W. J. McVICKER.

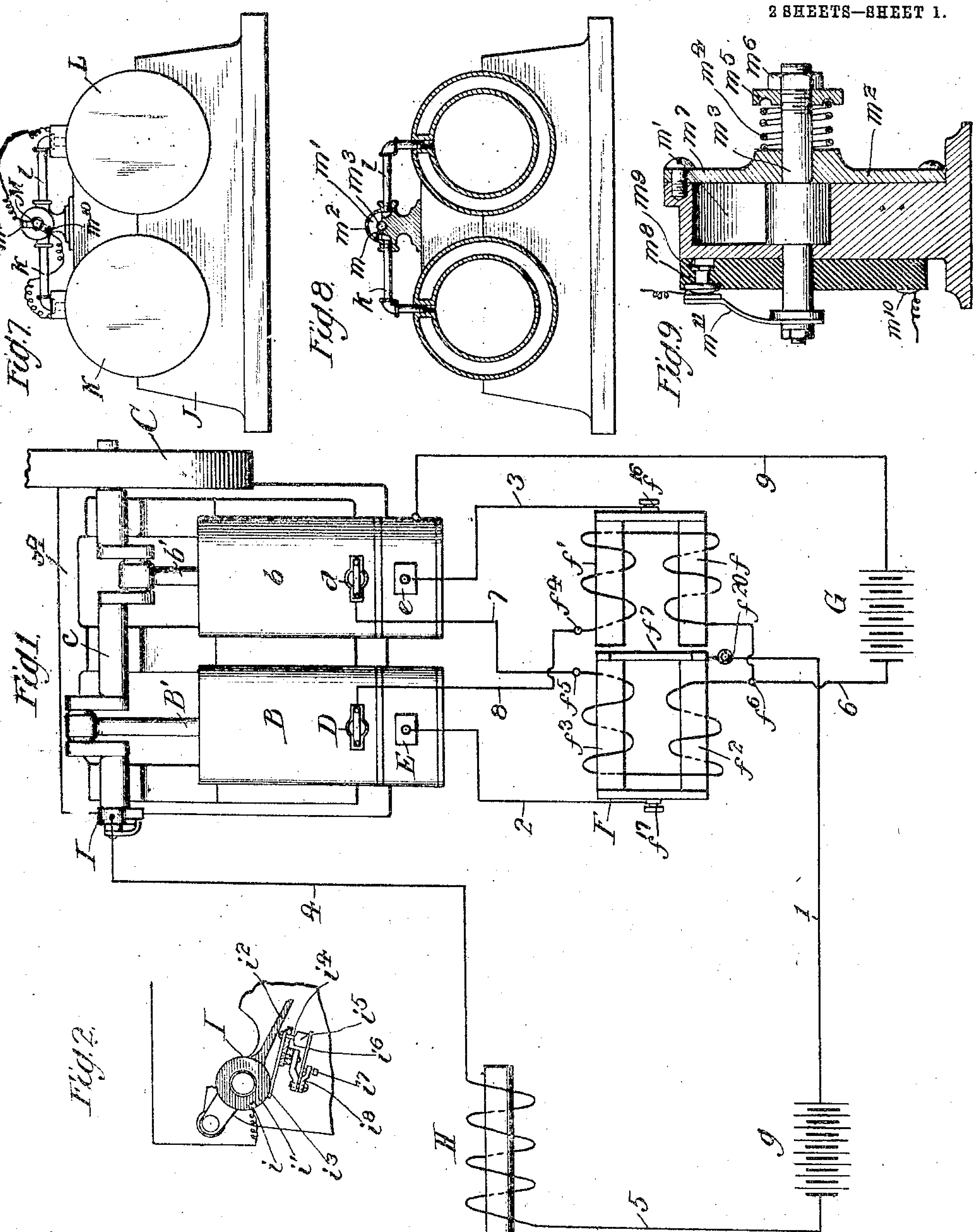
CONTROLLING MECHANISM FOR EXPLOSIVE ENGINES.

APPLICATION FILED AUG. 4, 1906.

951,833.

Patented Mar. 15, 1910.

2 SHEETS—SHEET 1.



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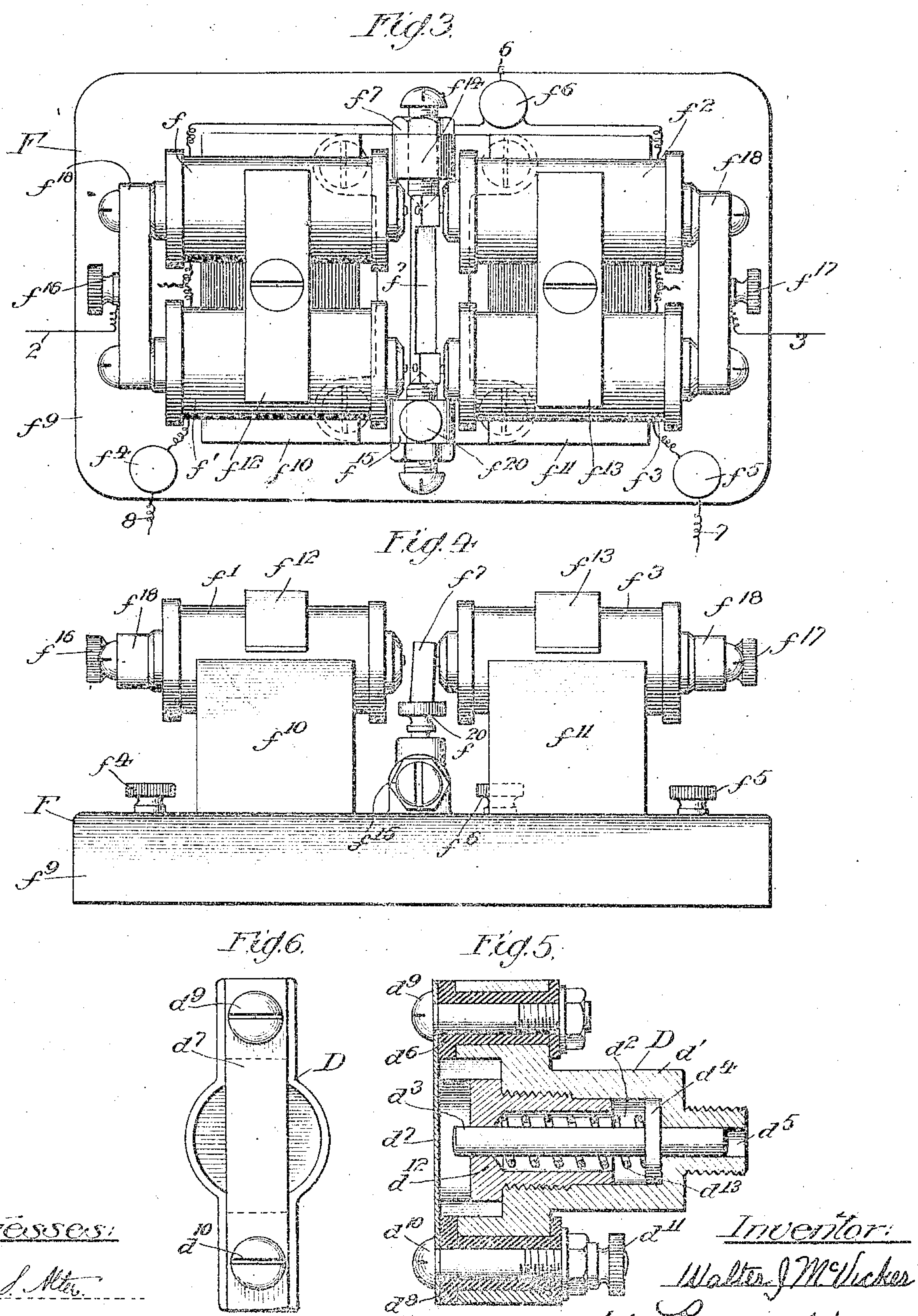

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UNITED STATES PATENT OFFICE.

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CONTROLLING MECHANISM FOR EXPLOSIVE-ENGINES.

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To all whom it may concern:

Be it known that I, WALTER J. McVICKER, a citizen of the United States, residing at Alma, in the county of Gratiot and State of Michigan, have invented certain new and useful Improvements in Controlling Mechanism for Explosive-Engines, of which the following is a specification.

My invention relates to mechanism for controlling the operation of explosive engines, such as gas and gasolene engines and the like, and my object is to provide a system of control wherein two or more engines, or cylinders, may be employed to drive the same load in such a way that the work will be evenly divided between them.

It is frequently of advantage to connect several small power units instead of a single one to drive a given load, but when this is done it has been found difficult to properly regulate the operation of the small units so that one or the other would not do a disproportionately large share of the work. For instance, if the governor of one engine happens to be adjusted to render the igniting device of that engine responsive at a slightly higher speed than the speed at which the igniter of the other engine becomes responsive, as the speed of both engines drops with an increasing load, the one which is adjusted to respond at the higher speed commences to do work before the other, and it may thus happen that, under certain conditions of load, one of the associated engines will do practically all of the work. Or, if the governor is common to both engines, it is entirely a matter of chance which engine will take the explosion when the work requires it; and it may thus happen that one engine or the other will be doing more than its share of work.

It is the principal object of my invention to provide means for insuring an even distribution of the work when a number of engines are connected to drive the same load, and this, generally speaking, I accomplish by the provision of mechanism which operates automatically upon the occurrence of an explosion in one engine, to shift the next explosion, whenever the work may require it, to the other engine. This renders it practicable to use a number of small engines on a given piece of work, instead of a single large one, with the result that a more efficient operation, and a better speed regulation may be obtained.

Referring to the drawings, Figure 1 is a diagrammatic view of a two cylinder explosive engine, equipped in accordance with my invention with means for alternating the ignition spark between the two cylinders; Fig. 2 is a diagrammatic view of the circuit of the governor; Figs. 3 and 4 are views in plan and elevation, respectively, of a form of electro-magnetic switch for alternating the ignition circuit; Figs. 5 and 6 are sectional elevation and plan views, respectively, of a form of pressure switch designed for controlling the circuit of the ignition alternator; Figs. 7 and 8 are views in end elevation, and in end cross-section, respectively, of the cylinders of a two cylinder engine equipped with a device for bringing about the alternation of the ignition circuit by purely mechanical means; and Fig. 9 is a vertical cross section of the ignition alternating device shown in connection with Figs. 7 and 8.

Referring to the present embodiment of my invention, as illustrated in the drawings, A represents a gas engine having two cylinders B b, the piston rods B^1 b^1 of which are connected with the crank shaft c of the engine, which is journaled in the frame of the engine and carries at one end the fly wheel C. A governor I is connected with some part moved by the engine,—in the present instance to one end of the shaft c. The cylinders B b are provided with igniters E e, respectively, and with electric switch devices D d, respectively, adapted to be operated by explosion pressure in the cylinder. The igniters E e, may be of any well known type, as, for instance, the type wherein a contact lever within or in communication with the cylinder normally rests against a contact anvil, and is separated therefrom to produce a spark by being engaged by the piston head at the end of its return stroke. The igniters E e are connected in an ignition circuit which includes a suitable source of current, as battery g, a self induction coil H, switch contacts in the governor I, and other contacts in the electro-magnetic switch or alternator F.

The office of the electro-magnetic switch or alternator F is to switch or alternate the ignition circuit between the two igniters E e, and it may assume a variety of forms. The one which I have preferred to employ in the present instance is illustrated in detail in Figs. 3 and 4, and consists of a base f^9 of suitable material, upon which are secured the electro-magnets f f^1, and f^2 f^3, respectively, whose forward ends or poles are presented to an armature f^7 on opposite sides thereof. The armature f^7 is supported in trunnions f^{14} f^{15}, which are provided with the customary adjusting screw and lock nuts, and one of which is provided with a binding post f^{20} by means of which electric connection may be made with the armature. The armature is preferably a permanent magnet with its two poles at its opposite ends, in order that it may adhere to and make proper electrical contact with the cores of either magnet to which it may be attracted. The two magnets f f^1 and f^2 f^3 of the electro-magnetic switch or alternator are supported on the base f^9 by means of insulating blocks f^{10} and f^{11}, respectively, and clamping pieces f^{12} and f^{13}, respectively, which extend transversely of the coils f f^1 f^2 f^3, and are firmly held in place by means of screws, as indicated. The cores of the magnets are thus insulated from each other, and are adapted to form part of independent branches of the circuit which includes the armature f^7, that branch being closed which includes the magnet against whose cores the armature f^7 is lying. The two magnets f f^1 and f^2 f^3 are provided with binding posts f^{16} f^{17}, respectively, which are mounted upon the metallic yokes f^{18} of the magnets. The energizing circuit for the magnets extends from the binding post f^6 serially through the coils f and f^1 to the binding post f^4, and serially through the coils f^2 and f^3 to the binding post f^5. The two coils of each magnet are so connected that their effect is additive, both tending to produce the same pole at a given end of the magnet; and the coils of each magnet are so connected that the two poles which each produce are presented to the poles of opposite sign on the armature f^7, so that whichever magnet is energized produces poles which exert an attractive influence on the permanent magnet of the armature, and thus draw it to them.

The form of explosion-actuated switch that I prefer to employ, and which in the present instance is of the form wherein explosion pressure in the cylinder brings about the closing of the switch contact, is illustrated in detail in Figs. 5 and 6 of the drawing. The device, as shown, comprises a frame or casing d^1, having a screw-threaded extension adapted to be screwed into the cylinder of the engine, and having a passage d^5 in the extension communicating with an enlarged cylindrical opening d^2 in the casing d^1. The end of the enlarged cylindrical opening d^2 opposite the end with which the passage d^5 communicates, is screw-threaded and adapted to receive an externally screw-threaded plug d^{12} having a central perforation in alinement with the passage d^5 in the frame or casing d^1. Within the cylinder thus formed, between the end of the plug d^{12} and the walls of the casing d^1, a piston is placed, comprising a stem d^3 arranged to fit snugly within the opening d^5 and the opening in the end of the plug d^{12}, and provided with an enlarged plug or collar d^4 fitting snugly within the cylindrical opening d^2. The piston is normally held in its forward position by means of a compression spring d^{13}, carried within the central perforation of plug d^{12}, and interposed between the end wall of said perforation and the collar d^4 on the piston. Supported by lugs extending from the frame d^1 is a metallic bridge d^7, which extends transversely across the end of the stem d^3 of the piston, and in position to come into contact therewith when the same is caused to move outward by pressure applied through passage d^5. The metallic bridge d^7 is insulated from the frame of the device by insulating pieces d^6 and d^8, interposed between the frame and the bridge, and the screws which hold it in place. One of the screws d^{10} carries a binding post d^{11} by means of which electric connection may be made with the bridge.

The circuit controlled by the mechanism described in the foregoing may now be traced. From the battery or other suitable source of current G, which may in practice be the same battery or other source of current shown separately and indicated by the reference character g, the circuit extends by way of conductor 6 to binding post f^6, and there divides, one branch extending serially through the windings f and f^1 of the electro-magnetic switch to the binding post f^4, and the other serially through the coils f^2 and f^3 to the binding post f^5. The branch which includes the windings f and f^1 thence extends by way of conductor 8 to the binding post connected with the bridge d^7 of the pressure switch D associated with cylinder B of the engine; while the branch which includes the windings f^2 and f^3 extends by way of conductor 7 to the bridge of pressure switch d of cylinder b. The pistons of both pressure switches are in electrical contact with the metallic parts of the engine, and consequently when either one is moved into contact with its bridge, the circuit of the associated branch is completed to the other pole of battery G by way of the metallic frame of the engine and conductor 9.

The ignition circuit of the engine may be traced as follows: One pole of the battery g is connected by way of conductor 1 with the binding post f^{20} mounted upon the trunnion f^{15} of electro-magnetic switch F, and thus with the armature f^7. Thence the circuit has two alternative paths, depending upon which side of the center and against the poles of which magnet the armature f^7 lies. One branch extends from the core of magnet $f\ f^1$ by way of binding post f^{16} and conductor 3, to the igniter e of cylinder b; while the other extends from the magnet $f^2\ f^3$ by way of binding post f^{17} and conductor 2 to the igniter E of cylinder B. One contact of each igniter is connected by way of the metallic frame work of the engine, or in any other suitable manner, to the governor I, whence it returns to the other pole of the battery g by way of conductor 4, self-induction coil H and conductor 5.

The circuit through the governor I, as indicated in Fig. 2, is from the metallic frame work of the engine,—or from the igniters E e, by way of a separate conductor, if it is desired to employ one,—to the spring plate i^6 secured at one end to the arm i^8 carried on the shaft of the engine, and having secured to its other end a weight i^7 which normally rests against a contact pin i^4 in metallic connection with a contact brush i^3, which brush is insulated from the arm i^8 upon which it is carried by means of an interposed block of insulating material. The free end of the brush i^3 is adapted as the shaft rotates to make contact at regular intervals with a metallic segment i carried on an insulating hub i^1 rotatably mounted on the bearing of the shaft so that it may be turned to bring the segment into position to make contact with the brush at any desired point in its rotation. When the speed of rotation increases beyond a certain predetermined limit, the weight i^7 on the end of spring plate i^6 is thrown out by centrifugal force, thus breaking contact with pin i^4 and interrupting the circuit.

The operation of my controlling mechanism is as follows: Assume that the armature f^7, or switch member, of the electro-magnetic switch F lies in contact with the cores of magnet $f^2\ f^3$, as shown in Figs. 3 and 4, that branch of the ignition circuit is completed which extends to igniter E associated with cylinder B of the engine, the branch extending to the igniter e of cylinder b remaining open. Consequently when the engine is started, the first spark and the first explosion will occur in cylinder B. The pressure developed by the explosion in cylinder B forces the piston of the pressure switch D out so as to bring the end of its stem d^3 into contact with the metallic bridge d^7. This completes the circuit of magnet $f\ f^1$ of the magnetic switch, which thereupon is energized to attract the armature f^7 over against its poles, the armature remaining,—after the retraction of stem d^3 from bridge d^7 of the pressure switch D with the falling pressure,—in the position to which it has been moved, by virtue of the permanent magnetism of the armature. This movement of the armature interrupts the branch of the ignition circuit that includes igniter E, thus rendering cylinder D temporarily inoperative, and completes the branch of the ignition circuit including igniter e, thereby placing cylinder b in condition to take the next explosion. When the explosion occurs in cylinder b the pressure switch d associated with it is actuated to momentarily complete the circuit of magnet $f^2\ f^3$ of the electro-magnetic switch F, thus causing the movement of the armature back to its original position, and again rendering cylinder B operative and cylinder b inoperative. This action continues as the engine gathers speed. When the speed exceeds the limit predetermined by the governor, that device operates to interrupt the igniter circuit, and thus to interrupt the explosions in the engine until the speed of the engine is reduced by the work that it is doing. When the speed again falls below the predetermined limit, instead of the explosion occurring by chance in whichever cylinder happens first to receive a spark, regardless of whether the last explosion took place in that cylinder or not, as has been the case heretofore, my system operates to allot the explosion to that cylinder which has not received the last explosion. The result is that no matter what the working conditions are, a control system equipped in accordance with my invention operates to distribute the explosions, and consequently the work is evenly divided between the two cylinders or engines.

In Figs. 7, 8 and 9 I have illustrated a modified form of my invention in which the alternation of the ignition between the different cylinders or engines is effected directly by purely mechanical agencies and without the intervention of electro-magnetic mechanism. In these figures, I have illustrated a two cylinder engine J whose cylinders K and L, water jacketed in the usual manner, are connected by pipes k and l, respectively, with a pressure switch M. This switch comprises a hollow substantially disk shaped casing one-half of which is hollow to form a semi-annular cylinder within which a piston m in the form of a vane, secured to a shaft m^3 journaled in the frame or casing m^2, is adapted to move. The pipes k and l communicate with opposite sides of the cylinder m^1. One end of the shaft m^3 protrudes through the casing, and has suitably secured to it a contact arm m^{11} which is arranged, as the vane or piston m oscillates, to sweep over the surface of an insulating block m^8 and to make contact at the limit of its movement with contact terminals m^9 and m^{10}. The other end of the shaft m^3 protrudes from the casing, and carries a washer, between which and the casing is interposed a compression spring m^4, the washer being adjustably secured on the shaft by a nut m^6, so that the tension of the compression spring may be adjusted, to prevent the vane and the switch arm attached to it from being moved by any pressure less than that of an explosion in the cylinder.

In the operation of the device, when an explosion occurs in cylinder K, the explosion pressure is transmitted by way of pipe k and moves the vane m, against the frictional resistance of the spring m^4, to the position shown in dotted lines at the other end of the cylinder. This moves the switch arm m^{11} to the point where it comes into engagement with the contact piece m^9. The switch arm and contact pieces m^9 and m^{10} are so connected in the ignition circuit that when the arm rests on contact piece m^9, the ignition circuit is completed to the igniter associated with cylinder L; and when the arm rests on contact m^{10} the circuit is completed to the igniter of cylinder K. It follows from this that cylinder L is now in condition to take the next explosion, which, when it occurs, moves the vane back into its original position, and the switch arm m^{11} back into engagement with contact piece m^{10}. The device thus operates to alternate the explosions between the cylinders.

Although I have described more or less precise forms and details of construction, I do not intend to limit myself thereto, as I contemplate changes in form, proportion of parts, and the substitution of equivalents as circumstances may suggest, or render expedient without departing from the spirit or scope of my invention and claims. For instance, although I have described my invention particularly in connection with an engine having two cylinders, it will be understood that it may readily be adapted for use with any desired number of cylinders or engines.

It will also be understood that my invention is applicable not only to a system of electrical ignition, in connection with which it has been illustrated and described, but also to any other system of ignition which it may be convenient to employ; also that a great variety of well known types of switches and electro-magnetic mechanism for operating the same may be used in place of the particular and novel form which I have described; and that the controller mechanism associated with the cylinder may be either a pressure actuated device, as I have illustrated and described it, or a device actuated by any other effect of an explosion in the cylinder, without departing from the broad spirit of my invention.

I claim:

1. In an ignition system for explosive engines, the combination with a plurality of cylinders and an igniter for each, of a circuit including a source of current associated with said igniters, a switch in said circuit adapted to render said igniters operative alternately, an electro-magnet for operating said switch, a circuit for energizing said electro-magnet, and a switch controlling said last mentioned circuit actuated by explosion effects in one of said cylinders.

2. In an ignition system for explosive engines, the combination with a plurality of cylinders and igniters therefor, of a circuit including a source of current associated with said igniters, an electro-magnetic switch in said circuit adapted to render said igniters operative alternately, a circuit for said electro-magnetic switch, and pressure operated switch mechanism associated with each of said cylinders adapted to control the circuit of said electro-magnetic switch, whereby an explosion in one cylinder adapts the igniter of the other cylinder to be rendered operative.

3. In an ignition system for explosive engines, the combination with a plurality of cylinders and igniters therefor, of a circuit for said igniters including a source of current, a switch for rendering said igniters operative alternately, two electro-magnets associated with said switch and arranged to move it from one side to the other, a device associated with each cylinder and adapted to be actuated by explosion effects therein, an electric switch associated with each explosion device and adapted to be operated thereby, and a circuit arranged to connect each of the aforesaid electro-magnets with one of the pressure operated switches.

4. In an ignition system for explosive engines, the combination with a plurality of cylinders each having an igniter, of a circuit including a source of current associated with said igniters, a switch in said circuit adapted to render said igniters operative alternately, two electro-magnets associated with said switch and adapted to move the same from one to the other of its alternate positions, a permanent magnet associated with said switch and adapted to maintain the switch in the positions to which it has been moved, an actuating circuit for said electro-magnets, and a pressure actuated switch associated with each of said cylinders, said switch being included in the circuit of the electro-magnets and being adapted to control the operation thereof.

5. In an ignition control system for explosive engines, the combination with a plurality of cylinders and an ignition circuit therefor, of an electro-magnetic switch for controlling said ignition circuit, said switch comprising a permanent magnet fulcrumed on a base, two electro-magnets arranged to present their poles to said permanent magnet on opposite sides thereof, said permanent magnet serving as the armature for said magnets, and being adapted to oscillate be-

tween them, and contact surfaces on said armature and the poles of said electromagnets adapted to complete alternate branches of said ignition circuit as the armature oscillates from one set of poles to the other.

6. The combination, with a plurality of explosive engines and their cylinders, of igniters for said cylinders, an electrical circuit divided in a plurality of branches, one for each cylinder, a switch adapted to complete any one of the branch ignition circuits, pressure actuated mechanisms responsive to the explosions in said cylinders and adapted to control the operation of said switch, and a governor controlled by the speed of the engines and coöperating with said electrical circuit to break the same whenever the speed exceeds a predetermined maximum.

7. The combination, with a plurality of explosive engines and their cylinders, of igniters for said cylinders, an electrical circuit divided in a plurality of branches, one for each cylinder, a switch adapted to complete any one of the branch ignition circuits, pressure actuated mechanisms responsive to the explosions in said cylinders and adapted to control the operation of said switch, and a governor controlled by the speed of the engines and coöperating with said electrical circuit to break the same whenever the speed exceeds a predetermined maximum, said governor comprising a spring-pressed weight rotated by the engine and interposed in the igniter circuit, said weight forming part of the circuit but arranged to open such circuit by its movement by centrifugal force through excessive rotation.

8. In an ignition system for explosive engines, the combination, with a plurality of cylinders each having an igniter, of a circuit including a source of current and having branches associated respectively with said igniters, an electromagnetic switch adapted to complete the circuit through said branches successively, a control circuit for said switch having a like number of branches associated with said switch to move it to its different positions, and pressure-controlled switch mechanism associated with each of said cylinders adapted to complete the circuit through the branches of said control circuit respectively to shift said magnetic switch, whereby an explosion in one cylinder will adapt the igniter of the succeeding cylinder to be rendered operative.

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