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IGNITING APPARATUS FOR EXPLOSIVE ENGINES.

APPLICATION FILED AUG. 8, 1908.

940,374.

Patented Nov. 16, 1909.

2 SHEETS—SHEET 1.

Fig. 1.

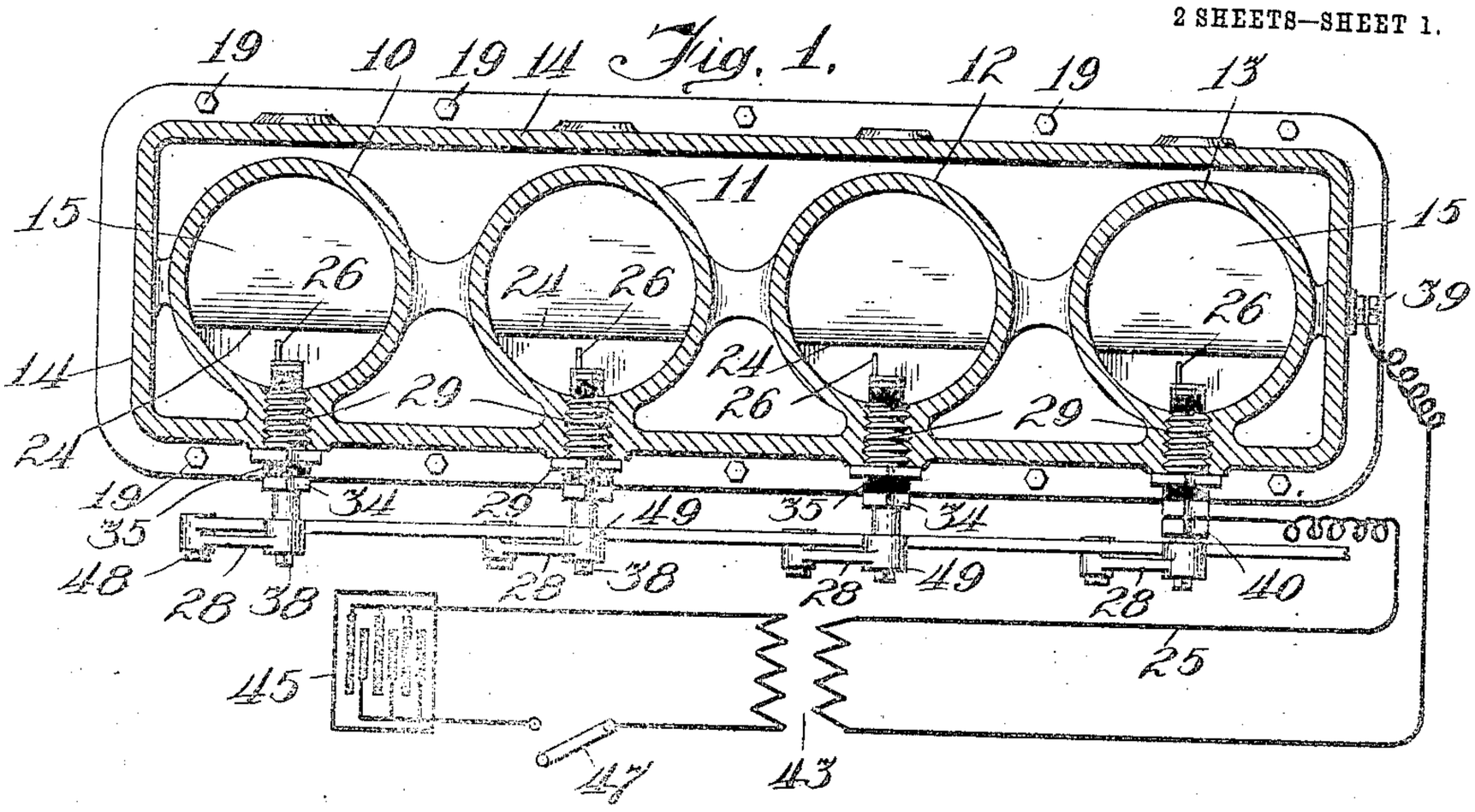


Fig. 2.

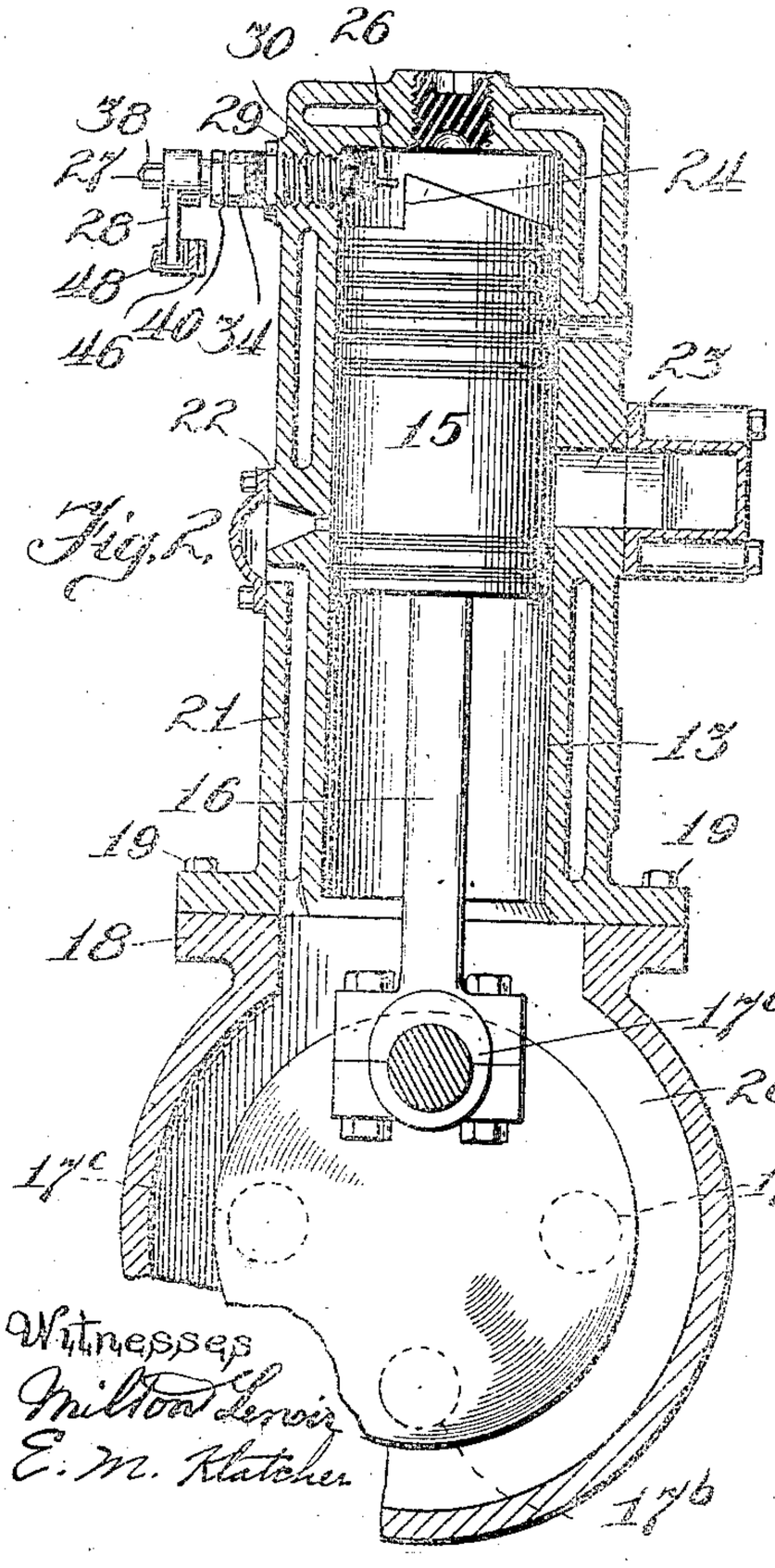


Fig. 4.

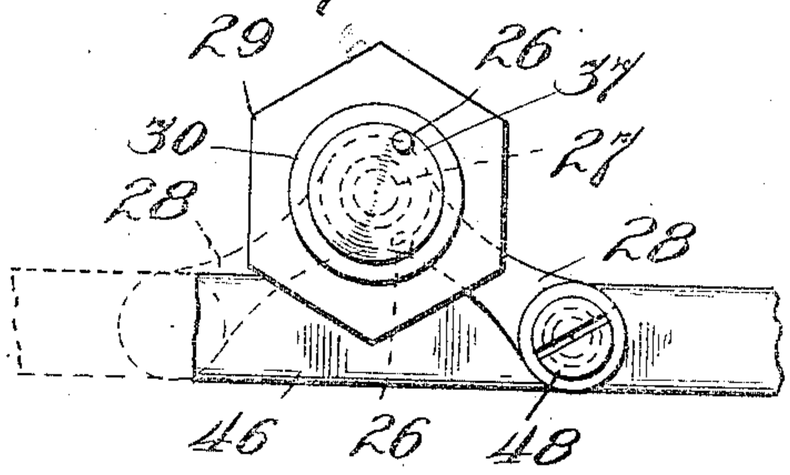
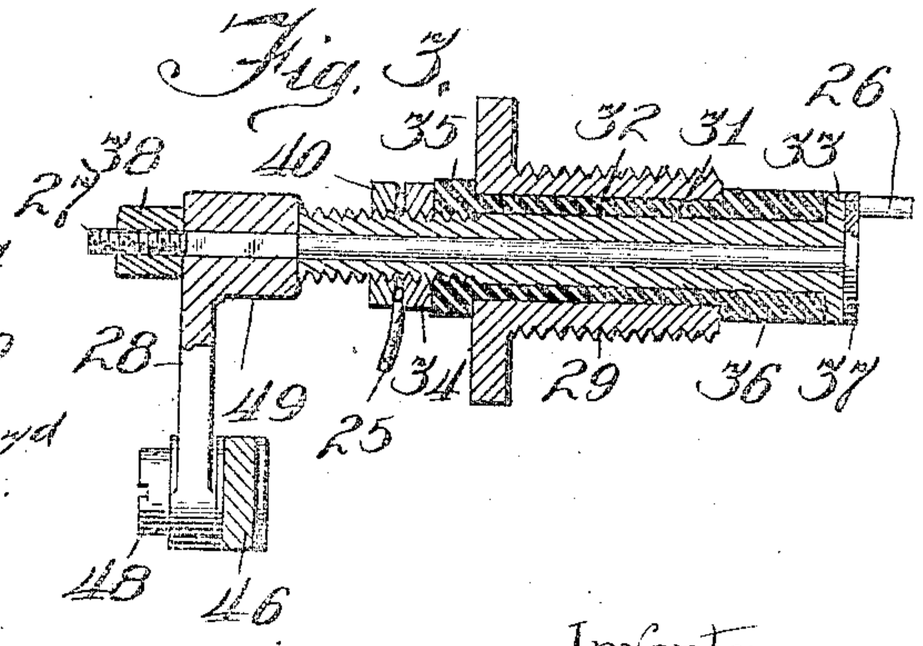


Fig. 3.



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2 SHEETS—SHEET 2.

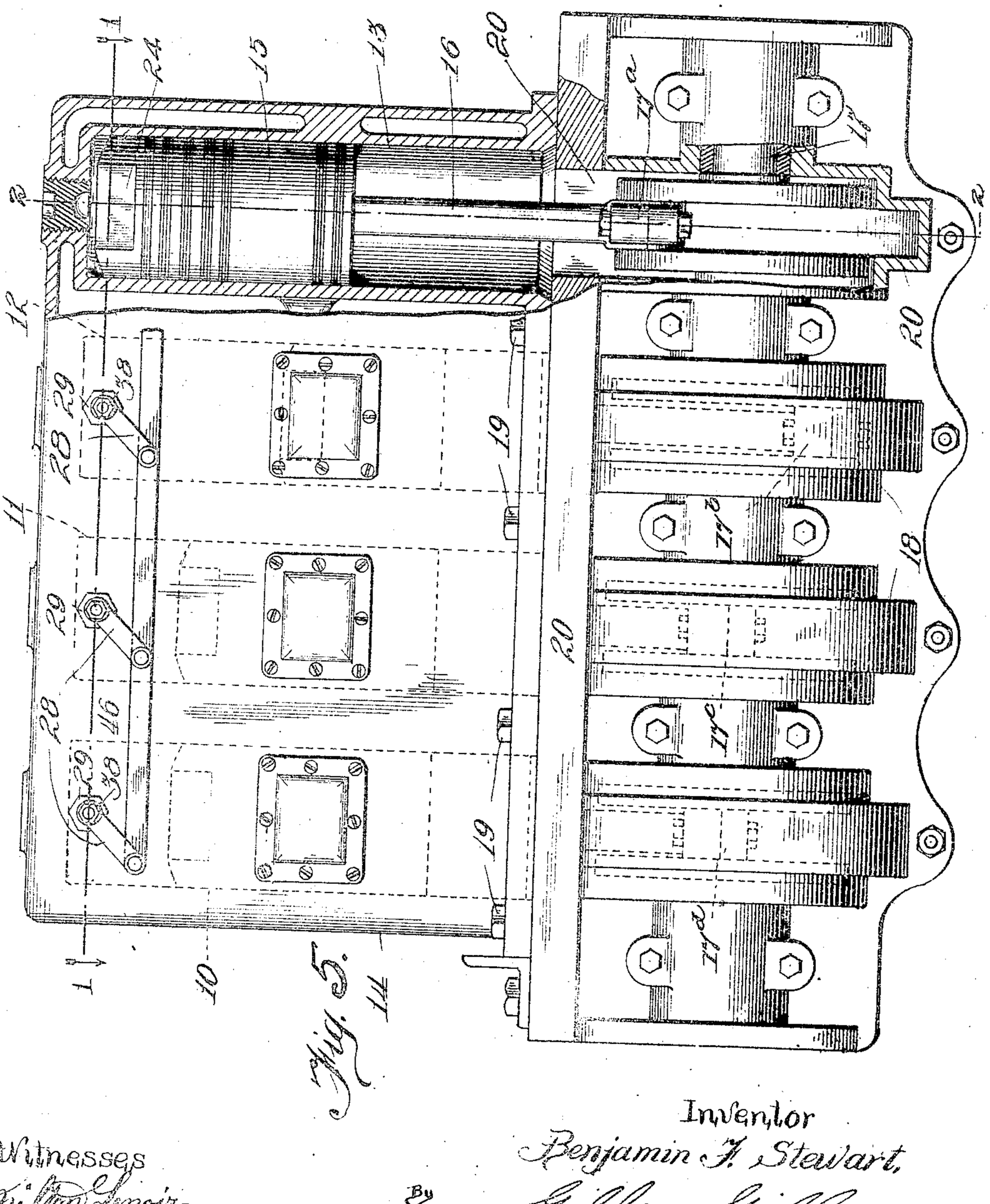

Fig. 5.

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UNITED STATES PATENT OFFICE.

BENJAMIN F. STEWART, OF CHICAGO, ILLINOIS.

IGNITING APPARATUS FOR EXPLOSIVE-ENGINES.

940,374. Specification of Letters Patent. **Patented Nov. 16, 1909.**

Application filed August 8, 1908. Serial No. 447,621.

To all whom it may concern:

Be it known that I, BENJAMIN F. STEWART, a citizen of the United States, and resident of Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Igniting Apparatus for Explosive-Engines, of which the following is a specification, and which are illustrated in the accompanying drawings, forming a part thereof.

The invention relates to apparatus for igniting the fuel charge in explosive engines, more particularly those explosive engines of the two-cycle type having a plurality of cylinders wherein provision is made for exploding a charge of fuel in each of the cylinders of the engine at every stroke of the piston therein.

The invention contemplates the ignition of the fuel charge in each cylinder of an explosive engine comprising a plurality of power cylinders by means of an electrical spark projected from an electrode entering the chamber of the cylinder through a side wall thereof when the electrode is approached by the piston, the several electrodes and the pistons for all of the cylinders being in the same electric circuit whereby the distribution of the electric current to the several cylinders is effected by the movement of the pistons within the cylinders toward and away from the corresponding electrodes. In order that the time at which each of the electrodes is approached to within a suitable distance for the passage of a spark by the corresponding piston, during the cycle of movement of the piston within the cylinder, may be adjusted, provision is preferably made for longitudinally shifting the electrodes within the cylinders.

The object of the invention is to provide means of simple and improved construction for igniting the explosive charge of gas engines at a predetermined time with reference to the position of the piston within the engine cylinder without the use of a mechanically operated electrical switch commonly termed the "timer".

In the accompanying drawings:—Figure 1 is a plan sectional view of a multiple cylinder gas engine equipped with igniting apparatus provided by the invention, the plane of the section being indicated by the line 1—1 on Fig. 5 and parts of the igniting apparatus being illustrated in diagram. Fig. 2 is a detail sectional view of the engine taken on the line 2—2 of Fig. 5. Fig. 3 is similar to a detail of Fig. 2 showing one of the electrodes of the igniting apparatus drawn to a larger scale. Fig. 4 is an end elevation of the parts shown in Fig. 3, and Fig. 5 is a side elevation of the engine illustrated in Fig. 1, some of the parts being shown in central vertical section.

The engine illustrated in the drawings comprises a plurality of power cylinders designated 10, 11, 12, and 13 respectively, the walls of the several cylinders being cast integral and being inclosed by an integral jacket 14. A piston 15 reciprocates within each of the cylinders 10, 11, 12 and 13, all of such pistons being connected by pitmen 16 to a crank shaft 17 the cranks 17^a, 17^b, 17^c, 17^d, of which are preferably so disposed about the shaft that the pistons 15 approach the inner ends of the cylinders 10, 11, 12 and 13 successively at regular intervals during the rotation of the shaft. As shown, the cranks 17^a, 17^b, 17^c and 17^d are angularly spaced about the crank-shaft 17 at intervals of ninety degrees, whereby one of the four pistons 15 of the engine reaches the limit of its instroke at each quarter revolution of the crank shaft.

A casing 18, secured by bolts 19 to a flange formed upon the walls of the power cylinders 10, 11, 12 and 13 and the jacket 14 incloses the cranks of the crank shaft 17, a separate compartment, as 20, being provided within the casing at the foot of each of the power cylinders 10, 11, 12 and 13. During the operation of the engine an explosive charge is compressed within each of the compartments 20 of the crank case 18 during the advance of the piston 15 in the power cylinder communicating therewith. When the piston reaches the end of its out stroke this charge is delivered to the space behind the piston through a duct 21 leading through the wall of the cylinder to a port opening 22 controlled by the piston. This incoming charge sweeps the products of combustion of the last preceding charge from the chamber of the cylinder through an exhaust port 23 also controlled by the piston and is itself deflected toward the head of the cylinder by a projection or baffle 24 formed upon the head of the piston 15 in front of the port opening 22.

Means are provided for electrically igniting the explosive charge delivered to each of the power cylinders 10, 11, 12 and 13 in

the manner just described, when the piston 15 again approaches the head of the cylinder. To this end an electrode 26 preferably insulated from the wall of the cylinder and constituting one of the terminals of an electrical circuit 25 which is supplied with current of sufficient tension to cause a spark to pass over a short gap in the circuit, as from an induction coil 43, projects into the chamber of each of the cylinders of the engine to such a position that an appurtenance of the engine piston 15, as the vertical face of the baffle 24 approaches it for the passage of a spark, when the piston approaches the end of its inward stroke. As shown each of the pistons 15 has electrical connection with the circuit 25 by reason of one of the circuit wires being connected to the wall of the engine at 39.

Preferably the electrodes 26 are directed laterally into the chambers of the cylinders 10, 11, 12 and 13 and the vertical faces of the baffles 24 move in a plane beyond the ends of the electrodes, the relation of these parts being such that a spark will be formed in each of the cylinders by the current impressed upon the circuit 25 only when the face of the baffle plate 24 reaches the level of the corresponding electrode 26 and such a spark will continue to pass between these members for as long as any part of the baffle plate 24 remains directly in front of the electrode 26.

The time when a spark will begin to pass in each of the cylinders may be varied by vertically shifting the electrodes 26 within the cylinders. As shown each of the electrodes 26 is eccentrically mounted upon the end of a rotatable shaft 27 which projects through the side wall of the cylinder and the jacket 14 and carries upon its outer end a crank arm 28. Each of the shafts 27 is preferably carried by a removable plug 29, Figs 3 and 4, adapted to enter a screw threaded aperture 30 formed in the wall of the cylinder. Preferably the shaft 27 is journaled in a sleeve 31 which in turn is supported within the plug 29 by being surrounded by a quantity of insulating material 32 such as a plurality of rings or washers of mica. This insulating material is clamped in position on the sleeve 31 between a flange 33 formed on the inner end of the sleeve and a nut 34 running on the sleeve adjacent its outer end, that part of the insulating material 32 adjacent each of the ends of the sleeve being of greater diameter than the intervening portions as indicated at 35—36 for gripping the ends of the plug 29 and thus firmly uniting the parts when the insulating material is compressed by the application of the nut 34 to the outer end of the sleeve 31. A head 37 is formed on the inner end of the shaft 27 for carrying the electrode 26. As shown this head is held in frictional electrical contact with the inner flanged end of the sleeve 31 by means of the crank arm 28 which is preferably adjustably secured to the outer end of the shaft 27 by a nut 38 for engaging the outer end of the sleeve 31.

In order that the shafts 27 at each of the cylinders 10, 11, 12 and 13 of the engine may be rotated for simultaneously adjusting all of the electrodes 26, a rod 46 conveniently accessible to an attendant, is connected to each of the crank arms 28 by a screw bolt 48 as most clearly shown in Figs. 1 and 4, the arrangement being such that movement of the rod in each direction is limited by contact with the hubs 49 of the crank arms 28. By reason of the rod 46 being located upon the inner side of the crank arms 28 any one of the plugs 29 and its appurtenances may be removed from the engine if the corresponding crank arm 28 be first disconnected from the rod 46 by the removal of the screw bolt 48.

Preferably the electric circuit 25 serves for supplying current to the electrodes 26 of all of the cylinders of the engine, one of the circuit wires being connected to that of one of the cylinders as 13, Fig. 1, by being clamped between the nut 34 employed for securing the parts carried by the plug 29 in assembled position and a second nut 40 running on the sleeve 31. The electrodes 26 for all of the other cylinders of the engine have electrical connection with the same branch of the circuit 25 as the electrode 26 of the cylinder 13 through the rod 46 and cranks 28 mounted upon the outer ends of the shaft 27. As shown current is supplied to the induction coil 43 from a storage battery 45, a simple switch 47 being provided in the primary circuit of the induction coil for interrupting the flow of current from the battery when the engine is not in operation.

During the operation of the engine current will be continuously supplied to the induction coil 43 from the battery 45, the secondary current from the coil being distributed to the several cylinders of the engine for the formation of a spark in each cylinder at the proper time by the movement of the engine pistons into and out of sparking positions in front of the electrodes 26. When each of the electrodes 26 is in the adjusted position illustrated by full lines in Fig. 4 of the drawings the baffle 24 formed upon the head of the pistons 15 will not move to a position in front of the electrode for the passage of a spark, until the piston reaches the end of the inward stroke. If however, the rod 46 be shifted to move the electrodes to the position represented by dotted lines in Fig. 4 or to an intermediate position by turning the shaft 27 the baffle 24 within each of the cylinders will move in front of one of the electrodes 26 for the passage of a spark

before the piston reaches the end of its inward stroke and will remain in front of the electrode until after the piston has begun its outward stroke. Such an adjustment in position of the electrodes 26 will ordinarily be accompanied by a high rate of speed of the engine but an ignition of each charge of fuel within the cylinder will nevertheless be insured by reason of the baffle 24 being in sparking position in front of the electrode 26 during a considerable period.

The baffle 24 formed upon the pistons of two-cycle gas engines is preferably formed with a flat vertical face as shown and for this reason provides a convenient part of the engine piston for coöperating with the electrode 26 for the formation of a spark, for while the electrode 26 is moved for adjustment through an arc by rotating the shaft 27, the horizontal distance from the end of the electrode to the face of the baffle remains the same.

I claim as my invention:—

1. In a gas engine in combination, a cylinder, a piston reciprocable within the cylinder, a projection formed on the head of the piston having a plane face parallel to the direction of the movement of the piston and adjacent a side wall of the cylinder, an insulated rotatable spindle entering the chamber of the cylinder through a side wall thereof, and an electrode coöperating with the face of the projection on the piston mounted on the inner end of the spindle out of line with the axis of rotation thereof.

2. In a gas engine, in combination, a plurality of cylinders, an electric circuit continuously supplied with current, a sparking electrode within the chamber of each of the cylinders, all of the electrodes being electrically connected in one branch of the electric circuit, means for simultaneously shifting all of the electrodes longitudinally with respect to the cylinders, a piston reciprocable with each of the cylinders toward and away from the electrode, all of the pistons being electrically connected in the other branch of the electric circuit, operative connection between the pistons whereby they approach the electrodes in succession, and means for delivering an explosive charge to each of the cylinders at each cycle of movement of the piston therein.

3. In a gas engine, in combination, a cylinder, a sparking electrode within the chamber of the cylinder, a piston reciprocable within the cylinder toward and away from the electrode but never contacting therewith, an electric circuit of which said electrode and said piston constitute the terminals, said electric circuit being continuously supplied with current, and lever-operated means for shifting the electrode within the cylinder longitudinally thereof whereby the time of relative approach between the piston and electrode to sparking position is changed with respect to the cycle of movement of the piston within the cylinder.

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