

thereby, a pump operated by said solenoid, means for supplying a fuel to said pump, and means for simultaneously actuating said spark plug and solenoid.

5 4. A self-starter for explosive engines, comprising a spark plug, a solenoid forming part thereof, a fuel supply pump operated by the solenoid, and means for conducting the fuel from said pump toward the
10 spark gap of said spark plug.

5. A self-starter for explosive engines, comprising a spark plug having a fuel duct, a solenoid secured to said plug and having a bore that communicates with said duct,
15 and a piston reciprocable in said bore and operated by the solenoid.

6. A self-starter for explosive engines, comprising a spark plug having a fuel duct, a pump carried by said plug and adapted to feed the fuel through said duct, and a baffle
20 blade on the spark plug for directing the fuel discharged from said duct toward the spark gap of said plug.

7. A self-starter for explosive engines, comprising a spark plug having a fuel duct, a pump carried by said plug and adapted to feed the fuel through the duct, a rotary
25 shaft, and means controlled by said shaft for simultaneously operating the spark plug and pump.

8. A self-starter for explosive engines, comprising a spark plug having a socketed stud and a duct communicating with the stud-socket, a perforated nipple fitted in
35 said socket, a solenoid secured to the nipple, and a pump piston operated by said solenoid.

9. A self-starter for explosive engines, comprising a spark plug having a socketed stud and a duct communicating with the stud-socket, a perforated nipple fitted in
40 said socket, a solenoid having a central bore and secured to the nipple, a spring-influenced piston reciprocable within said bore and operated by said solenoid, and a fuel
45 supply duct opening into said bore.

10. A self-starter for explosive engines, comprising a spark plug having a socketed stud and a duct communicating with the stud-socket, a perforated nipple fitted into
50 said socket and having a seat, a spring-influenced valve adapted to engage said seat, a solenoid secured to the nipple and having a bore, a spring-influenced piston reciprocable in said bore and operated by said
55 solenoid, and a fuel supply duct opening into said bore.

11. A self-starter for explosive engines, comprising a spark plug having a socketed stud and a duct communicating with the stud-socket, a perforated nipple fitted into
60 said socket and having a seat, a spring-influenced valve adapted to engage said seat, a solenoid secured to the nipple and having a bore, a spring-influenced headed piston reciprocable in said bore and operated by
35

said solenoid, means for checking the stroke of said piston, a duct communicating with said bore, and a fuel reservoir communicating with said duct.

12. A self-starter for explosive engines 70 having a plurality of cylinders, a plurality of spark plugs, a plurality of fuel supply pumps, one pump being provided for each spark plug, a timing shaft, and means controlled by said shaft for consecutively actuating the cooperating spark plugs and
75 pumps of the several cylinders, the spark plug and pump of each cylinder being simultaneously actuated.

13. A self-starter for explosive engines 80 having a plurality of cylinders, a spark plug and a fuel supply device for each cylinder, a timing shaft, a first set of substantially quadrantal contacts on said shaft for controlling the spark plugs, and a second set of
85 substantially quadrantal contacts for controlling the fuel supply devices.

14. A self-starter for explosive engines having a plurality of cylinders, a spark plug and a fuel supply device for each cylinder, a
90 timing shaft, and a plurality of substantially quadrantal contacts on said shaft for controlling the spark plugs and fuel supply devices.

15. A self-starter for explosive engines 95 having a plurality of cylinders, a spark plug and a fuel supply device for each cylinder, a timing shaft, a first set of comparatively short contacts on said shaft for controlling the spark plugs during the normal run of
100 the engine, and a second set of comparatively long contacts likewise on said shaft for controlling the spark plugs during starting.

16. A self-starter for explosive engines 105 having a plurality of cylinders, a spark plug and a fuel supply device for each cylinder, a timing shaft, a first set of comparatively short contacts on said shaft for controlling the spark plugs during the normal run of
110 the engine, a second set of comparatively long contacts likewise on said shaft for controlling the spark plugs during starting, and a third set of comparatively long contacts also on the shaft for controlling the
115 fuel supply devices.

17. A self-starter for explosive engines, comprising a spark plug, an electromagnetic device, a piston operated thereby, a chamber in which said piston is adapted to re-
120 ciprocate, means for supplying a fuel to said chamber, a rotary shaft, and contacts on said shaft for operating the spark plug and energizing the electromagnetic device.

18. A self-starter for explosive engines, 125 comprising a spark plug, an electromagnetic device, a fuel supply pump operated thereby, a rotary shaft, and contacts on said shaft for operating the spark plug and energizing the electromagnetic device. 130

UNITED STATES PATENT OFFICE.

BENJAMIN F. HUTCHES, JR., OF ALLENDALE, NEW JERSEY.

SELF-STARTER FOR EXPLOSIVE-ENGINES.

1,134,537.

Specification of Letters Patent.

Patented Apr. 6, 1915.

Application filed February 4, 1914. Serial No. 816,439.

To all whom it may concern:

Be it known that I, BENJAMIN F. HUTCHES, JR., a citizen of the United States, and residing at Allendale, county of Bergen, and State of New Jersey, have invented certain new and useful Improvements in Self-Starters for Explosive-Engines, of which the following is a specification.

This invention relates to a self-starting device for explosive engines, more particularly adapted for engines used in driving automobiles, motor boats, flying machines, etc. By my invention the objectionable cranking of the machine is obviated and the employment of electric and other starting motors is dispensed with, so that the fitting of the self-starter to the engine is greatly simplified. Briefly stated my device comprises novel means controlled by the timer shaft for automatically supplying to that engine cylinder, the piston of which occupies the power stroke position, an auxiliary charge of fuel, and for simultaneously forming a spark to ignite said charge.

The invention also comprises other novel features as brought out in the appended specification and claims.

In the accompanying drawing: Figure 1 is an axial section through a spark plug embodying my invention, Fig. 2 a plan thereof with the fuel reservoir omitted, Fig. 3 a wiring diagram, and Fig. 4 a cross section of the timing shaft on line 4—4, Fig. 3.

My novel self-starter is composed essentially of a spark-plug A and of an automatic fuel supply device B. The spark plug A comprises a metallic cup 10 tapped at a convenient place into the cylinder 11 of the explosive engine in the usual manner, and is provided with the ground electrode 12. The other electrode 13 is inclosed within an insulating stem 14 that is fitted into cup 10 and is firmly clamped in position by a threaded bushing 15. Cup 10 is provided with a lateral extension or stud 16 having a threaded socket into which is tapped a nipple 17. The latter is furnished with a contracted duct 18, an outer coniform seat 19 and an inner coniform seat 20 that opens into an enlarged bore 21. Seat 20 is normally engaged by a coniform valve 22, that is influenced by a spring 23. Bore 21 communicates with an angular duct 24 of cup 10, said duct opening into the engine cylinder in proximity to a baffle plate 25 carried by said cup, and directing the fuel which is

discharged through duct 24 in manner hereinafter described, toward the spark gap 26. To nipple 17 is firmly secured a solenoid 27 the windings of which are inclosed with an iron casing 28. Within the bore 29 of solenoid 27 is reciprocally mounted a cylindrical pump piston or armature 30 made of magnetizable material and provided with an outer disk or head 31 the outward play of which is checked by a suitable stop 32. Between seat 19 and the coniform end 33 of piston 30 is interposed a spring 34 that tends to move the piston into its outermost position. Directly back of piston 30 when in said outermost position (Fig. 1), there opens into bore 29 a fuel supply duct 35 that receives its charge from a suitable reservoir 36.

Normally the space between nipple 17 and piston 30 is filled with liquid fuel, an accidental discharge thereof into the engine cylinder being prevented by valve 22. Whenever solenoid 27 is energized, piston 30 is moved toward nipple 17 thereby overcoming the tension of spring 23 and discharging the fuel contents of bore 21 through duct 24 into the engine cylinder, the baffle plate 25 directing the jet of fuel emanating from said duct toward spark gap 26.

The above described device may be applied to the engine cylinders in various manners, Fig. 3 showing each cylinder provided with such a device in lieu of the common spark plugs hitherto generally used, but it is to be expressly understood that my invention is not restricted to said particular showing.

It may here be stated that the usual contacts of the timer are but relatively short, and are placed in a certain position relatively to the position of the cooperating crank of the engine shaft, so as to produce the spark at the proper moment when ignition should take place. With my improved self-starting device, a charge of the cylinder with the combustible fuel and an ignition of such charge should be effected in any position of the piston while on its power stroke. For this reason the timing shaft is provided with an additional set of comparatively long timing contacts that are placed in circuit with the spark plugs, whenever the self-starting device is to be used. For energizing the solenoids 27 at the proper time, a third set of contacts is provided on the timing shaft, as hereinafter more fully described.

In Fig. 3, the numeral 37 indicates a timing shaft which is made of insulating material and is driven from the engine shaft (not shown) in the usual manner. The insulated electrode 13 of the spark plug of each engine cylinder I, II, III, IV, is connected to the respective normally used contacts I¹, II¹, III¹, IV¹ of the timer shaft 37 by wires 38¹, 38², 38³, 38⁴ and coöperating contact members. All of the contacts I¹, II¹, III¹, IV¹ are connected to a common conductor 39, the exposed end of which is engaged by a contact 40. The latter is, by wire 41, connected to a magneto 42 which is in turn by wires 43, 44 connected to the engine frame, a switch 45 being interpolated in wire 43. Wire 41 is, by branch 46 connected to the contact 47 of a switch 48 that is, by wire 49, connected to the secondary winding 50 of an induction coil 51, said secondary winding being in turn, by wire 52 connected to wire 44. The primary winding 53 of coil 51 is, by wire 54, connected to wire 52 and, by wire 55, to a battery 56. The latter is in turn, by wire 57, connected to a pair of twin switch levers 58, 59 that are adapted to either engage contacts 60, 61 or contacts 61, 62, the latter being a dead contact.

The second contact 63 of switch 48 is, by wire 64, connected to a contact 65 that engages a slip ring 66 mounted on shaft 37. Slip ring 66 is, by conductor 67 connected to four contacts I'', II'', III'', IV'', which are of substantially quadrantal shape as illustrated in Figs. 3 and 4. These contacts are adapted to engage suitable contact members of wires 68¹, 68², 68³, 68⁴ that are relatively connected to wires 38¹, 38², 38³, 38⁴.

Contact 60 is, by wire 69 and a contact member 69^a connected to a slip ring 70 of shaft 37 that is, by conductor 71 connected to contacts I''', II''', III''', IV''' corresponding in all respects to contacts I'', II'', III'', IV''. The former contacts are adapted to be engaged by corresponding contact members of wires 72¹, 72², 72³, 72⁴, each wire leading to one end of the winding of the corresponding solenoid 27, the other end of which is grounded.

If my self-starter is to be put into operation, the various switches are so set as to occupy the position shown in Fig. 3, in which case conductor 39 is cut off magneto 42 and induction coil 51, so that contacts I', II', III', IV' are rendered inoperative. If now contact I'' happens to be in conductive connection with its wire 68¹, a sparking circuit is established which is induced by a primary circuit the current of which flows from battery 56 through wire 57, switch lever 59, contact 61, wires 73, 52, 54, primary winding 53 and wire 55 back to battery 56. In this way, a current is induced in winding 50 that flows through wire 49, switch lever 48, contact 63, wire 64, contact 65, slip ring

66, conductor 67, contact I'', wires 68¹, 38¹ electrode 13 of the spark gap pertaining to cylinder I, spark gap 26, grounded electrode 12, and wires 44, 52 back to winding 50. While in this way a spark is produced in cylinder I, a quantity of fuel is simultaneously introduced into said cylinder in the following manner:

As contacts I'' and I''' are similarly disposed, contact I''' is now in conductive connection with wire 72¹, whereby a circuit is established the current of which flows from battery 56 through wire 57, switch lever 58, contact 60, wire 69, slip ring 70, conductor 71, contact I''', wire 72¹, solenoid 27 of cylinder I, wires 44, 52, 54, winding 53 and wire 55 back to battery 56. In this way, solenoid 27 of cylinder I becomes energized to attract its armature 30 and thus eject the fuel entrapped between nipple 17 and said armature, through duct 24 into the engine cylinder. As simultaneously with this fuel discharge, a spark is formed in the manner above described, ignition will take place so that the engine is started, the succeeding similar ignitions in the other cylinders keeping the engine in motion. After the engine has thus been properly started, switches 48 and 58, 59 are thrown to the left (Fig. 3) thereby interrupting the current supply to slip rings 66, 70. At the same time, the regular sparking circuit is established, the current being supplied from secondary winding 50 and normal contacts I', II', III', IV' to the spark plugs, the primary winding 53 being supplied with current from battery 56 through wire 57, switch lever 58, contact 61, wires 73, 52, 54 and wire 55. In case of a break down of battery 56, magneto 42 may be used by closing switch 45 and opening switches 48 and 58, 59.

It will be seen that by my invention novel and effective means are provided for starting a combustible engine without having to resort to a cranking or other objectionable operation of the engine shaft.

I claim:

1. A self-starter for explosive engines, comprising a spark plug, a solenoid, a piston operated thereby, means for supplying a fuel to said piston, a rotary shaft, and starting contacts on said shaft for operating the spark plug and energizing the solenoid.

2. A self-starter for explosive engines, comprising a spark plug, a solenoid, a piston operated thereby, means for supplying a fuel to said piston, a rotary shaft, starting contacts on said shaft for operating the spark plug, and for energizing the solenoid, thereby actuating the piston, and means for conducting the fuel discharge by the piston toward the spark gap of said plug.

3. A self-starter for explosive engines, comprising a spark plug, a solenoid carried

thereby, a pump operated by said solenoid, means for supplying a fuel to said pump, and means for simultaneously actuating said spark plug and solenoid.

5 4. A self-starter for explosive engines, comprising a spark plug, a solenoid forming part thereof, a fuel supply pump operated by the solenoid, and means for conducting the fuel from said pump toward the
10 spark gap of said spark plug.

5. A self-starter for explosive engines, comprising a spark plug having a fuel duct, a solenoid secured to said plug and having a bore that communicates with said duct,
15 and a piston reciprocable in said bore and operated by the solenoid.

6. A self-starter for explosive engines, comprising a spark plug having a fuel duct, a pump carried by said plug and adapted to
20 feed the fuel through said duct, and a baffle blade on the spark plug for directing the fuel discharged from said duct toward the spark gap of said plug.

7. A self-starter for explosive engines, comprising a spark plug having a fuel duct,
25 a pump carried by said plug and adapted to feed the fuel through the duct, a rotary shaft, and means controlled by said shaft for simultaneously operating the spark plug
30 and pump.

8. A self-starter for explosive engines, comprising a spark plug having a socketed stud and a duct communicating with the
stud-socket, a perforated nipple fitted in
35 said socket, a solenoid secured to the nipple, and a pump piston operated by said solenoid.

9. A self-starter for explosive engines, comprising a spark plug having a socketed stud and a duct communicating with the
40 stud-socket, a perforated nipple fitted in said socket, a solenoid having a central bore and secured to the nipple, a spring-influenced piston reciprocable within said bore and operated by said solenoid, and a fuel
45 supply duct opening into said bore.

10. A self-starter for explosive engines, comprising a spark plug having a socketed stud and a duct communicating with the
stud-socket, a perforated nipple fitted into
50 said socket and having a seat, a spring-influenced valve adapted to engage said seat, a solenoid secured to the nipple and having a bore, a spring-influenced piston reciprocable in said bore and operated by said
55 solenoid, and a fuel supply duct opening into said bore.

11. A self-starter for explosive engines, comprising a spark plug having a socketed stud and a duct communicating with the
stud-socket, a perforated nipple fitted into
60 said socket and having a seat, a spring-influenced valve adapted to engage said seat, a solenoid secured to the nipple and having a bore, a spring-influenced headed piston
35 reciprocable in said bore and operated by

said solenoid, means for checking the stroke of said piston, a duct communicating with said bore, and a fuel reservoir communicating with said duct.

12. A self-starter for explosive engines 70 having a plurality of cylinders, a plurality of spark plugs, a plurality of fuel supply pumps, one pump being provided for each spark plug, a timing shaft, and means controlled by said shaft for consecutively actu- 75 ating the coöperating spark plugs and pumps of the several cylinders, the spark plug and pump of each cylinder being simultaneously actuated.

13. A self-starter for explosive engines 80 having a plurality of cylinders, a spark plug and a fuel supply device for each cylinder, a timing shaft, a first set of substantially quadrantal contacts on said shaft for controlling the spark plugs, and a second set of 85 substantially quadrantal contacts for controlling the fuel supply devices.

14. A self-starter for explosive engines having a plurality of cylinders, a spark plug and a fuel supply device for each cylinder, a 90 timing shaft, and a plurality of substantially quadrantal contacts on said shaft for controlling the spark plugs and fuel supply devices.

15. A self-starter for explosive engines 95 having a plurality of cylinders, a spark plug and a fuel supply device for each cylinder, a timing shaft, a first set of comparatively short contacts on said shaft for controlling the spark plugs during the normal run of 100 the engine, and a second set of comparatively long contacts likewise on said shaft for controlling the spark plugs during starting.

16. A self-starter for explosive engines 105 having a plurality of cylinders, a spark plug and a fuel supply device for each cylinder, a timing shaft, a first set of comparatively short contacts on said shaft for controlling the spark plugs during the normal run of 110 the engine, a second set of comparatively long contacts likewise on said shaft for controlling the spark plugs during starting, and a third set of comparatively long contacts also on the shaft for controlling the 115 fuel supply devices.

17. A self-starter for explosive engines, comprising a spark plug, an electromagnetic device, a piston operated thereby, a chamber in which said piston is adapted to re- 120 ciprocate, means for supplying a fuel to said chamber, a rotary shaft, and contacts on said shaft for operating the spark plug and energizing the electromagnetic device.

18. A self-starter for explosive engines, 125 comprising a spark plug, an electromagnetic device, a fuel supply pump operated thereby, a rotary shaft, and contacts on said shaft for operating the spark plug and energizing the electromagnetic device. 130

19. A self-starter for explosive engines having a plurality of cylinders, a plurality of sets each comprising a spark plug and a fuel supply pump, one of said sets being
5 provided for each cylinder, and means for consecutively actuating said sets.

20. A self-starter for explosive engines having a plurality of cylinders, a plurality of spark plugs and fuel supply pumps, one
10 of said spark plugs and pumps being pro-

vided for each cylinder, and means for consecutively actuating the cooperating spark plugs and pumps of the several cylinders, the spark plug and pump of each cylinder being simultaneously actuated.

BENJAMIN F. HUTCHES, JR.

Witnesses:

ARTHUR E. ZUMPE,

FRANK V. BRIESEN.