

No. 709,598.

Patented Sept. 23, 1902.

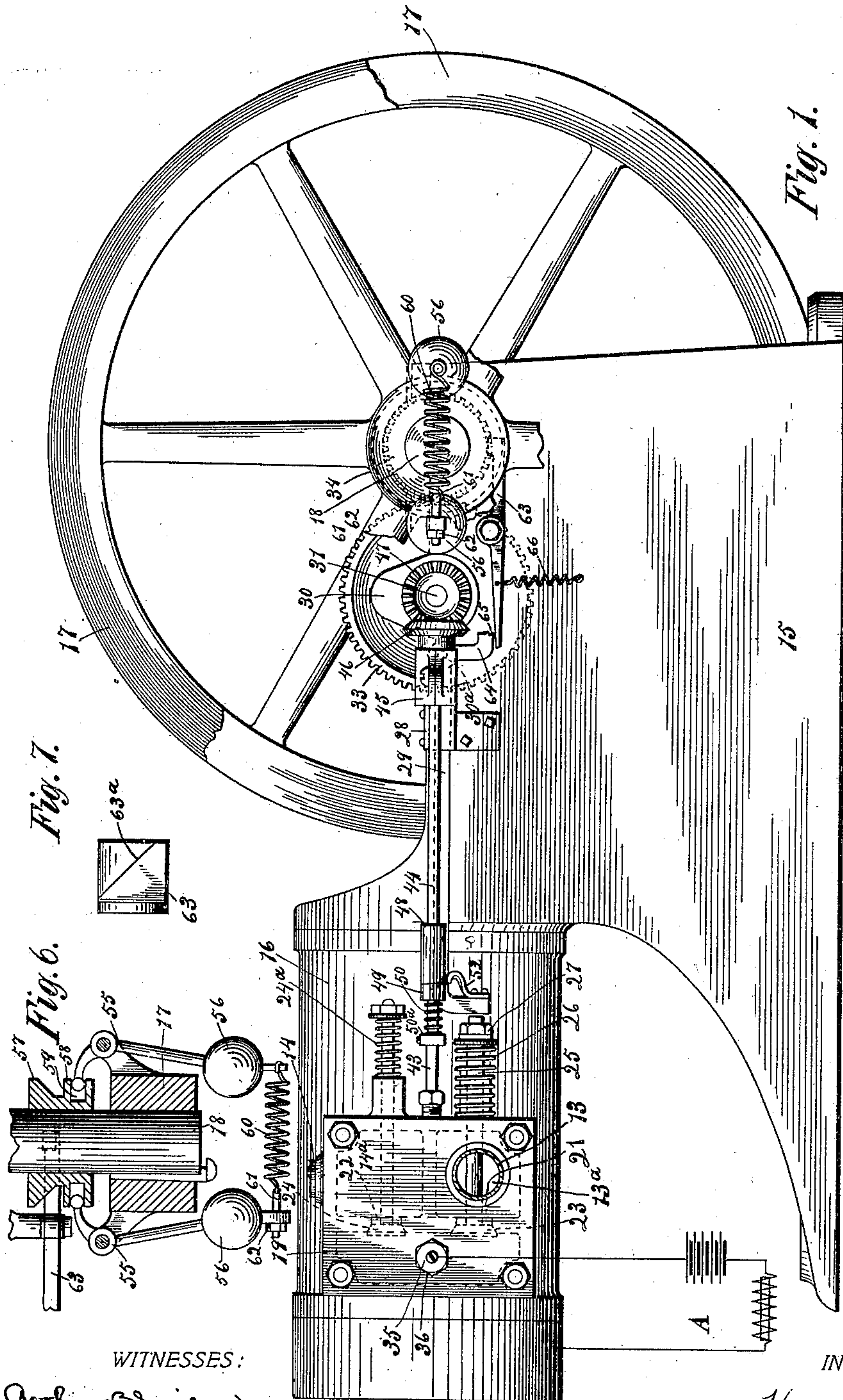
H. A. GRAY.

ELECTRIC IGNITER FOR EXPLOSIVE ENGINES.

(Application filed Oct. 1, 1901.)

(No Model.)

2 Sheets—Sheet 1.



WITNESSES:

Arthur D. Seibert.  
W. H. Cotton

INVENTOR.

BY Howard A. Gray.

Louis A. Gilson ATTORNEY.

H. A. GRAY.

## ELECTRIC IGNITER FOR EXPLOSIVE ENGINES.

(Application filed Oct. 1, 1901.)

(No Model.)

2 Sheets—Sheet 2.

Fig. 2.

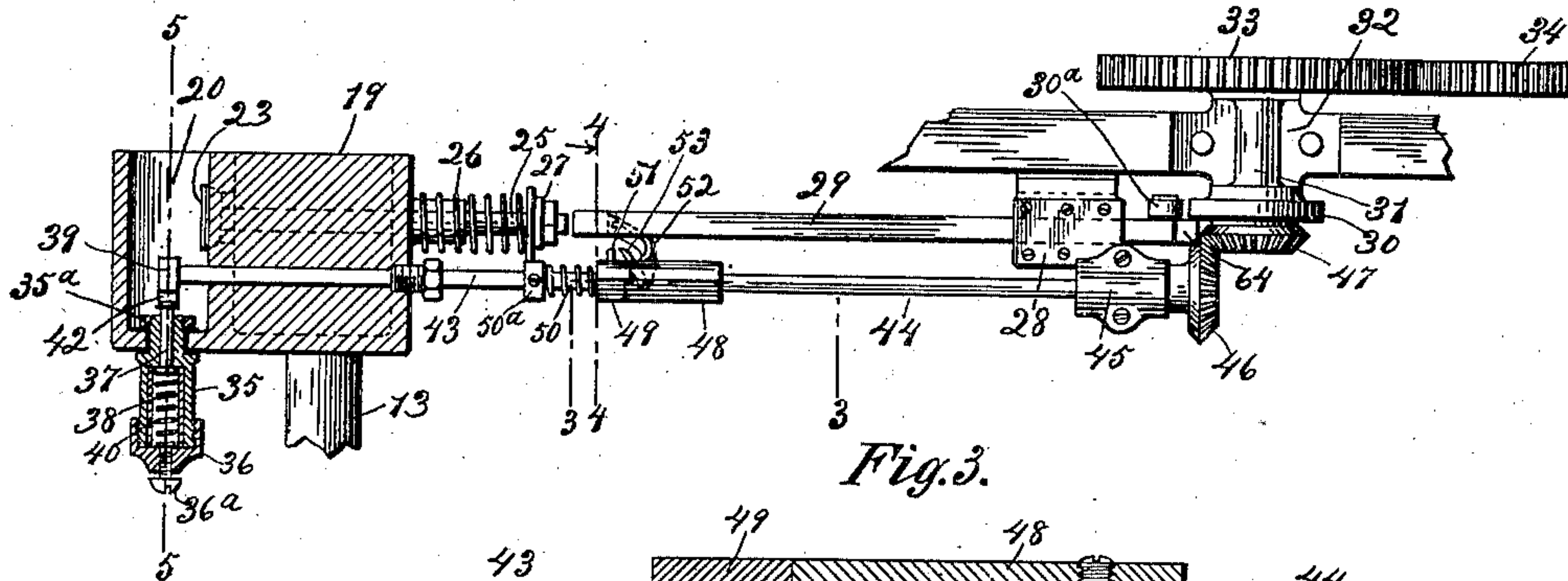


Fig. 3.

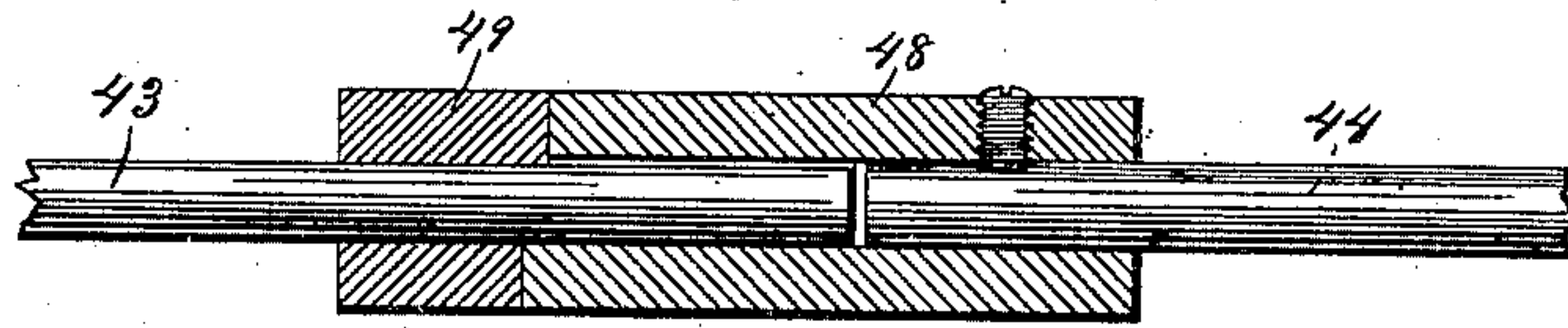


Fig. 4.

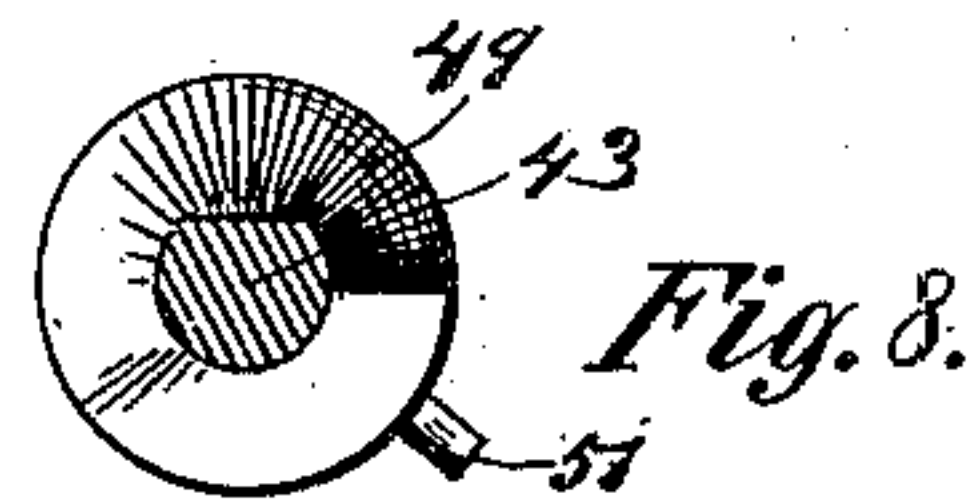
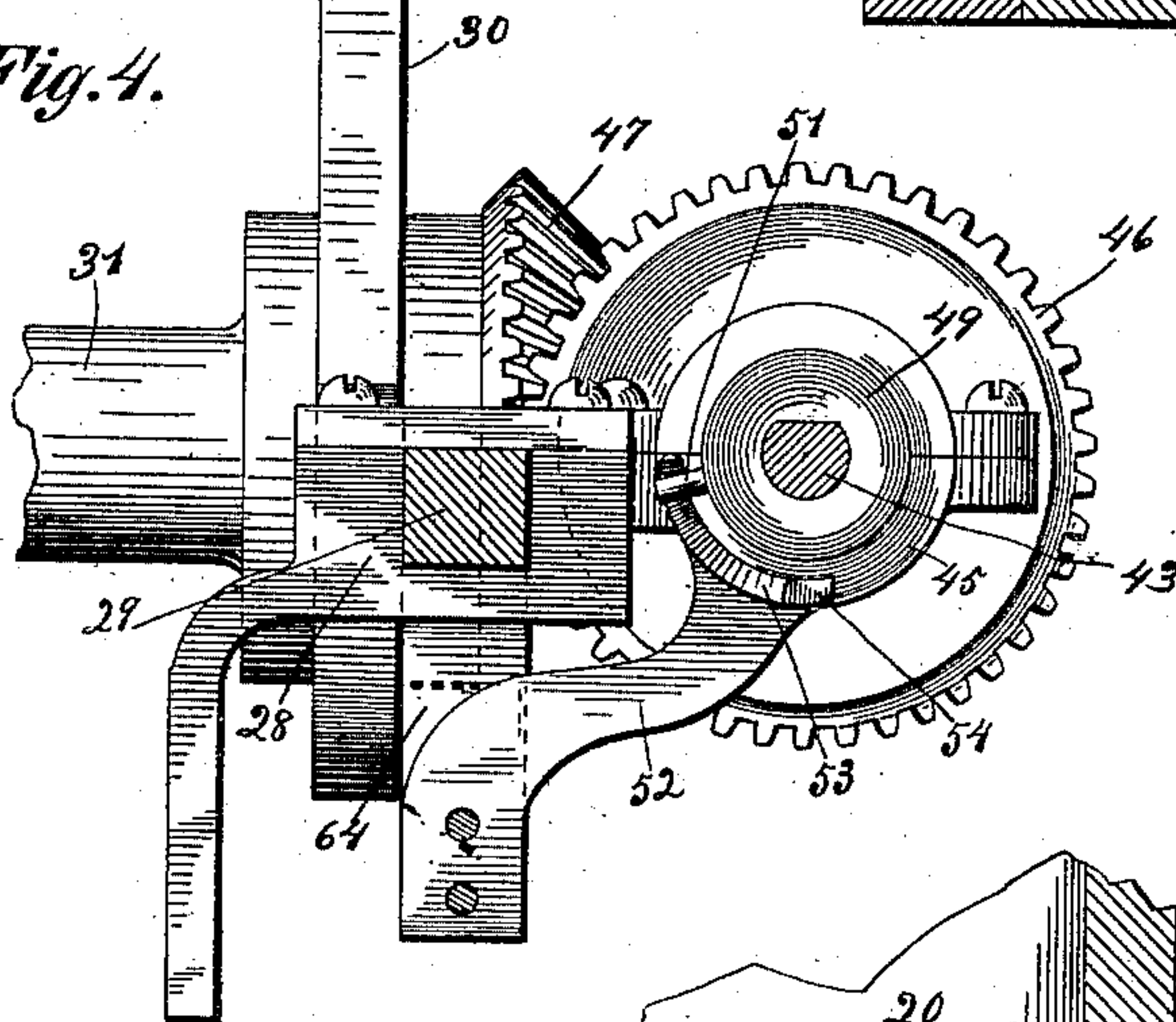


Fig. 8.

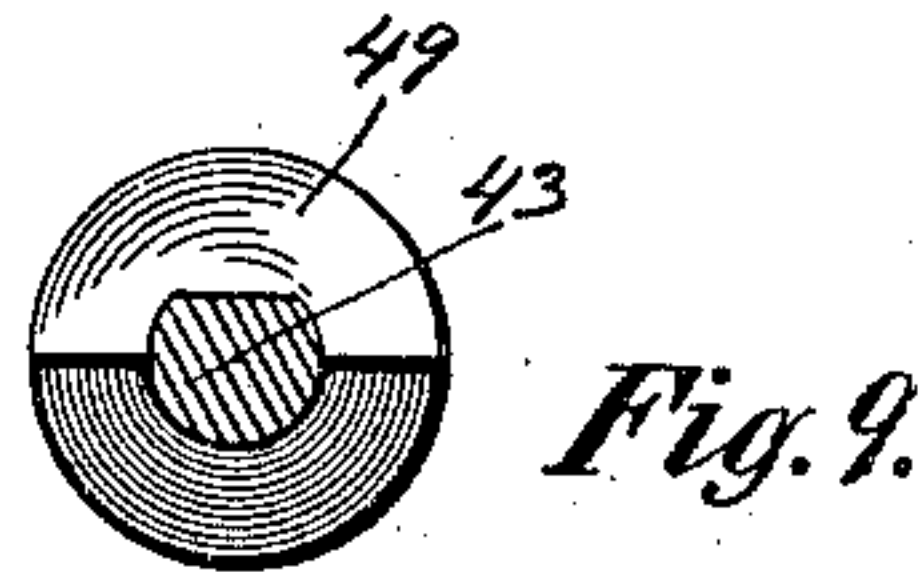


Fig. 9.

Fig. 5.

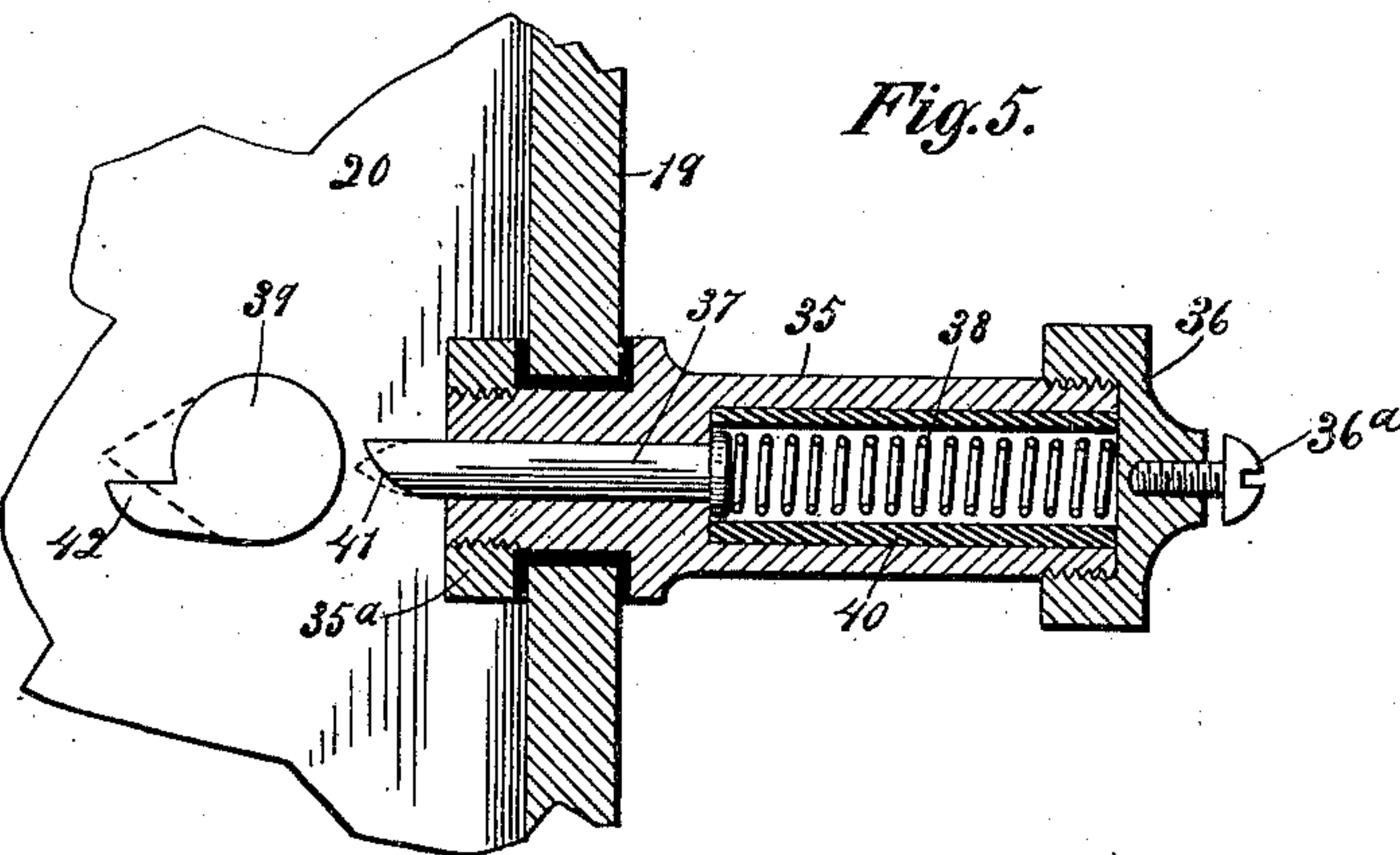
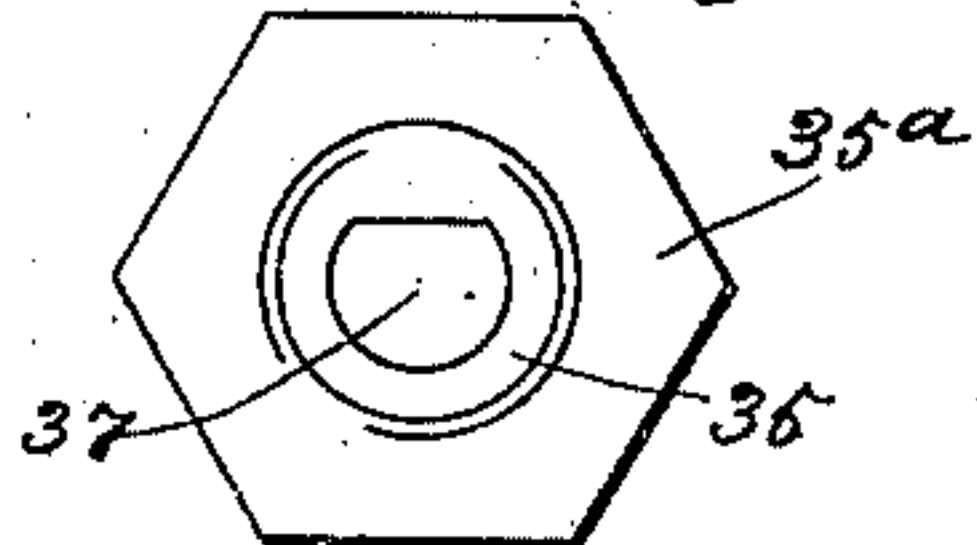


Fig. 10.



WITNESSES:

Arthur H. Seibold.  
W. H. Cotton

INVENTOR.

BY Howard A. Gray.  
Louis H. Green ATTORNEY.



# UNITED STATES PATENT OFFICE.

HOWARD A. GRAY, OF PLAINFIELD, ILLINOIS.

## ELECTRIC IGNITER FOR EXPLOSIVE-ENGINES.

SPECIFICATION forming part of Letters Patent No. 709,598, dated September 23, 1902.

Application filed October 1, 1901. Serial No. 77,210. (No model.)

*To all whom it may concern:*

Be it known that I, HOWARD A. GRAY, a citizen of the United States, and a resident of Plainfield, county of Will and State of Illinois, have invented certain new and useful Improvements in Electric Igniters for Explosive-Engines, of which the following is a specification and which are illustrated in the accompanying drawings, forming a part thereof.

My invention relates to explosive-engines, and has particular reference to electrical igniting devices therefor.

The object of the invention is to provide a simple and effective igniter and one controlled by the governor through the medium of the valve mechanism of the engine—as, for instance, the rod for operating the exhaust-valve in an engine of the four-cycle type or the rod or other device governing the feed-valve in an engine of the two-cycle type.

The invention consists in the novel construction and arrangement of parts more fully hereinafter set forth and which are illustrated in the accompanying drawings, in which—

Figure 1 is a side elevation of an explosive-engine, showing my invention applied thereto. Fig. 2 is a plan of a part of the engine with particular reference to the valve-rod and connections and the electrode-shaft and clutch for the same, the valve-casing being shown in section. Fig. 3 is a section on the line 3 3 of Fig. 2. Fig. 4 is a section, on an enlarged scale, on the line 4 4 of Fig. 2 looking in the direction of the arrow. Fig. 5 is a section, also on an enlarged scale, on the line 5 5 of Fig. 2, illustrating the electrodes, a modification of the same being shown in dotted lines. Figs. 6 and 7 relate to details of the governor. Fig. 8 is a face view of one of the members of the clutch shown in Figs. 1 and 2. Fig. 9 shows a square-faced clutch used with a reversing-engine when the modified form of electrodes is employed, and Fig. 10 is a detail of the reciprocating or sliding electrode illustrated in Fig. 5.

I have shown in Fig. 1 the bed-plate 15, cylinder 16, fly-wheels 17, and crank-shaft 18 of an explosive-engine of ordinary construction. The piston and connecting-rod are not seen.

Secured to the cylinder 16, near the inner end thereof, is a valve-casing 19 of common

construction, the chamber 20 of which opens into the interior of the said cylinder, and 21 and 22 designate the exhaust and inlet ports, which are closed by the inwardly-opening valves 23 and 24, respectively, the latter being held to its seat by a spring 24<sup>a</sup>. As shown by the dotted lines in Fig. 1, the ports 21 and 22 communicate with the chamber 20 for feeding the explosive mixture entering by the pipe 14 to the chamber 14<sup>a</sup> and exhausting the products of combustion from the chamber 13<sup>a</sup> to the pipe 13. The exhaust-valve 23 is provided with a stem 25, which extends through the wall of the casing 19 and is held to its seat by an expansion-spring 26 reacting between the wall of the casing and a nut 27, screwed on the said stem.

Reciprocating in a guide 28, secured to the bed-plate 15, is a rod 29, having at the end thereof adjacent to the crank-shaft 18 a friction-roller 30<sup>a</sup>, and the opposite end of the said rod pushes against the end of the valve-stem 25 when moved by a cam 30, fixed on a shaft 31, journaled in the bearing 32 on the bed-plate 15. This shaft 31 has keyed to it a gear 33, which meshes with a pinion 34, keyed to the crank-shaft 18. The ratio of the gear 33 to the pinion 34 is such that the former makes one revolution to two of the latter, the engine now being described being of the four-cycle type. When the cam 30 is turned away from the reciprocating rod 29, the latter is moved to its original position by the expansion of the spring 26 in closing the exhaust-valve 23.

Secured in but insulated from the wall of the chamber 20 of the valve-casing 19 by a nut 35<sup>a</sup> is a hollow plug 35, closed by a cap 36. In the open end of the plug 35, extending into the chamber 20, is seated a sliding or reciprocating pin 37, serving as one of the electrodes of the igniter, and interposed between the head of this pin and the cap 36 is an expansion-spring 38, which holds the electrode in the path of the cam or electrode 39, also located in the chamber 20. The spring 38 is surrounded by an insulating-sleeve 40 to avoid sparking and the consequent wasting of the battery, which would occur on the expansion and contraction of the spring if no means were provided to prevent contact there-



with with the walls of the plug 35. The pin 37 has a flat side, and also the seat therefor, as shown in Fig. 10, to prevent the turning of the pin, and the contact-point thereof is beveled, as at 41. The electrode 39 is in the shape of a cam having an angular face 42, thereby rendering the rotation of the same possible only in one direction, the flat faces of the two electrodes meeting when the motion of the cam 39 is reversed. One wire of an electric circuit, conventionally shown at A, is grounded in the cylinder 16 and the other led to a binding-post 36<sup>a</sup> on the cap 36 of the plug 35. The electrode 39 is fixed to a shaft which passes through the casing 19, said shaft consisting of two parts or sections 43 and 44. The end of this shaft is journaled in a bearing 45, supported from the bed-plate 15, and provided with a beveled gear 46, which meshes with and is driven by a beveled gear 47, keyed to the shaft 31, and the two sections are coupled by means of a ratchet-clutch, one member, as 48, of which is fast on the end of the shaft-section 44, while the other, 49, is carried by the shaft-section 43. The member 49 of the clutch is capable of a sliding movement on the shaft-section 43, but is held against turning thereon by reason of the flattened side of the said shaft, as illustrated in Fig. 8, and a spring 50, encircling the shaft and reacting against a collar 50<sup>a</sup>, serves to hold the said movable member in engagement with the member 48. The clutch member 49 is also provided with a pin 51, which is engaged by a cam or extension 53 of an arm 52, secured to the valve-rod 29, the said extension being concentric with the clutch and its end beveled or inclined, as seen in Figs. 2 and 4, the beveled portion terminating in a flat seat 54.

The sparking of the electrodes 37 and 39 may be controlled by means of any suitable governor capable of coaction with the valve-rod 29. I have shown a governor of ordinary construction, consisting of the bell-crank levers 55, pivoted to the hub of one of the fly-wheels 17 and provided with the usual balls 56. Splined on the shaft 18, so as to be capable of longitudinal movement, is a conical sleeve 57, provided with a collar 58, having an annular recess 59, in which the short arms of the levers 55 play. The centrifugal force acting on the governor-balls 56 is resisted by a spring 60, connecting the said balls, and the tension of said spring is adjusted by means of a screw-bolt 61 and nut 62. Pivoted to the bed-plate 15 of the engine is a lever 63, the beveled end 63<sup>a</sup> of which bears against the conical sleeve 57 of the governor, and the other lies adjacent to an arm 64 of the valve-rod 29.

From the foregoing it will be understood that at every revolution of the cam 30 the valve-rod 29 is moved forward, opening the exhaust-valve 23, and at the same time the

cam extension 53 of the arm 52, carried by the valve-rod 29, strikes the pin 51 of the clutch member 49 and turns the shaft-section 43 in advance of the section 44. As soon, however, as the cam is withdrawn from engagement with the rod 29 the said rod is returned to its normal position, releasing the clutch member 49, which is immediately thrown by the spring 50 into engagement with the member 48, and then at the proper moment the electrode 39 is brought into contact with the electrode 37, and upon separation therefrom a spark is generated which ignites the charge within the cylinder. If the engine exceeds a certain speed, the governor-balls 56 are thrown outwardly, thereby sliding, through the medium of levers 55, the conical sleeve 57 on the crank-shaft 18, and the lever 63 is moved on its pivot into the path of the end of the arm 64 of the rod 29, its free end engaging a notch 65 in the end of the said arm, thereby holding the exhaust-valve 23 open so long as the end of the lever remains in engagement with the arm 64 of the valve-rod. Of course while the rod 29 is in its advanced position and the valve 23 held open the clutch member 49 will be held separated from the clutch member 48 by the cam extension 53 of the arm 52, as heretofore described. The arm 52 not only serves to separate the clutch members, but also by reason of the beveled extension to turn the shaft-section 43 until the pin 51 rests in the squared seat 54, thereby holding the electrode 39 in such position that it is out of contact with the electrode 37 when the shaft-section 43 is stationary. As soon as the speed of the engine is reduced to normal the lever 63 is released by the governor-sleeve and drawn out of engagement with the arm 64 of the rod 29 by a spring 66, one end of which is anchored to the bed-plate and the other to the lever. If the engine be reversed, as soon as the squared face of the rotating electrode 39 comes into contact with the pin 37 the clutch will permit the section 44 of the shaft to turn, while the other section will remain stationary, thereby avoiding injury to the electrodes.

It will be obvious that the invention herein described may with slight modification be adapted to an engine of the two-cycle as well as any other type—as, for example, by placing the arm 52, carried by the valve-rod 29 for opening the exhaust-valve, on a rod or other device for actuating the feed-valve.

If the igniter is employed with a reversible engine, the electrode 37 may be provided with a tapering point and a double-faced cam employed, as shown by dotted lines in Fig. 5, so as to permit of the sparking of the electrodes when running in either direction. Under this latter construction instead of the ratchet-clutch a straight-jaw or lap-joint clutch, such as is shown in Fig. 9, might be employed.

Various modifications may be made in the



construction of the invention, and I do not limit myself to details so long as the spirit thereof is not departed from.

I claim as my invention—

5 1. In an explosive-engine, in combination, a cylinder, a pair of intermittently-contacting igniting-electrodes one of which is rotatable, means for rotating said electrode, a charge-controlling valve, means for actuating the valve, a governor for interrupting the  
10 action of the valve, and an adjunct of the valve-actuating means engaging the electrode-rotating means to hold the rotatable electrode against movement.

15 2. In an explosive-engine, in combination, a cylinder, intermittently-contacting electrodes one of which is rotatable, means for rotating said electrode, a clutch-controlling connection between the rotatable electrode  
20 and the rotating means, a reciprocating rod, and a detent carried by the rod and separating the clutch to prevent rotation of the electrode.

25 3. In an explosive-engine, in combination, a cylinder, a valve therefor, a rod controlling the valve, means for moving the rod, a pair of electrodes one of which is rotatable, a shaft to which the rotatable electrode is fixed, and  
30 a connection between such shaft and the valve-controlling rod for holding the rotatable electrode against movement.

35 4. In an explosive-engine, in combination, a cylinder, a valve therefor, a rod controlling the valve, means for moving the rod, a pair of electrodes, a rotating shaft to which one of the electrodes is fixed, a clutch for the  
40 shaft, an arm carried by the rod and for separating the clutch to throw the electrodes out of action, a governor, and a lever operated by the governor for holding the rod against movement.

45 5. In an explosive-engine, in combination, a cylinder, an exhaust-valve, a rod controlling the valve, means for moving the rod, a pair of electrodes one of which is rotatable, a shaft to which the rotatable electrode is fixed, and  
an arm carried by the valve-rod for holding the rotatable electrode against movement.

50 6. In an explosive-engine, in combination, a cylinder, a valve therefor, a rod controlling the valve, a cam actuating the rod, a reciprocating electrode, a second electrode, a rotating shaft comprising two sections to one of which the second electrode is fixed, a clutch  
55 connecting the two shaft-sections, a pin projecting from one of the clutch members, and an arm secured to the valve-rod and having a beveled extension for engaging the pin to uncouple and also turn the shaft-section to  
60 which the second electrode is fixed.

65 7. In an explosive-engine, in combination, a cylinder, a valve therefor, a rod for opening the valve, means for moving the rod, a pair of electrodes one of which is rotatable, a shaft to which the rotatable electrode is fixed, means controlled by the valve-rod for holding the ro-

tatable electrode against movement, a governor, and connection between the governor and the valve-rod.

8. In an explosive-engine, in combination, 70 a cylinder, a valve therefor, a rod for opening the valve, a cam engaging the rod, a pair of electrodes one of which is rotatable, a shaft to which the rotatable electrode is fixed, an arm carried by the valve-rod for holding the  
75 rotatable electrode against movement, a governor, and connection between the governor and the rod.

9. In an explosive-engine, in combination, a cylinder, a valve therefor, a rod controlling 80 the valve, means for moving the rod, a pair of electrodes, a shaft comprising two sections to one of which one of the electrodes is fixed, a clutch coupling the two sections, an arm carried by the valve-rod and uncoupling the  
85 clutch to throw the electrodes out of action, and a spring for throwing the clutch into engagement when released by the arm.

10. In an explosive-engine, in combination, a cylinder, a valve therefor, a cam driven by 90 the engine and moving the rod, a movable electrode, a second electrode, a shaft comprising two sections to one of which the second electrode is fixed, a clutch for coupling the two shaft-sections and one of the members of which  
95 is slidably mounted upon the shaft, a pin projecting from such clutch member, an arm secured to the valve-rod and having a beveled extension for engaging the pin to uncouple the clutch and also turn the shaft-section to  
100 which the electrode is fixed, a spring for coupling the clutch when the arm is withdrawn from the pin, a governor, and a pivoted lever actuated by the governor and for engaging the valve-rod when advanced by the cam. 105

11. In an explosive-engine, in combination, a cylinder, intermittently-contacting electrodes one of which is rotatable, means for rotating said electrode, a clutch controlling connection between the rotatable electrode and  
110 the rotating means, and means timed to act intermediate of contacts between the electrodes for separating the clutch members to prevent movement of the rotatable electrode.

12. In an explosive-engine, in combination, 115 a pair of electrodes one of which is moved intermittently into contact with the other, a shaft to which the moving electrode is fixed, a valve, a rod controlling the valve, a pin rotatable with the electrode-shaft, and a cam  
120 carried by the valve-controlling rod and for engaging the pin to throw the moving electrode out of action.

13. In an igniting device for explosive-engines, in combination, a pair of electrodes, a 125 shaft comprising two sections and to one of which one of the electrodes is secured, a clutch for coupling the two sections, a spring for holding the clutch members in engagement, a valve, means for operating the valve, 130 and means carried by the valve-operating means for separating the clutch members.

14. In an igniting device for explosive-engines, in combination, a pair of electrodes, a shaft comprising two sections and to one of which one of the electrodes is secured, a  
5 clutch for coupling the two sections, a spring for holding the clutch members in engagement, a valve, means for operating the valve, means carried by the valve-operating means for separating the clutch members, a governor, and means controlled by the governor 10 for holding the valve-operating means against movement.

HOWARD A. GRAY.

Witnesses:

WM. G. STOPP,

F. F. HOAG.