture is directed to and is compressed in the crank-chamber during the downward movement of the piston and from thence is delivered to the cylinder A. Inasmuch as this type of engine is familiar and my invention may be applied to different types of engines, the details of the parts last mentioned are not shown.

The circuit-wires of the sparking circuit of the igniting mechanism embraces the wire *e*, which is grounded to the engine-frame, a second wire *e′*, leading from the secondary coil

of an induction-coil (not shown) and is attached to a binding-screw a' at the top of the cylinder, forming part of an arc sparking plug, and a third wire e^3, leading from the primary coil of the induction-coil in circuit with a suitable battery, and which wire is attached to a binding-screw e^4, insulated from the engine-frame and constituting a part of a make-and-break device. The wire e constitutes a common return for the primary and secondary circuits. The binding-screw e^4 is fixed to a ring E′, which has a limited rotative movement on a hollow annular bearing-boss a', surrounding and concentric with the crank-shaft and projecting laterally from the crank-chamber. Said ring is held from endwise movement on said boss by a pin a^6, which engages a curved guide-groove in the ring. Said binding-screw e^4 has contact with a bar e^5, Figs. 3 and 6, that is fixed to a flange or lug at the top of the ring, it being fastened thereto by a bolt e^6 and insulated therefrom by a block e^7 of insulating material, as a piece of hard fiber. The insulating-block e^7 is fastened to the lug or flange of ring E′ by means of screws e^8, Fig. 6. The other member of the make-and-break device consists of a spring-pressed pin e^9, which is located in a transverse opening in the crank-shaft in line with the inner end of said bar e^5, which inner end of said bar extends inwardly toward the shaft for contact with the pin e^9 in a manner to close the primary current of the igniting mechanism once, as herein shown, during each rotation of the crank-shaft. The transverse opening in the shaft in which is located the pin e^9 is interiorly shouldered near one end to engage an exterior annular shoulder e^{10} of the pin. The pin is held against said shoulder and with its small end projected from the cylindric surface of the shaft by means of a spiral spring e^{11}, Fig. 6, interposed between the larger end of the pin and a screw-plug e^{12}, which has screw-threaded engagement with the larger end of the shaft-opening. The smaller end of the pin e^9 therefore extends beyond the cylindric surface of the crank-shaft and has contact with the bar e^5 once during each rotation of the shaft. The ring E′ being rotative on the annular bearing a' may be angularly shifted to vary the sparking-period of the sparking mechanism, and this is accomplished by mechanisms now to be described, which mechanism also operates to regulate the area of the inlet-valve by more or less opening or closing of said valve.

F designates a sleeve which is free to slide endwise of the crank-shaft, but is splined or otherwise non-rotatively secured thereon by a spline or key f, Figs. 1 and 5. The sleeve F constitutes in the present instance a coupling between the crank-shaft B and a shaft C, which may be the propeller-shaft of a boat, such as shown in my copending application for United States Letters Patent, Serial No. 224,685, filed September 6, 1904. Said coupling-sleeve is non-rotatively fixed to the shaft C by a spline c and is also fixed thereto to prevent endwise movement of the sleeve relatively to the shaft by means of a set-screw C′, Figs. 1 and 2. The coupling is shifted endwise of the crank-shaft by the following device: G designates a split collar surrounding and located in an annular recess in the sleeve, so that the coupling-sleeve may rotate freely therein. G′ designates a vertically-reciprocatory lever, which is forked at its lower end, the fork-arms $g\,g$ extending on either side of the collar and being pivoted at their lower ends by a bolt g' to a link g^2, which latter is in its turn pivoted at its other ends to the engine-frame by a bolt g^3. Said link g^2 is made wide to constitute a pan g^4 to catch oil which may drop thereon from the parts above. Said pivot-bolts g' g^3 extend through fork-arms g^5 g^6, which engage the fork-arms of the lever G′ and laterally-separated studs a^5 on the engine-frame. The arms g of said lever G′ are also pivoted to the opposite sides of the collar above their pivoted connection with the link g^2 by means of screw-studs g^7 extending therethrough and into screw-threaded sockets in the split collar. The said lever G′ is adapted to be locked in any adjusted position to a curved slotted guide-bar G^3, which is herein shown as fixed to the muffler A^5 of the engine. Said guide is slotted and receives a locking-screw g^8, that extends through said lever. Any other suitable means for locking the lever in an adjusted position may be employed. The mechanism for communicating motion from said sliding sleeve F thus mounted on the crank-shaft to the ring E′ of the make-and-break device in a manner to rock or angularly displace said ring on its bearing, and thus rotatively adjusting the ring relatively to the shaft B, and for also communicating motion to actuate the inlet-valve is made as follows: The collar G on said sliding sleeve F is provided with a horizontal guide-arm G^4, that extends toward the engine-frame and parallel with the axis of the crank-shaft and has guiding engagement at its inner end or that adjacent to the engine-frame by means of a stud a^{16}, projecting laterally from the engine-frame and entering an axial guide-socket in said arm. Said arm G^4 is provided on its side remote from the crank-shaft, as herein shown, with a horizontal web g^{10}, in which is formed a generally V-shaped cam-groove G^5. G^6 designates a vertically-swinging lever provided at one end with a bearing-sleeve g^{11}, which has rocking engagement with a stud a^7, that projects laterally from the engine-frame. (Shown broken away in Fig. 2.) Formed on said sleeve g^{11} is a downwardly-extending arm g^{12}, provided at its lower end with a friction-roller g^{13}, Fig. 6, that engages the cam-groove G^5 of the arm G^4 of the endwise-movable collar G. Said lever extends transversely over

the crank-shaft and is pivotally connected at its free end to the lower end of a connecting rod or link H, the upper end of which rod is pivotally connected with an arm a^8, Fig. 4, that is non-rotatively attached to the rocking stem A^4 of the inlet-valve A^2 of the engine. Said lever G^6 is also pivotally connected at the point of its connection with the link H with a short link G^8, the lower end of which latter link is pivotally connected with a slotted arm or lug G^9, formed on or rigid with the ring E'. With this construction it will be observed that when the lever G' is swung toward or from the engine-cylinder the sleeve F is moved longitudinally of the shaft, carrying with it the cam-grooved arm G^4, which operates, through the arm g^{12} of the lever G^6, to swing said lever vertically about its pivot pin or hinge a^7, and such movement of the lever G^6 transmits a rocking motion to the ring E' on its supporting-boss, whereby the bar e^5 of the make-and-break device is angularly shifted or displaced relatively to the coöperating spring-pressed pin g^9 of said device, thereby varying the sparking-period of the ignition mechanism relatively to the stroke of the piston. The same movement of the lever G^6 acts to shift endwise the connecting rod or link H and through the rocking stem A^4 of the inlet-valve to angularly shift or displace said inlet-valve in a manner to admit more or less of the explosive mixture to the compression-chamber of the engine, depending upon the direction of movement of the parts. In the central or intermediate position of the lever or when it is locked to the central part of the slotted curved guide-bar the inlet-valve is so adjusted as to admit only sufficient explosive mixture through the valve as is necessary to turn the piston of the engine over, and the angularly-shiftable part of the make-and-break device is adjusted to produce sparking late in the outward stroke of the piston. Movement of the lever G' in either direction acts, through said cam-actuated mechanism described, with a like effect on the sparking mechanism and the valve-controlling mechanism—that is, to produce the spark earlier in the outward stroke of the piston and to admit a greater volume of the explosive mixture to the cylinder—and the maximum volume of the explosive mixture is admitted to the cylinder and the sparking occurs earliest in the outward stroke of the piston when the roller of the arm g^{12} of the lever G^6 occupies the end of said cam-slot. Such action of the parts described occurs if the lever G' is swung to move the roller of said arm g^{12} in either direction from the center or apex of the **V**-shaped cam-groove. For some uses said cam-groove may consist of a single inclined portion; but the double or **V** form herein shown adapts the mechanism to the action of a propeller of a boat or launch, as described in said application, Serial No. 224,685, inasmuch as it provides increasing power of the engine both when the boat or launch is advancing or is reversed.

The mechanism described is simple and readily applied to the engine and is so arranged that the parts are held true or in accurate relative position, so that there is no likelihood of the harmonious action of the parts becoming deranged. The device adds but little cost to an engine, nor does it require costly changes in any part of the engine to attach it thereto.

It is obvious that many changes may be made in the structural details of the mechanism described without departing from the spirit of the invention, and I do not wish to be limited to the exact construction, except as hereinafter made the subject of specific claims.

I claim as my invention—

1. In an explosive-engine, the combination with the crank-shaft of the engine, the inlet-valve mechanism for the explosive mixture and the ignition mechanism, of a sleeve slidable on the said crank-shaft, a lever pivoted to the engine-frame for sliding said sleeve and operative connections between said sliding sleeve and the valve and ignition mechanisms, constructed to operate in unison said mechanisms to control the supply of explosive admixtures to the engine-cylinder, and to regulate the sparking period of the ignition device relative to the stroke of the piston.

2. In an explosive-engine, the combination with its crank-shaft, its valve mechanism and ignition mechanism, the latter including a make-and-break device, one member of which is adjustable in a curved path concentric with the crank-shaft, and the other member of which is mounted on said crank-shaft, a sliding sleeve on the crank-shaft, a cam-arm movable with said sleeve, and operative connections between said cam-arm, the adjustable member of the make-and-break device and the valve mechanism, acting to effect in unison the shifting of the adjustable member of the make-and-break mechanism and the adjustment of the valve mechanism, when the cam-arm is shifted with the said sleeve.

3. In an explosive-engine, the combination with its crank-shaft, its valve and ignition mechanisms, the latter including a rocking ring concentric with the crank-shaft, a make-and-break device, one of the members of which is mounted on said ring, and the other member of which is mounted on the shaft, operative connections between the said rocking ring and the said valve mechanism, a sleeve having sliding but non-rotative connection with said crank-shaft and operative connections between sleeve and ring acting to angularly displace the ring, and therethrough to operate the valve mechanism.

4. In an explosive-engine, the combination with its crank-shaft, its valve mechanism and

ignition mechanism, the latter including a rocking ring, concentric with the crank-shaft, a make-and-break device, one member of which is mounted on said ring and insulated therefrom, the other member of which is mounted on the crank-shaft, a sliding non-rotative sleeve on the crank-shaft, a cam-arm movable with said sleeve, operative connections between said cam-arm and the rocking ring, acting to angularly displace said ring relatively to the shaft when the sleeve and cam-arm are shifted endwise on the shaft, and operative connections between said rocking ring and the valve mechanism, operating to adjust said mechanisms in unison.

5. In an explosive-engine, the combination of its crank-shaft and its valve and ignition mechanisms, the valve mechanism embracing a rocking arm, and the ignition mechanism including a rocking ring which has bearing on an annular part of the engine-frame and is concentric with the crank-shaft, a make-and-break device, one of the members of which is mounted on said ring and insulated therefrom, and the other member on the crank-shaft, a lug on said ring connected by a link with the rocking stem of the valve mechanism, a sleeve having sliding but non-rotative engagement with said crank-shaft, and operative connections between the said sleeve and rocking ring, constructed to angularly displace said ring and to rock said valve-stem when the sleeve is shifted endwise on the crank-shaft.

6. In an explosive-engine, the combination with its crank-shaft and its valve and ignition mechanisms, the latter including a rocking ring concentric with the crank-shaft, a make-and-break device, one of the members of which is mounted on said ring and the other of which is carried by the shaft, a cam having movement parallel with the axis of said crank-shaft, a lever pivoted between its ends to a stationary part of the engine and actuated at one end by said cam, and operative connections between the other end of said lever and said rocking ring and valve mechanism.

7. In an explosive-engine, the combination with its crank-shaft and its valve and ignition mechanisms, the latter including a rocking ring concentric with the crank-shaft, a make-and-break device, one of the members of which is mounted on said ring and the other of which is carried by the shaft, a part having movement longitudinally of said crank-shaft and provided with a V-shaped cam-slot, a pivoted lever provided at one end with an arm which engages said cam-slot, and operative connections between the other end of said lever and said rocking ring and valve mechanism.

8. In an explosive-engine, the combination with its crank-shaft and its valve and ignition mechanisms, the latter including a rocking ring concentric with the crank-shaft, a make-and-break device, one member of which is mounted on said ring and insulated therefrom, and the other member of which is mounted in a transverse opening in the crank-shaft, a spring for normally projecting said pin into position for contact with said member of the make-and-break device carried by the ring, a sleeve which has sliding but non-rotative engagement with the crank-shaft, operative means between the sleeve and said ring acting to rock the latter when the sleeve is moved endwise of the shaft, and operative connections between the rocking ring and the valve mechanism.

9. In an explosive-engine, the combination with its crank-shaft and its valve and ignition mechanisms, the latter including a rocking ring concentric with the crank-shaft, a make-and-break device, one member of which is mounted on said ring and insulated therefrom, and the other member of which is mounted in a transverse opening in the crank-shaft, a spring for normally projecting said pin into position for contact with said member of the make-and-break device carried by the ring, a sleeve which has sliding but non-rotative engagement with the crank-shaft, an arm rigid with the sliding sleeve and having guiding engagement with the engine-frame, a cam-slot in said arm, a lever which is pivoted to the engine-frame and provided at one end with an arm which engages said cam-slot and is connected at its other end with a lug on said rocking ring, and operative connections between the latter end of the lever and said valve mechanism.

10. In an explosive-engine, the combination with the crank-shaft thereof, its valve and ignition mechanisms, the valve mechanism including a rock-shaft, and the ignition mechanism including a rocking ring concentric with the crank-shaft, a make-and-break device, one member of which is mounted on said ring and insulated therefrom, and the other member of which is mounted on the crank-shaft, a sleeve having sliding but non-rotative connection with said crank-shaft, operative connections between said sleeve and rocking ring, whereby when the sleeve is shifted endwise of the shaft, the ring is rocked to angularly displace the member of the make-and-break device carried by the ring, and a link connected at its lower end with a lug on said rocking ring and at its upper end with an arm, rigid with the rock-shaft of the valve mechanism.

In testimony that I claim the foregoing as my invention I affix my signature, in presence of two witnesses, this 6th day of September, A. D. 1904.

WILLIAM E. COLLIER.

Witnesses:
W. S. SUMNER,
L. E. STARKS.