No. 872,075. PATENTED NOV. 26, 1907.

H. A. MILLER & B. G. GILBOUGH.

SPARKING DEVICE.

APPLICATION FILED FEB. 14, 1906.

2 SHEETS—SHEET 1.

Fig. 1.

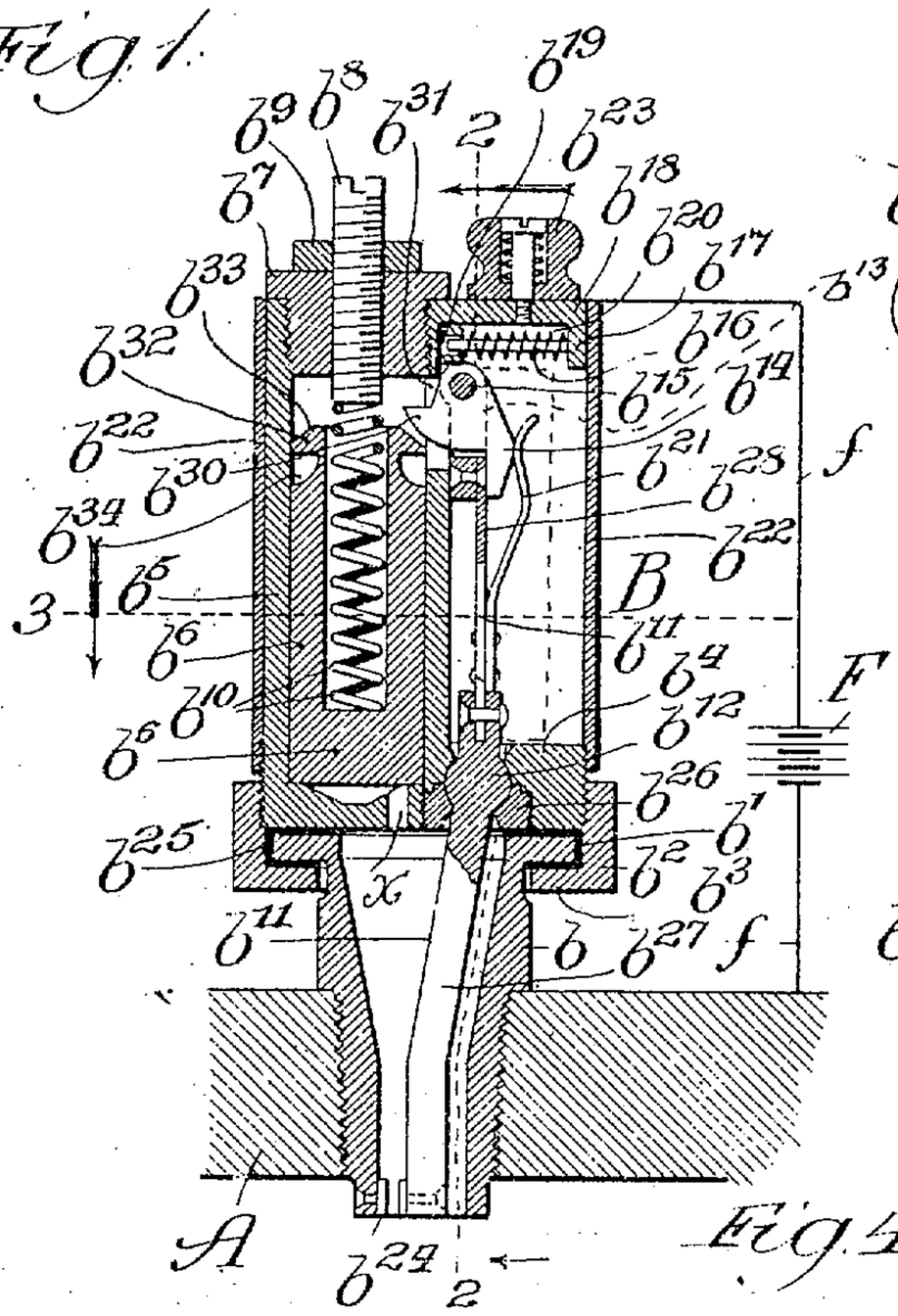


Fig. 2.

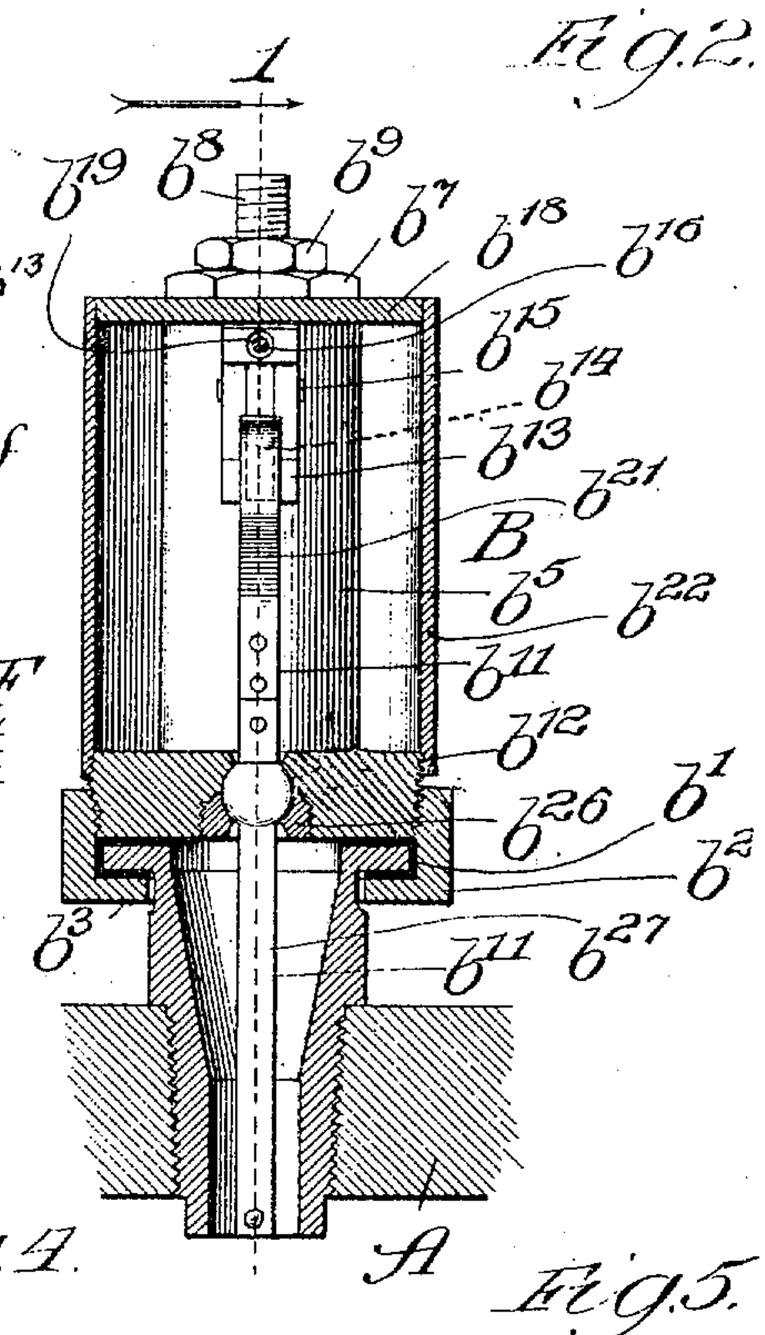
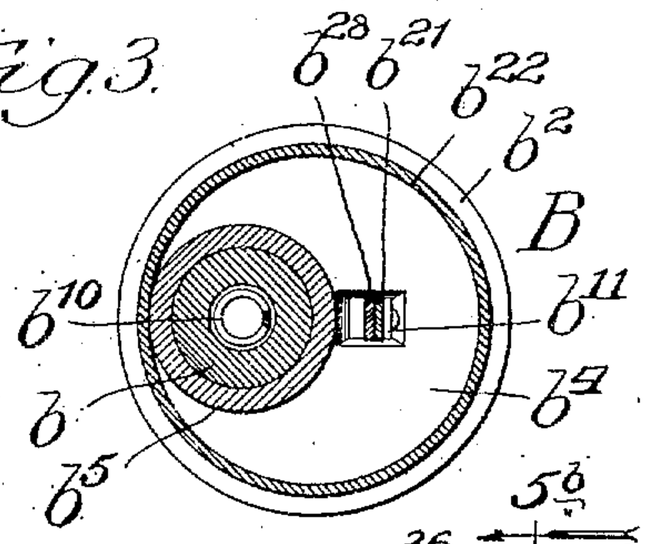
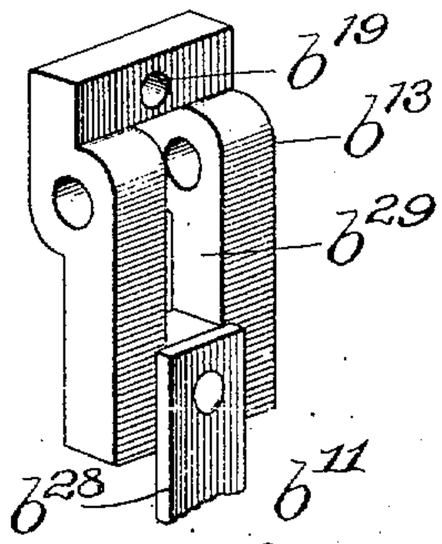


Fig. 4.

Fig. 5.

Fig. 3.





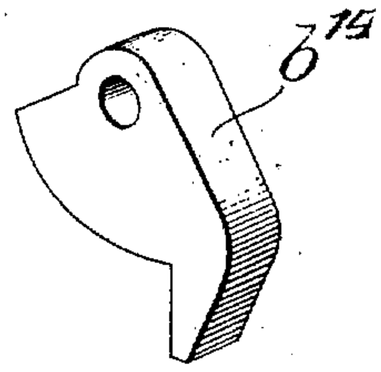


Fig. 5a.

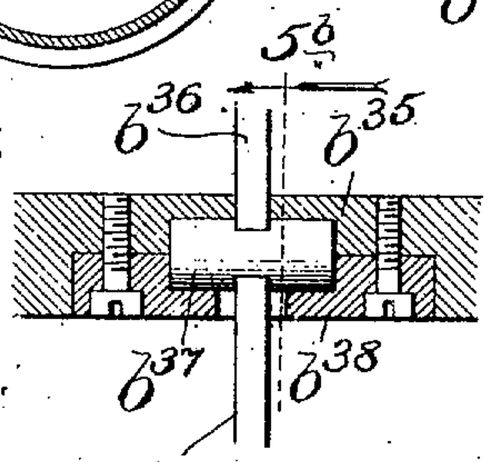
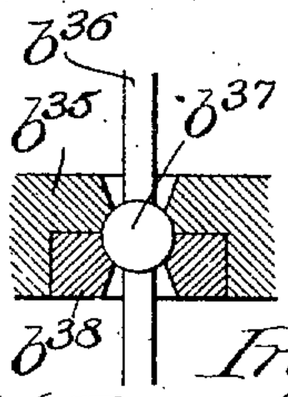


Fig. 5b.



Witnesses.
C. E. Twyford.
John Enders.

Inventors.
{Harry A. Miller,
{Benjamin G. Gilbough,
By Dyrenforth, Dyrenforth and Lee
Attys.

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2 SHEETS—SHEET 2.

Fig. 6.

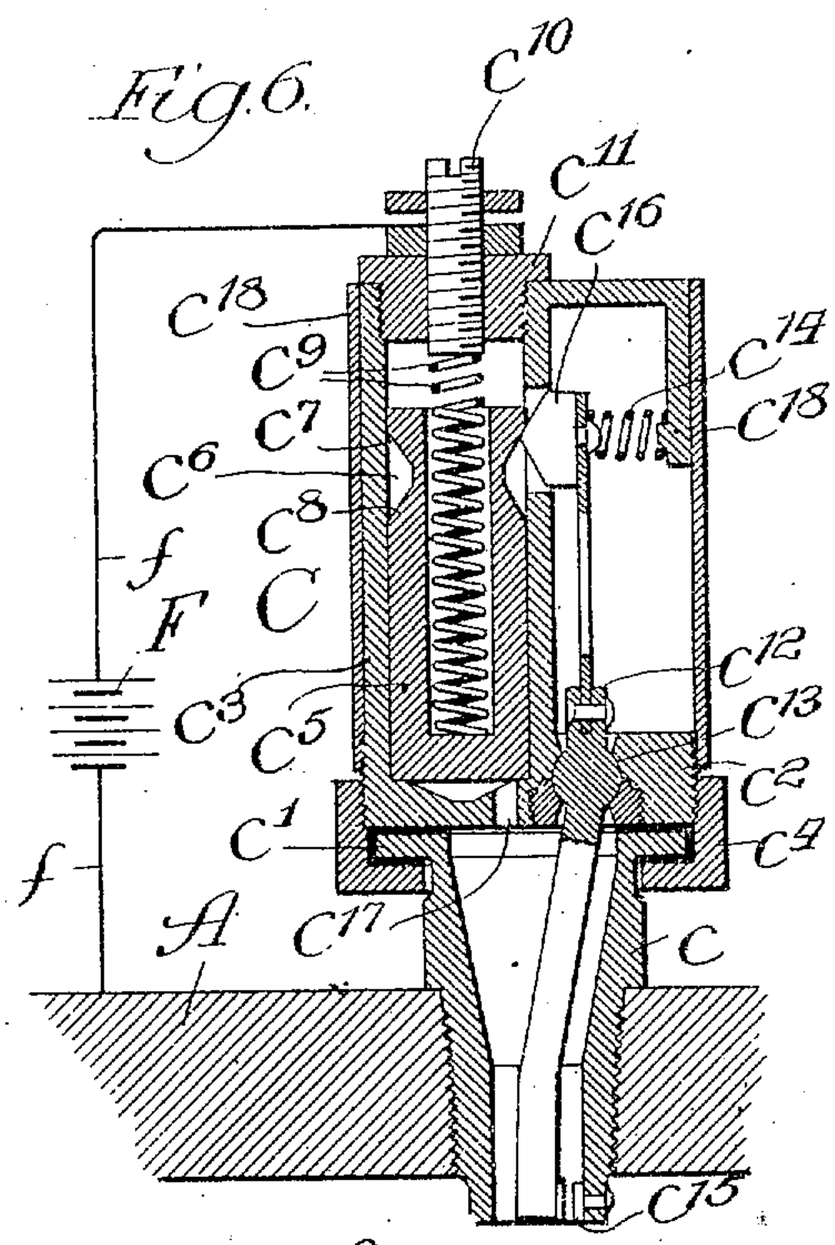


Fig. 7.

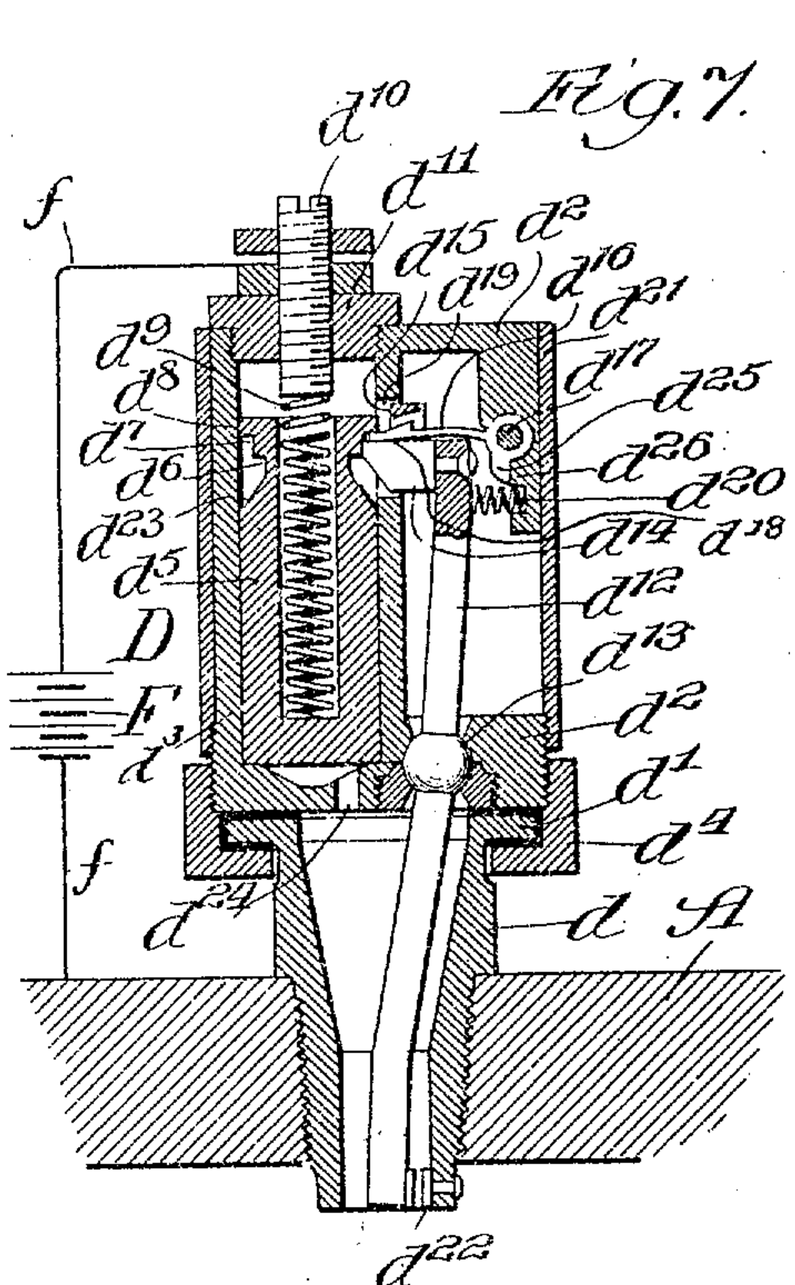


Fig. 8.

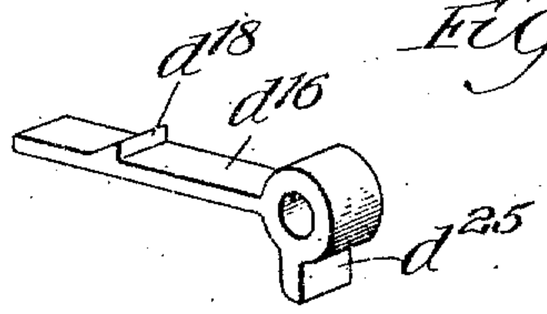


Fig. 9.

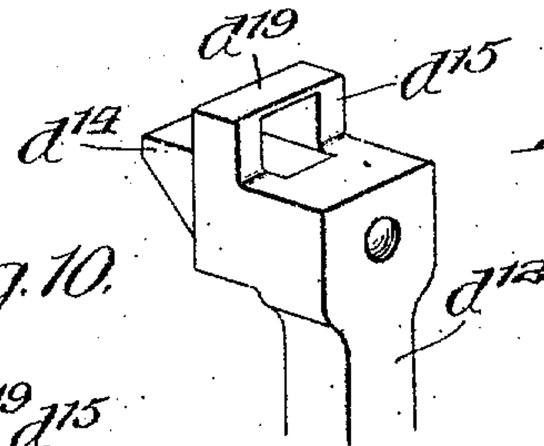


Fig. 11

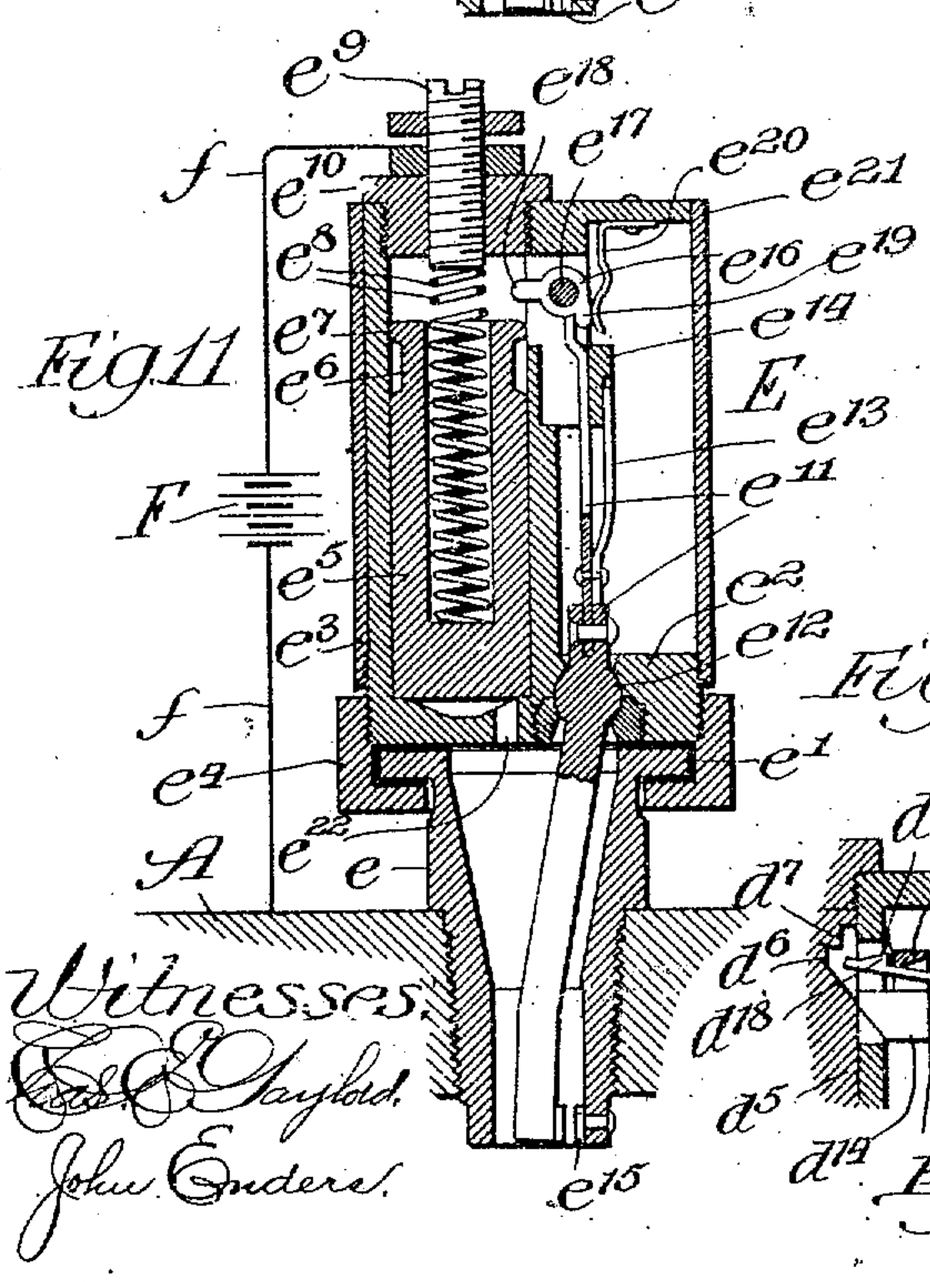
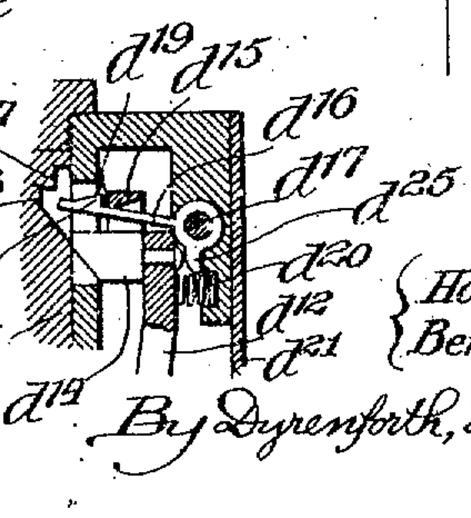


Fig. 10.



Witnesses:
Chas. E. Gaylord.
John Enders.

Inventors:
Harry A. Miller, and
Benjamin G. Gilbough,
By Dyrenforth, Dyrenforth & Lee,
Attys.

UNITED STATES PATENT OFFICE.

HARRY A. MILLER, OF PASADENA, CALIFORNIA, AND BENJAMIN G. GILBOUGH, OF CHICAGO, ILLINOIS.

SPARKING DEVICE.

No. 872,075. Specification of Letters Patent. Patented Nov. 26, 1907.

Application filed February 14, 1906. Serial No. 301,103.

To all whom it may concern:

Be it known that we, HARRY A. MILLER and BENJAMIN G. GILBOUGH, citizens of the United States, residing, respectively, at Pasadena and Chicago, in the counties of Los Angeles and Cook and States of California and Illinois, have invented a new and useful Improvement in Sparking Devices, of which the following is a specification.

Our invention relates to sparking-devices of the general character disclosed in Patent No. 805,790, granted to Benjamin G. Gilbough November 28th, 1905.

Our primary object is to provide an improved sparking-device of the type mentioned, particular attention being paid to securing durability of construction and quickness of action in making the break between the electrodes of the device.

The invention is illustrated in the accompanying drawings, in which—

Figure 1 represents a broken sectional view of an engine-cylinder equipped with our improved sparking-device in its preferred embodiment, the section being taken as indicated at line 1, Fig. 2; Fig. 2, a section taken as indicated at line 2, Fig. 1; Fig. 3, a section taken as indicated at line 3 of Fig. 1; Fig. 4, a broken perspective view showing the construction of the upper portion of a lever employed; Fig. 5, a perspective view of a self-releasing actuating arm employed in connection with the member shown in Fig. 4; Fig. 5^a, a broken section illustrating a modification in the construction of the vibrating electrode, shown in Fig. 1; Fig. 5^b, a section taken as indicated at line 5^b, Fig. 5^a; Fig. 6 a sectional view showing a modified form of the invention; Fig. 7, a sectional view showing another modified form of the invention; Fig. 8, a perspective view of a spring-catch employed in connection with the device shown in Fig. 7; Fig. 9, a broken perspective view of a member co-acting with the member shown in Fig. 8; Fig. 10, a broken sectional view illustrating a portion of the device shown in Fig. 7, the parts being in a different position, however; and Fig. 11, a sectional view showing a still further modification of the invention.

A represents a portion of an engine-cylinder; B, our improved sparking-device in the form illustrated in Figs. 1 to 5 inclusive; C, our improved sparking-device in the form illustrated in Fig. 6; D, our improved sparking-device in the form illustrated in Figs. 7 to 10 inclusive; and E, our improved sparking-device in the form illustrated in Fig. 11.

The device B comprises a tubular plug b having at its upper end an external flange b^1; a nut b^2 having a flange b^3 located beneath the flange b^1; a member b^4 having an enlarged lower or inner end connected with the nut b^2 and having a cylinder b^5 constituting a portion thereof, said cylinder communicating through a port x with the interior of the tubular plug b, and hence with the engine-cylinder; a piston b^6 movable in the cylinder b^5; a plug b^7 having threaded connection with the upper portion of the cylinder b^5 and through which extends a screw b^8, secured by a lock-nut b^9, the lower end of said screw bearing upon a spring b^{10} fitting in a socket with which the piston b^6 is provided; a lever-form electrode b^{11}, having ball and socket connection with the member b^4 adjacent to one side of the base of the cylinder b^5; a member or head b^{13} carried by the upper end of the lever b^{11}; an automatically disengageable actuating arm b^{14} connected by pivot b^{15} with the member b^{13} and adapted to be actuated by the piston b^6; a guide pin b^{16} carried by a flange b^{17} on the upper head b^{18} of the member b^4, said guide pin extending through a perforation b^{19} with which the member b^{13} of the lever b^{11} is provided; a spring b^{20} encircling the guide pin b^{16} and adapted to hold the lever b^{11} in the position shown in Fig. 1; a spring b^{21} carried by the upper portion of the lever b^{11} and bearing upon the member b^{14}, said spring serving to maintain the member b^{14} in the path of the piston, as illustrated in Fig. 1; a cylinder b^{22} encircling the member b^4 and having screw connection at its lower end with the lower portion of the member b^4; and a binding post b^{23} connected with the upper end b^{18} of the member b^4.

The tubular plug b has a threaded portion extending through the engine-cylinder, the lower portion of which is equipped with an electrode b^{24}, which co-acts with the lower end of lever-form electrode b^{11}. The insulating material b^{25} is employed to insulate the plug b from the remainder of the device.

The plug b is provided adjacent to the engine-cylinder with wrench receiving means, as indicated. The member b^4 comprises upper and lower disks connected by the cylinder b^5, the cylinder being formed integrally with the disks at one edge of the latter, as illustrated. The ball and socket connection for the lever-form electrode b^{11} preferably is provided by providing a socket in the lower portion of the member b^4, said socket having a removable section b^{26}, and by providing the lever with a ball contained in said socket. The lever is shown formed in two sections, a lower or inner section b^{27} and an upper or outer section b^{28}. The member b^{13} is rigidly connected with the outer portion b^{28} of the lever b^{11}. Said member b^{13} is provided with a channel b^{29}, which receives the movable actuating arm b^{14}. The member b^{14} has a finger b^{30}, which extends through a slot b^{31} in the upper portion of the cylinder b^5 and into the path of the piston b^6. The piston is provided with a head b^{32}, having a sloping surface b^{33} which serves to actuate the lever b^{11} through the medium of the member b^{14}, when the piston moves upwardly; and beneath the head b^{32} is an annular channel b^{34}, which permits the member b^{14} and the lever b^{11} which it actuates to return to the normal position after the head b^{32} has passed the finger b^{30} during the upward stroke of the piston. The normal position of the electrode b^{11} is that indicated in Fig. 1, where said electrode is shown out of contact with the electrode b^{24}. It will be understood, therefore, that when the piston moves upwardly it moves the upper end of the lever b^{11} to the right from the position shown in Fig. 1, the upper end of the lever being guided by the pin b^{16}; and as soon as the head b^{32} of the piston passes above the finger b^{30}, the lever is permitted to return to its original position, breaking the contact with the electrode b^{24} formed during the upward stroke of the piston. After the pressure on the lower end of the piston b^6 is released, the spring b^{19} returns the piston to its normal position at the inner end of the stroke, the arm b^{14} yielding to enable the piston head to pass the finger b^{30}.

In the modification shown in Figs. 5^a and 5^b, b^{35} represents a part corresponding with the part b^4; and b^{36} represents a vibrating electrode corresponding with the electrode b^{11}. In this modification, the lever-form electrode b^{36} is provided with a trunnion b^{37} of cylindrical form which is received by a similarly shaped bearing formed in member b^{35} and having a removable section b^{38} set into a recess on the lower side of the member b^{35}. The bearing is formed half in the member b^{35} and half in the member b^{38}, so that a gas-tight joint is provided. While a gas-tight connection may be made in this manner, still, for reasons which will be readily understood, the ball-joint shown in Figs. 1 and 2 is preferred.

In the construction shown in Fig. 6, the device C comprises a tubular plug c having threaded connection with the engine-cylinder and equipped at its outer end with a flange c^1; a member c^2 formed with a cylinder c^3; a nut c^4 connecting the member c with the member c^2; a piston c^5 having at its upper portion an annular recess c^6, forming inclined surfaces c^7, c^8; a spring c^9 serving to return the piston to its normal position at the inner end of its stroke; a tension-adjusting screw c^{10} connected with a cap c^{11} of the cylinder c^3; a vibratory electrode c^{12} having ball-joint connection c^{13} with the base of the member c^2; a spring c^{14}, tending to throw the inner end of the electrode c^{12} into contact with an electrode c^{15}, with which the member c is equipped; and a cam c^{16} with which the upper end of the lever c^{12} is equipped. The member c^2 is provided with a port c^{17}, connecting the interior of the tubular plug c with the interior of the cylinder c^3. A removable cylinder c^{18} incloses the member c^2, the cylinder c^3 forming a part thereof, and the upper end of the lever c^{12} and its spring. It will be seen that when the piston moves outwardly under the gas-pressure, the cam c^{16} will enter the recess c^6, allowing the spring c^{14} to actuate the lever c^{12} and close the circuit at the electrodes. Further movement of the piston in the outward direction will cause the electrodes to separate, producing a spark at the proper moment to ignite the compressed charge in the cylinder. After the pressure within the engine-cylinder is relieved, the piston c^5 returns under the action of its spring, again making and breaking the circuit. Inasmuch as a spark is produced during the return movement of the piston, it is evident that this construction has a feature of disadvantage not present in the construction shown in Figs. 1 and 2, viz., that the spark produced during the return movement of the piston c^5 is wasted.

In the construction shown in Fig. 7, the device D comprises a tubular plug d having threaded connection with the engine-cylinder and equipped at its outer end with a flange d^1; a member d^2 having formed integrally therewith a cylinder d^3; a nut d^4 connecting the member d^2 to the member d; a piston d^5, having at its outer portion an annular recess d^6 above which is a reduced section d^7 surmounted by a flange d^8; a piston-spring d^9, whose tension is adjusted by a screw d^{10}, extending through a cylinder cap d^{11}; a vibrating electrode d^{12} having ball-joint connection d^{13} with the base-portion of the member d^2 adjacent to the base of the cylinder d^3; a cam d^{14} connected with the upper

end of the lever-form electrode; a stirrup or catch d^{15} supported by the lever-form electrode adjacent to the cam d^{14}; a pawl d^{16} supported on a pivot d^{17} and equipped with a tooth d^{18} adapted to engage the shoulder d^{19} of the stirrup d^{15}; a spring d^{20} serving to force the upper end of the electrode d^{12} against the piston; and a removable cylinder d^{21} inclosing the various parts which project above the base of the member d^2. The lever d^{12} normally occupies the position shown in Fig. 7, with its lower end separated from the stationary electrode d^{22}. The recess d^6 of the piston affords at its lower side a sloping surface d^{23} upon which the cam d^{14} rides during the upward movement of the piston. The cylinder d^2 connects with the interior of the tubular plug d through a passage d^{24}. When the piston moves outwardly, under pressure of the compressed gas in the engine-cylinder, the cam d^{14} enters the recess d^6 so that the electric circuit is closed at the electrodes. Further outward movement of the piston causes the upper end of the lever d^{12} to be moved to the position shown in Fig. 10, whereupon the catch d^{16} of the pawl d^{16} engages the shoulder d^{19} of the stirrup d^{15}, whereby the lever is locked in position until the projecting end of the pawl d^{16} is encountered by the flange d^8 of the piston during the inward movement of the piston. This action occurs when the piston reaches approximately the position shown in Fig. 7, allowing the lever d^{12} to return to the position shown in Fig. 7. As shown, the pawl d^{16} is provided with a short arm d^{25}, which engages a shoulder d^{26} on the member d^2, and the main arm of the pawl is flexible to a certain degree and of sufficient resilience to serve as a spring, so that the pawl will rise under its own resilience to the position shown in Fig. 10, when relieved of the pressure of the flange d^8, owing to the outward travel of the piston. The details of construction of the ball-joints shown in Figs. 6 and 7 are similar to those of the ball-joint shown in Figs. 1 and 2 and need not be further described.

In the construction shown in Fig. 11, the device E comprises a tubular plug e having threaded connection with the engine-cylinder and equipped at its outer end with a flange e^1; a member e^2 having formed integrally therewith a cylinder e^3; a nut e^4, joining the base of the member e^2 to the flange e^1; a piston e^5 provided at its outer portion with an annular recess e^6 above which is a flange e^7; a piston-spring e^8 whose tension is adjusted by a screw e^9, extending through the cap e^{10} of the cylinder e^3; a vibrating electrode e^{11} having ball and socket connections e^{12} with the base of the member e^2; a spring e^{13} connected with the outer portion of the member e^{11} and having a bearing on a stirrup e^{14}, carried by the cylinder e^3, said stirrup receiving the upper portion of the member e^{11} and said spring tending normally to hold the vibrating electrode out of contact with the stationary electrode e^{15}, with which the tubular plug e is provided; a bell-crank lever e^{16} supported on a stationary pivot e^{17} carried by the member e^2, and having an arm e^{18} projecting into the path of the piston, and an arm e^{19} bearing upon the upper end of the electrode e^{11}; a spring e^{20} holding the bell-crank lever e^{16} normally in the position shown in Fig. 11; and a cylinder e^{21} inclosing the parts above the base of the member e^2. The ball-joint construction is similar to the construction shown in Fig. 1. The cylinder e^3 communicates through a passage e^{22} with the interior of the tubular plug e. It will now be understood that when the piston e^5 moves outwardly, owing to the pressure of the compressed gas in the engine-cylinder, the flange e^7, through the medium of the bell-crank lever e^{16}, actuates the vibratory electrode, moving the latter against the pressure of its spring and closing the electric circuit. When the piston moves outwardly far enough so that the flange e^7 passes the arm e^{18} of the bell-crank lever, the pressure is relieved, permitting the vibratory lever under the action of its spring, to resume the position shown in Fig. 11, thereby interrupting the current and producing a spark.

In each construction, a battery F is joined by a conductor f to the outer portion of the sparking-device and to the engine-cylinder with which the inner tubular plug is electrically connected. The circuit closes, of course, when the electrodes are brought into contact. Preferably, the electrodes are normally separated, are closed by the piston of the sparking-device, and are again separated by spring-action. This is true of all the constructions illustrated except the constructions shown in Figs. 6 and 7, where the piston in its movement separates the electrodes, and the action of the spring closes them, when the position of the piston permits.

What I regard as new and desire to secure by Letters Patent, is:

1. An ignition device, for the purpose set forth, comprising a cylinder adapted to communicate with the engine-cylinder, a spring-held gas-actuated piston movable therein, a vibratory electrode extending above the base of and outside of said cylinder, a gas-tight bearing for said electrode, and means connected with the piston and with the outer end-portion of the vibratory electrode for actuating the vibratory electrode.

2. An ignition device, for the purpose set forth, comprising a tubular plug constituting an electrode adapted for connection with an engine-cylinder, a member carried thereby

and equipped with a cylinder communicating with the interior of said tubular plug, a vibratory electrode extending through the base of said member adjacent to said cylinder, a gas-tight joint between said electrode and the base of said member, a piston movable in said cylinder, and means carried by said piston for actuating said electrode.

3. An ignition device comprising a member adapted for connection with an engine-cylinder, a member having a base-portion insulatingly connected with said first-named member and equipped at one side with a cylinder rising therefrom, said cylinder communicating, through said first-named member, with the engine-cylinder, a vibratory electrode extending through the base of said second-named member adjacent to the cylinder carried thereby, a bearing formed in the base-portion of said second-named member and having a removable section, said vibratory electrode having an enlargement in said bearing, a spring-held piston movable in the cylinder of the device, and means actuated by said piston for moving the vibratory electrode.

4. An ignition device comprising a tubular plug adapted for connection with an engine-cylinder, a cylinder and a chamber at the side thereof insulatingly mounted on the tubular plug, said cylinder adapted to communicate with the engine-cylinder, a spring-held piston movable in said cylinder, a vibratory electrode extending from the interior of the tubular plug into said chamber, a gas-tight bearing for said electrode between said chamber and the interior of said tubular plug, and means located at the outer end of the piston and the outer end of the vibratory electrode for moving said electrode.

5. An ignition device comprising a tubular plug adapted for connection with an engine-cylinder, a cylinder and a chamber at the side thereof mounted on said tubular plug, said cylinder adapted to communicate with the engine-cylinder, a spring-held gas-actuated piston movable in said cylinder, a vibratory electrode pivoted adjacent to the base of said cylinder and having its inner end extending into the tubular plug and its outer end extending into said chamber, a stationary electrode at the inner end of the tubular plug, yielding means for holding the vibratory electrode normally out of contact with the stationary electrode, and piston actuated-means serving to move the vibratory electrode to the closed position and then release the same to permit its return to its normally open position, for the purpose set forth.

6. An ignition device comprising a tubular plug adapted for connection with an engine-cylinder, a member insulatingly mounted thereon and equipped at one side with a cylinder adapted to communicate with the engine-cylinder, a vibratory electrode extending through the base-portion of said member adjacent to said cylinder, a ball and socket joint between the vibratory electrode and the base-portion of said member, including a removable section set into the base-portion of said member, means for housing the outer portion of the vibratory electrode, and means near the outer end of the piston for moving the vibratory electrode.

7. An ignition device comprising a tubular plug adapted for connection with an engine-cylinder, a cylinder and an adjacent chamber insulatingly mounted on said tubular plug, said cylinder adapted to communicate with the engine-cylinder, a vibratory electrode journaled adjacent to the base of said cylinder and extending into said chamber, a pivoted member adjacent to the outer end portion of said cylinder, serving to actuate said vibratory electrode in one direction, and a spring-held piston within said cylinder equipped at its outer end portion with means for actuating said last-named pivoted member.

8. An ignition device comprising a tubular plug adapted for connection with an engine-cylinder, a member insulatingly mounted thereon equipped with a cylinder projecting from one side of the base-portion thereof, said cylinder adapted to communicate with the engine-cylinder, a vibratory electrode journaled in the base-portion of said member, a spring yieldingly holding said vibratory electrode in the open position, a bell-crank lever serving to actuate said electrode and having an arm projecting into the path of said cylinder, a spring serving to maintain said bell-crank lever in the operative position, and a spring-held piston within said cylinder provided at its outer end with a flange adapted to actuate said bell-crank lever, said last-named spring yielding to permit idle movement of the bell-crank lever during the return stroke of the piston.

9. An ignition device comprising a tubular plug adapted for connection with an engine-cylinder, a member insulatingly mounted thereon comprising a disk-form base-portion and a disk-form top-portion with a cylinder connecting said base and top-portion at one side thereof, said cylinder adapted to communicate with the engine-cylinder, a vibratory electrode journaled in the base-portion of said member, means projecting normally through the upper portion of said cylinder and serving to actuate the vibratory electrode, a spring-held piston equipped at its outer end portion with means for actuating said last-named means, and a cylinder in-

closing the member carried by said tubular plug, for the purpose set forth.

10. An ignition device, comprising a cylinder adapted to communicate with an engine-cylinder, a gas-actuated piston, a vibratory electrode having a part presented to the charge in the engine-cylinder, and a pivotal bearing for said vibratory electrode, affording a gas-tight joint thereat.

11. An ignition device, comprising a cylinder adapted to communicate with an engine-cylinder, a gas-actuated piston, a vibratory electrode, having a part presented to the charge in the engine-cylinder, and a ball-and-socket bearing for said vibratory electrode having a removable section, for the purpose set forth.

HARRY A. MILLER.
BENJAMIN G. GILBOUGH.

Witnesses as to Harry A. Miller:
L. HEISLAR,
M. S. MACKENZIE.

Witnesses as to Benjamin G. Gilbough:
A. U. THORIEN,
J. H. LANDES.