W. W. DEAN.

STARTING DEVICE FOR INTERNAL COMBUSTION ENGINES.

APPLICATION FILED NOV. 15, 1912.

1,219,630.

Patented Mar. 20, 1917.

Fig 1

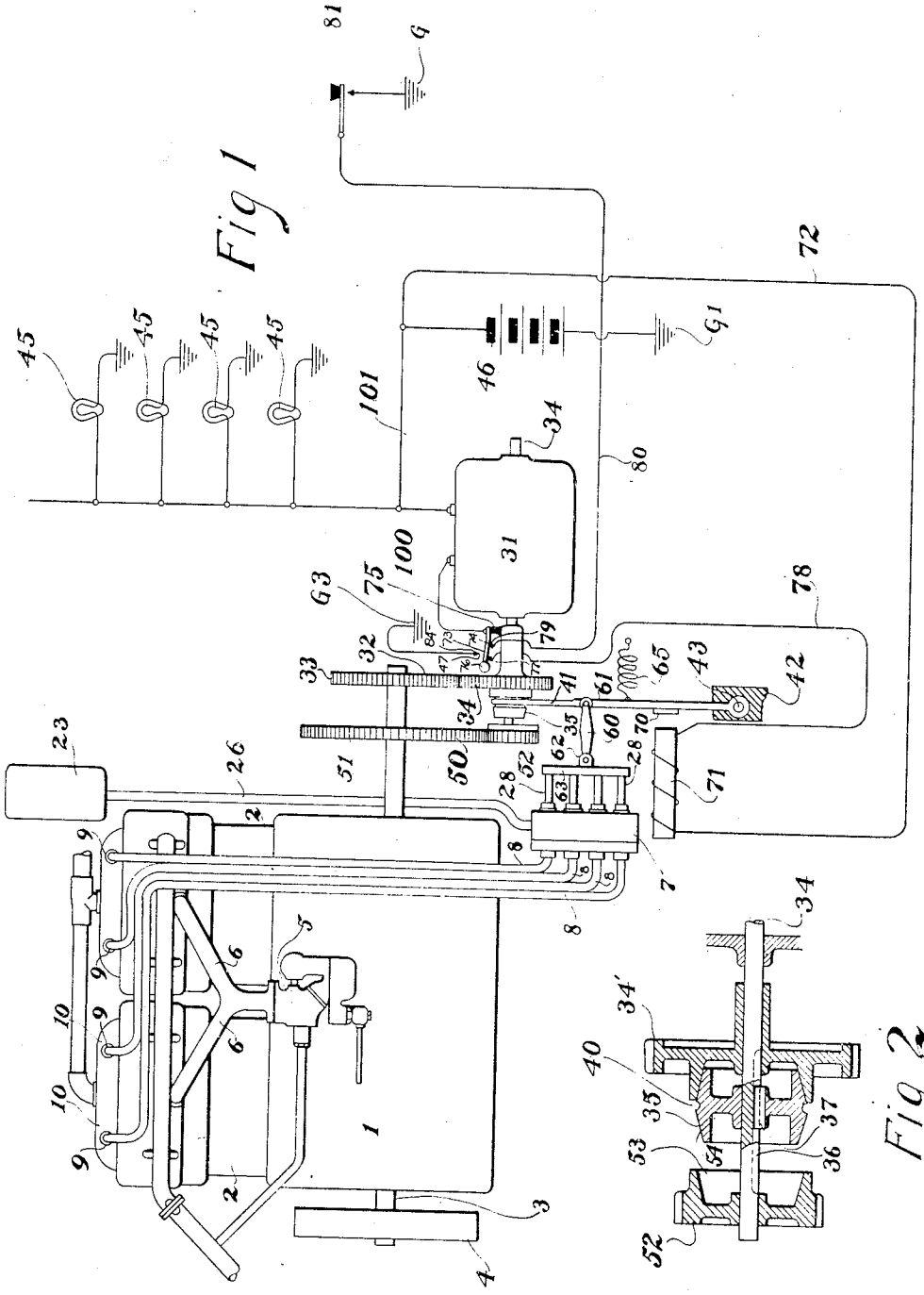

Fig 2

Witnesses

Meta Schmittberger

T. M. Slough

Inventor

William W. Dean

By F. O. Richey

His Attorney

UNITED STATES PATENT OFFICE.

WILLIAM W. DEAN, OF CHICAGO, ILLINOIS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE GARFORD MANUFACTURING COMPANY, OF ELYRIA, OHIO, A CORPORATION OF OHIO.

STARTING DEVICE FOR INTERNAL-COMBUSTION ENGINES.

1,219,630. Specification of Letters Patent. Patented Mar. 20, 1917.

Original application filed May 10, 1911, Serial No. 626,258. Divided and this application filed November 15, 1912. Serial No. 731,482.

To all whom it may concern:

Be it known that I, WILLIAM W. DEAN, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Starting Devices for Internal-Combustion Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to starting devices for internal combustion engines, my main object being the elimination of the so-called cranking in vogue now, and which constitutes the manual starting of the engine by rotating the shaft or other normally driven member capable of communicating motion to the essential parts of the machine. The practice is well known in connection with automobile engines, as such machines are commonly provided with a crank in the front part of the machine for this purpose. This operation starts the performance of the various functions of the different parts of the engine and once started, these parts continue the performance with the result that the engine continues to operate without further cranking until it has been allowed to run down.

The engine may be started by what is known as "spinning" the engine shaft by means of an electric motor or other suitable driving device, thus substituting the motor for the manual operation. This offers considerable difficulties and does not guarantee success under all conditions.

One of the objects of my invention is to provide means for relieving the motor or other driving device employed from certain duties in starting, which would otherwise be imposed upon it under the conditions named in order to insure success at each starting. Every prime mover must overcome a certain amount of running load which is due to friction of its parts, etc., and in an explosion engine, includes drawing the charge into the sparking apparatus, overcoming pressure in the cylinders, etc., all of which must be overcome when the engine is running free from any external load. This I call for convenience the internal or running load. It is, as will be plainly seen, desirable to relieve the prime mover and the starting device of as much of this load as possible when the prime mover is being started. In order to realize this object, I may substitute for the carbureter or other charge preparing and introducing means, commonly employed upon internal combustion engines, some means for inserting a charge independently of the carbureter.

Another object of my invention is to simplify the starting of the prime mover by centralizing the control over the various units employed in that act. How this is done in the particular form illustrated will appear from the particular description.

Inasmuch as electric machines, which I shall here call for the sake of convenience, motors, are commonly employed in connection with internal combustion engines, and which are driven by those engines and when so driven operate as dynamos to charge storage batteries or perform other functions, I may utilize this kind of a device for starting a driven element of the engine so as to set the parts in motion when the charge is introduced to the cylinders. I have found it better to change the ratio between the connecting means through which the engine and the motor may drive one another when I start the connecting means, as the motor is then better enabled to move the driven part of the engine from rest.

Other objects of my invention and the invention itself will be best understood by referring to the following description when taken in connection with the accompanying illustration showing one specific embodiment of my invention, while the scope of the invention will be more particularly pointed out in the appended claims.

This application is a division of my application #626,258, filed May 10th, 1911.

Figure 1 is a diagrammatic representation of the apparatus and the circuits of my invention.

Fig. 2 is a cross section through the connecting means connecting the engine and the motor.

Referring now to the drawings and to the embodiment of my invention shown therein, I show at 1 a prime mover, such as an internal combustion engine, such, for example, as is employed to drive automobiles, motor boats, etc. The cylinders of this engine are

shown at 2. The shaft which constitutes one of the normally driven members, is shown at 3, while a balance wheel is shown upon this shaft at 4. The general construction and operation of this engine is well known and constitutes no part of my invention. I will not describe it, except to say that as is well known, pistons work within the cylinder 2, and in addition to driving the shaft 3, compress the charge and are themselves driven by the explosion, thus constituting in themselves, driven members. At 5 I show the charge preparing means which is commonly used in connection with such engines. This device, which may be a carbureter is used when the engine is working under normal conditions to introduce fuel or an explosive charge into the engine, where it is ignited by an electric spark or other suitable means and exploded. Ducts 6—6 are shown leading from the device 5 into the engine. At 7 I show a special means for introducing a charge into the engine when it is desired to start the same. I prefer to introduce the fuel as such, into the engine by this means, though the charge may be mixed before introduction, if desirable. Ducts 8 lead from the device 7 to ports 9 in the cylinders 2 where they enter the cylinders. Valves 10 are placed in these ducts, preferably in the ports 9. These valves permit the charge introduced by the device 7 to pass into the engine, but will prevent the passage of gas or other substances from the engine back to the ducts 8.

At 31 I show a machine, which I will, for the sake of convenience here show as an electric dynamo, though the same is adapted to be and in fact is used either as a motor or a generator, in one case serving to transform electrical energy into mechanical energy and in the second case transform mechanical energy into electrical energy. This machine is normally driven by the engine 1 through the shaft 3 and motion transmission means 32 here shown as a set of intermeshing gears, one gear wheel 33 being fastened to the engine shaft 3 and a second, 34′, loosely journaled upon a shaft 34 of the motor. Means are employed for fastening the wheel 34′ to the shaft 34, here shown as a friction clutch 35, though any suitable means may be employed for this purpose. The friction clutch is keyed to the shaft by what is known as a sliding key 36, the key being preferably mounted upon the clutch wheel 34′ and a channel corresponding thereto being shown at 37 upon the axle 34. The wheel 35 is channeled at 40 and a forked arm 41 which is pivoted to the frame piece 42 by a pivot 43 fits with its prongs in a channel 40 controlling the movement of the wheel 35 along the shaft 34. When thus driven by the engine, the machine serves as a dynamo to charge the storage battery accumulator 46 or to operate the lamps 45, a circuit being completed through the machine 31 and the switch 47, which is closed after the motor reaches a certain speed. A second motion transmission means for transmitting motion from the motor 31 to the engine is shown at 50 and preferably consists of a set of gears, one wheel 51 being fastened upon the shaft 3 of the engine and a second wheel 52 being loosely mounted upon the dynamo shaft 34. This wheel is provided with a friction surface 53 adapted to engage a friction surface 54 upon the friction wheel 35. When the lever 41 is thrown to a left hand position, shown in Fig. 1, the friction surfaces 53 and 54 will engage coupling up the second motion transmitting means and disconnecting the first set. The ratio between the second motion transmitting means is greater than the ratio between the first set, in the form of transmission means shown in the drawing. This will be understood by explaining that the ratio between the diameter of the wheels 51 and 50 is greater than the ratio between the diameter of the wheels 33 and 34′. The lever 41 is connected to the piston rods 28 by any suitable means, preferably as shown in the drawing by a link 60 which is pivoted at 61 to the lever 41 and at 62 to a member 63 employed in the form of my invention shown to unite the various piston rods 28. A spring 65 normally holds the lever arm and the friction clutch wheel 35 in the position shown in the drawing, coupling up the engine and the motor through the first transmission means, as is also shown in the drawing. An armature 70 is mounted upon the lever 41. The lever 41 is adapted to be actuated through the armature 70 by an electrically controlled device 71 which may be, as shown in the drawing an electromagnet, connected when the motor is at rest through a conductor 72 with the battery 46. At 73 I show an automatic circuit controller, which in the form illustrated consists of a spring 74 mounted at one end upon the shaft 34 of the dynamo and insulated as shown at 75 from said shaft. A ball 76 is mounted upon the free end of the spring. This spring normally engages a contact 77 connected to a conductor 78 with the electromagnet 71 and with a second contact 79 connected through a conductor 80 with a switch 81. The connection with these two contacts is made when the motor is at rest and obtains until the motor reaches a predetermined speed, when owing to a centrifugal force, the ball 76 draws away from the shaft, opening this circuit and later closing a circuit through a contact 84.

My device will be best understood from a description of the operation of the same. In the normal condition, illustrated in Fig. 1, the charge of fuel which it is desired to introduce into the engine to start the same,

will flow from the reservoir 23 through the duct 26, into the cylinders filling the same, and if conditions are suitable, up into the pipes 8. When it is desired to start the engine, the switch 81 is closed completing a circuit through ground at G—81—80—79—74—77—78—71—72—46—to ground at G^1. The magnet 71 is energized, attracting its armature 70, overcoming the tension of the spring 65, forcing in the pistons and introducing a charge of fuel into the cylinder of the engine, as will be clear from the previous description. In the form shown, this acts as an injector though it will be obvious that I may introduce fuel by any suitable method which is within the scope of the appended claims. The shifting of the lever 41 also moves the clutch wheel 35 to the left hand position, uncoupling the gear wheel 34' from the shaft 34 and coupling the gear wheel 52 with said shaft so that the dynamo is now connected with the engine through the second motion transmission means. At the same time that the circuit was completed through the magnet 71, a circuit was completed through the dynamo and the storage battery 46 as follows: ground at G—switch 81—conductor 80—79—74—100—31—101—46 to ground at G^1. The dynamo 31 will be driven by current from the battery 46 and motion from the dynamo shaft will be transmitted through the means 50 to the engine 1, moving parts thereon from rest and causing the explosion of the charge of fuel introduced as described. This will start the engine to operate independently of the device 7, the charge of fuel for the subsequent operations being introduced through the carbureter 5, as usual. As soon as the dynamo 31 has reached a predetermined speed, the circuit controller 74 will interrupt the circuits through the magnet 71 and the motor 31, whereupon the battery 46 will be cut off from the motor and the springs 65 will retract the lever 41, returning the clutch wheel 35 to the position shown in the drawing, uncoupling the second motion transmission means 50 and coupling up the first motion transmission means 32. The circuit controller will further close the switch 47, completing a circuit from G^1 through the battery 46—101—31—100—74—84—to ground at G^3. The electric machine 31 being now driven as a dynamo by the engine, serves to charge the storage battery 46. When the engine is stopped, the parts will return to the positions shown in the drawings.

It will be obvious that I may employ any suitable motion transmission means, any suitable clutch device and any suitable automatic circuit controller in connection with my invention and that the invention may be employed with any form of internal combustion engine. It will also be obvious that numerous and extensive departures from the forms and the details of the apparatus here shown may be made without departing from the spirit of this invention, the same being herein shown solely for the purpose of clearly illustrating one specific embodiment thereof.

I claim:—

1. In combination with an internal combustion engine, a starter comprising a motor, power transmitting mechanism between the engine and motor comprising two members, one of which is movable into and out of engagement with the other, mechanism adapted to be controlled by the operator for establishing driving relation between the motor and engine, and means for rendering said mechanism inoperative when the engine is in operation.

2. In combination with an internal combustion engine, a starter comprising a motor, power transmitting mechanism between the engine and motor comprising two members, one of which is movable into and out of engagement with the other, mechanical mechanism for establishing driving relation between the motor and engine, electrically controlled means governed by the operator for causing the operation of said mechanism and means for rendering said controlling means inoperative when the engine is in operation.

3. In combination with an internal combustion engine, a starter comprising a motor, power transmitting mechanism between the engine and motor comprising two members, one of which is adapted to be brought into and out of operative engagement with the other, a clutch for clutching the motor to the engine, an electromagnet controlling said clutch and a switch under control of the operator controlling said magnet and speed-controlled means for rendering said clutch inoperative when the engine is in operation.

4. In combination with an internal combustion engine, a starter comprising a motor, power transmitting mechanism between the motor and engine comprising two members, one of which is movable into and out of engagement with the other, a starter controlling member, mechanism for placing the movable member of the power transmitting mechanism under the control of the starter controlling member, said last named mechanism including two members adapted to be connected and disconnected, and means for causing the disconnection of said parts when the engine is in operation.

5. In combination with an internal combustion engine, a starter comprising a motor, power transmitting mechanism between the motor and engine comprising two members, one of which is movable into and out of engagement with the other, a starter controlling member, means for placing the movable

member of the power transmitting mechanism under the control of said starter controlled member, said last named means including two parts adapted to be connected and disconnected, and means for causing the disconnection of said parts after the engine begins to operate under its own power.

In testimony whereof, I have affixed my signature in the presence of two witnesses.

WILLIAM W. DEAN.

Witnesses:
ROBERT LEWIS AMES,
MABEL REYNOLDS.