L. W. NELSON.

DYNAMO ELECTRIC MACHINE.

APPLICATION FILED MAY 16, 1910.

1,027,273.

Patented May 21, 1912.

3 SHEETS—SHEET 1.

Fig. 4.

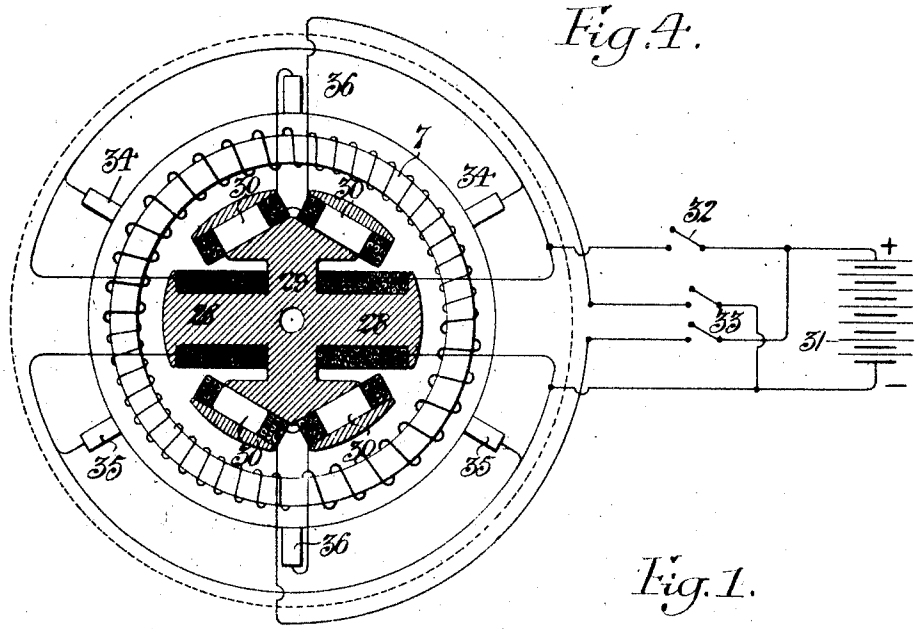
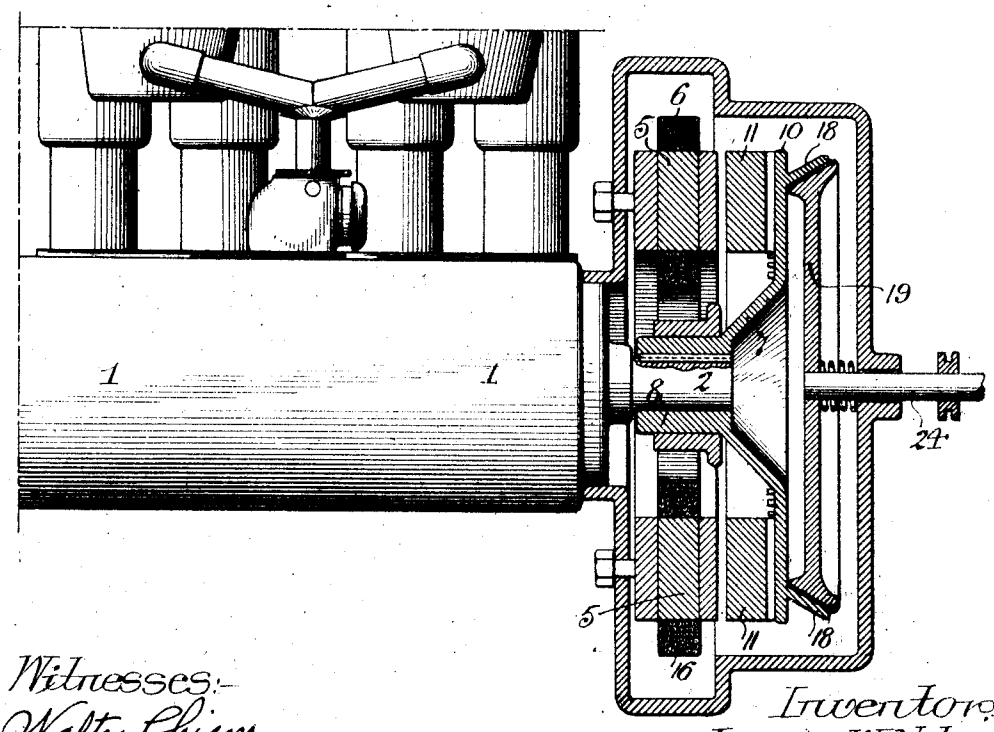


Fig. 1.



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Titus H. Dorsey

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3 SHEETS—SHEET 2.

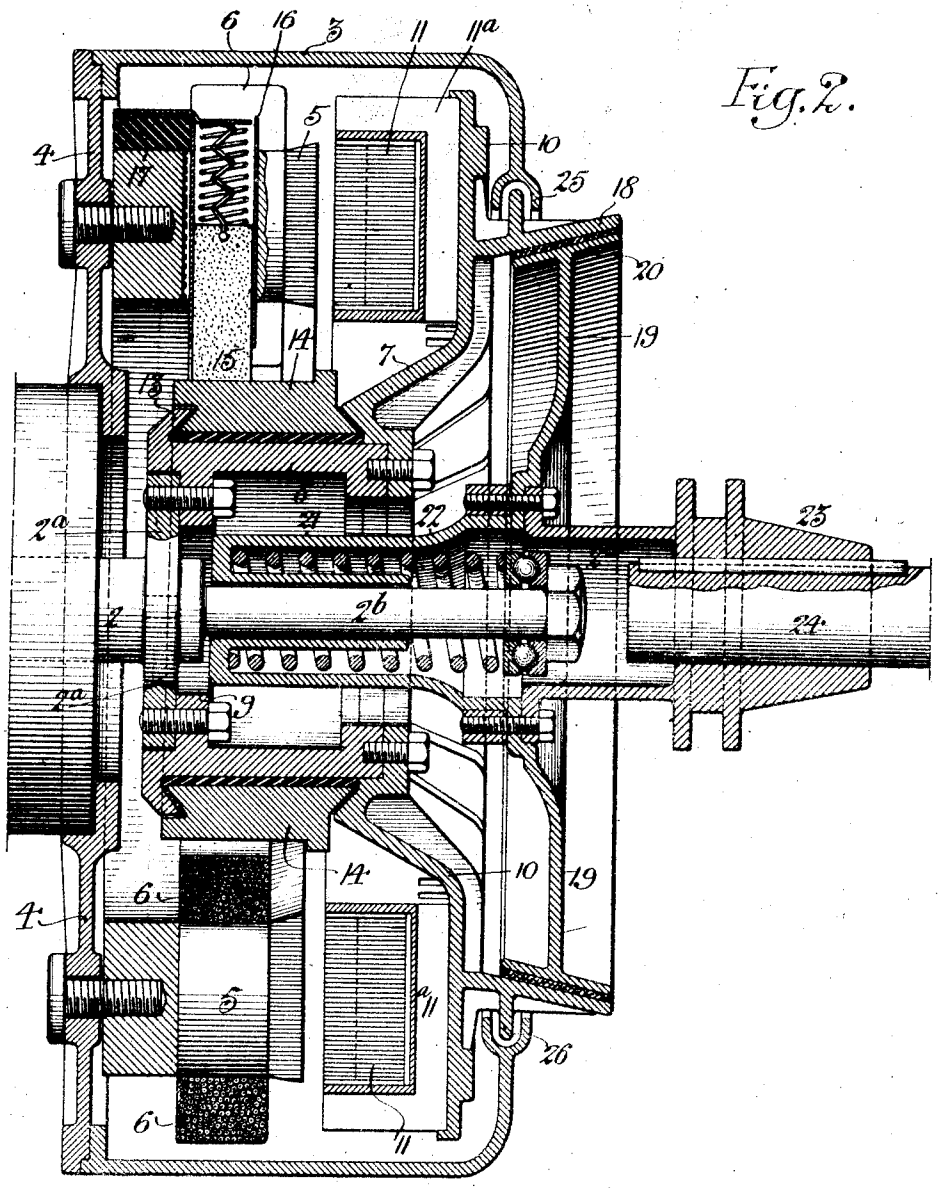

Fig. 2.

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3 SHEETS—SHEET 3.

Fig. 3.

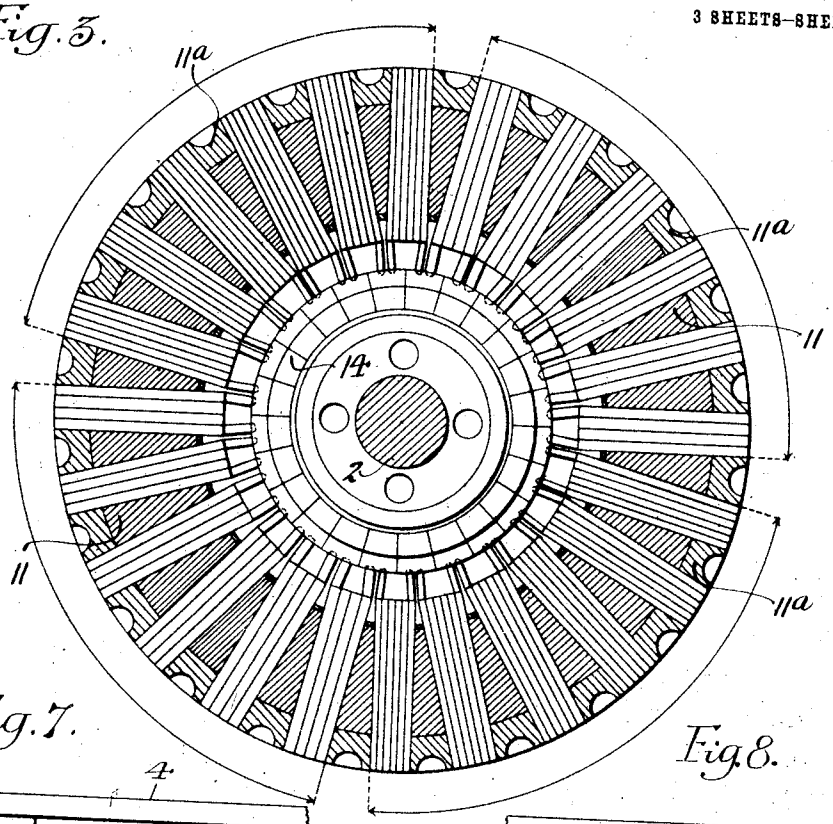


Fig. 7.

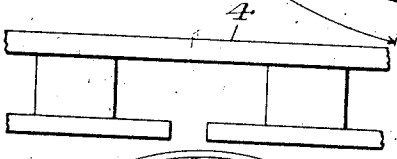


Fig. 8.

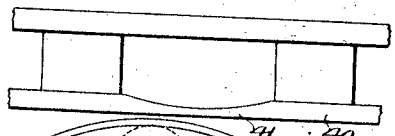


Fig. 5.

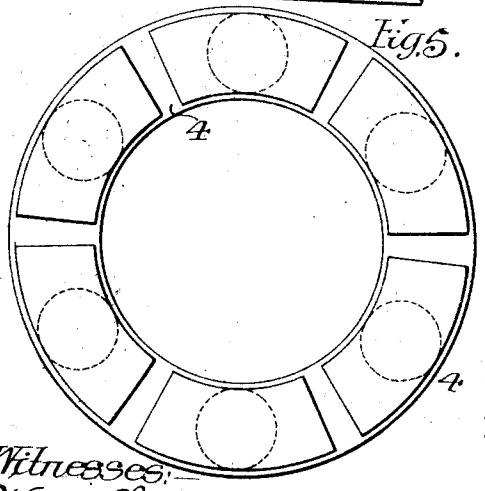
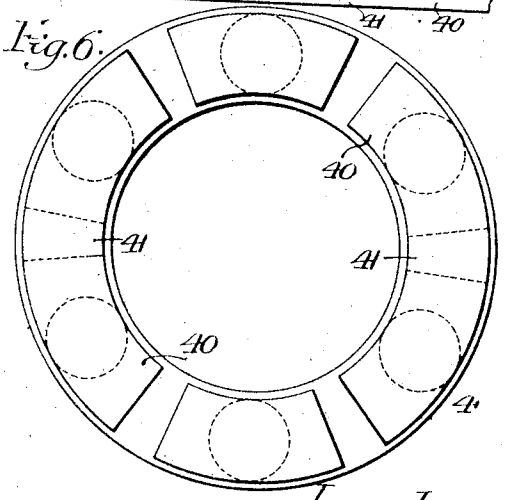


Fig. 6.



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UNITED STATES PATENT OFFICE.

LEWIS W. NELSON, OF PHILADELPHIA, PENNSYLVANIA.

DYNAMO-ELECTRIC MACHINE.

1,027,273. Specification of Letters Patent. Patented May 21, 1912.

Application filed May 16, 1910. Serial No. 561,546.

To all whom it may concern:

Be it known that I, LEWIS W. NELSON, a citizen of the United States, residing in Philadelphia, Pennsylvania, have invented certain Improvements in Dynamo-Electric Machines, of which the following is a specification.

One object of my invention is to provide an electric machine capable of use either as a generator or as a motor and particularly adapted for direct connection to an internal combustion engine, in order that said engine may be cranked by the operation of the machine when the latter is supplied with current, and may also, when working on its own fuel, operate said machine to generate an electric current with which to charge a battery used for starting or for any other purpose.

I further desire to provide a dynamo electric machine of such design that it shall when supplied with current be capable of exerting a materially varying torque at different parts of each revolution; its construction being such that for the other parts of its revolution it shall tend to attain a maximum speed. This arrangement is particularly desirable when the machine is employed for cranking an internal combustion engine, for its construction and mounting are such that the maximum torque is exerted during the compression stroke or strokes of the engine, while during the scavenging stroke or strokes the engine is speeded up so that the momentum of the moving parts tends to assist in the operation of the machine during the succeeding compression stroke.

A further object of my invention is to provide a dynamo electric machine particularly adapted for use in connection with an internal combustion engine and whose revolving element shall be particularly designed to replace the fly wheel of such an engine. I also desire that the machine shall be of a relatively compact and substantial construction, with its parts so arranged as to occupy a minimum space and of such design as to require but little if any attention under operating conditions.

I further desire to provide a dynamo electric machine of such a construction as will particularly adapt it for mounting between an internal combustion engine and the clutch whereby power from said engine may be transmitted at will to any desired driven machine.

These objects and other advantageous ends I secure as hereinafter set forth, reference being had to the accompanying drawings, in which;—

Figure 1, is a side elevation, partly in section, illustrating my machine as mounted for use in connection with an internal combustion engine; Fig. 2, is an enlarged vertical section of a machine constructed according to my invention, showing the preferred arrangement of its parts; Fig. 3, is a front elevation partly in section illustrating the armature of my dynamo electric machine; Fig. 4, is a diagrammatic view illustrating the connections of the various elements of a machine constructed according to my invention and showing it as connected with a battery and the necessary controlling switches; Figs. 5 and 6 are elevations illustrating the construction of two forms of field magnet frames which may be used in carrying out my invention and Figs. 7 and 8, are fragmentary plan views of portions of Figs. 5 and 6 respectively, further illustrating the construction shown in said latter figures.

Referring to Figs. 1 to 3 inclusive of the above drawings, 1 represents an internal combustion engine of any desired type having a main shaft indicated at 2. To the crank case or other suitable part of the engine frame is attached the inclosing casing 3 of my dynamo electric machine which in the present case is of the revolving armature type. The rear end 4 of said case has mounted on its inner face within said casing 3 an armature yoke 5^a carrying a series of pole pieces 5 on which are placed the field magnet windings 6. The armature of the machine, as indicated at 7, includes a cylindrical shell 8 concentric with the engine shaft 2, having an inwardly projecting flange 9 directly bolted to a flange 2^a which in the present instance is formed integral with said shaft. At the end of the shell 8 opposite that connected to the shaft, is an outwardly extending annular web 10 carrying an annular toothed frame 11^a on which is mounted a laminated ring 11. The armature windings are disposed around this

casing and core in the manner well understood by those skilled in the art and are positioned by the teeth of said frame. As is obvious from Fig. 2, this armature is revoluble immediately adjacent the faces of the pole pieces of the field magnets and it is noted that the web 10 carrying the armature core and windings is overhung as indicated at 12 so as to coöperate with a similarly overhung portion 13 of the shell 8 to support and hold in place the segments 14 of the commutator, which is mounted on the exterior surface of the said shell within the cavity defined by the circle of field magnets. Between these latter are mounted the required number of brushes 15 which may be carried in any desired or suitable form of boxes 16, shown in the present instance as supported on a body 17 of insulating material mounted upon the field magnet yoke or ring. From that face of the disk or web 10 carrying the armature core and opposite the latter there projects a slightly flared flange 18 serving as one member of a clutch, whose second member 19 has a portion 20 designed to coöperate with said part 18 and mounted on an extension 2^b of the engine shaft 2; said shaft in the present instance being provided with a head 2^c while the clutch member 19 has a tubular portion extending concentrically with the extension 2^b within the shell 8 of the armature. Between the end of said part 21 and the head 2^c is a spring 22 normally tending to hold the two members of the clutch in their coupled positions. The member 19 has bolted or otherwise attached to it a grooved collar 23 splined to a shaft 24 connected to any desired mechanism which it is wished to drive. In order to make a tight connection between the fixed casing 3 of the generator and the revolving armature 7, one of these two members is provided with a semicircular grooved lip 25 into which projects a rib 26 carried by the other member.

In the preferred form of my invention, the armature is wound in the manner indicated diagrammatically in Fig. 4, that is to say, two opposite portions of said armature of substantially 90° in angular extent are provided with coils each having comparatively few turns of relatively large conductor, while the two remaining diametrically opposite sections of said armature have coils wound with a relatively large number of turns of small diameter wire. All of these coils are connected to the commutator in the well known manner and under operating conditions, when current is supplied to the machine, its distribution in the armature is such that the coils having but few turns receive considerably heavier current than those which are composed of the greater number of turns of smaller wire; it being obvious that the proportioning of the windings may be widely varied in order to obtain an irregular flux distribution without departing from my invention.

While the iron in the field magnets may be disposed in any of a number of different ways as in Figs. 5 to 8 inclusive, I have illustrated it in Figs. 1, 2, and 7 as designed for the reception of six similar field coils. Since these coils as well as the commutator brushes are connected to a source of current supply by conductors which in no way differ from those employed in any dynamo electric machine, they have been omitted from the drawings for the sake of clearness.

If it is desired to start the engine, current is supplied to the dynamo electric machine through any suitable switch (not shown). Owing to the disposal of the field magnets relatively to the cranks on the engine shaft, as well as to the peculiar armature windings heretofore described, there is exerted upon said armature at certain parts of its revolution a relatively great torque, and it may be noted that the connections of the various parts are such that this great torque is exerted during the compression stroke of each of the engine cylinders; this action being due to the non-uniform flux distribution caused by the alternating coarse and fine armature windings and to the current flow resulting therefrom. At other parts of the armature revolution the relation of the fine winding of many turns to the field magnets is such that there is a tendency to speed up the armature; this action occurring during that part of the engine stroke when one or more of the pistons are scavenging or are drawing in charges of fuel. As a consequence, the rotation of the armature is materially accelerated during this part of its revolution, so that on the succeeding compression stroke of the engine, the moving parts of the machine possess considerable momentum, which with the relatively great torque due to the heavy current flowing through the coarse armature windings of few turns, insures a continued cranking of the engine until it starts and continues to operate under its own motive power. It is obvious that there are other ways than that above noted of accomplishing this peculiar action of the armature, for as illustrated in Fig. 4, as well as in Figs. 6 and 8 inclusive, the field magnets may be arranged and constructed with this end in view so that either by themselves or in combination with the irregular armature windings, they attain the same result. Thus in Fig. 4, on two opposite pole pieces 28 there are mounted coils having many turns of fine wire and while the core supporting the other field magnets extends as to its main portion in a line at right angles to the line of the cores 28, as indicated at 29, its opposite ends are

branched to provide cores 30 each of which carries a magnet coil having but few turns of relatively coarse wire. Under operating conditions this arrangement causes the uneven flux distribution heretofore noted, so that, especially if the armature be wound unevenly as heretofore described, the force exerted to turn it varies materially at different parts of its revolution, although it may in some cases be used with a uniformly wound armature. In the case illustrated in Fig. 4, I have shown the dynamo electric machine as connected to a storage battery 31 through conductors in which are interposed switches 32 and 33; the latter of these governing the supply of current to the magnets 28 and two pairs of the brushes 34 and 35. The other switch 33 controls the flow of current to the other pair of brushes 36 and to the four field magnets 30, so that whenever it is desired to start the engine to which the machine is connected both the switches 32 and 33 are closed and the motor is supplied with current through all of its brushes with the results above noted. After the engine has started, the switch 33 is opened and the machine is permitted to operate as a generator with the magnets 28 energized, the current being taken from the commutator through the brushes 36 and used to charge the battery 31 or for any other purpose for which it is suited.

If desired, the armature and field windings may be designed in the well known manner customarily found in direct current machines, but the desired flux variation necessary for turning the armature in the manner above described may be obtained by properly altering the disposition of the iron in the field magnet 4 as indicated in Figs. 6 and 8. In this case the pole shoes 40 of certain pairs of the field magnets may be united so as to short circuit a portion of the flux otherwise passing through the armature; the connecting pieces 41 being preferably of restricted cross section so as to be incapable of carrying all the flux. As a result there is an uneven flux distribution around the circular path through which any armature conductor or set of conductors pass under operating conditions so that as before noted the turning force exerted on said armature is not uniform throughout its revolution, but is caused to vary at predetermined points for the purpose heretofore described.

It is to be noted that the distribution of material in the armature is such that this latter is particularly adapted to act as the fly wheel and as a matter of fact is designed to replace this particular element of the engine to which it is attached. By mounting one of the clutch members on this armature structure it is possible to assemble the various parts in a relatively small space immediately adjacent the engine itself, especially since the necessity of an independent fly wheel is obviated. It will be noted that the clutch operating spring is contained within the body of the dynamo electric machine whose commutator is likewise so arranged that it economizes space to the greatest possible extent. Moreover this machine is interposed between the shaft to be driven and the driving engine so that the apparatus as a whole is essentially compact: this characteristic being particularly due to the employment of a discoidal armature and to the mounting of the commutator within the cavity designed by the armature and field magnets.

While I have described the armature windings employed in one form of my invention as consisting of two sets of coils one of a number of turns of relatively fine wire and the other of a less number of turns of heavier wire, it will be understood that the lengths and sizes of this wire constituting the armature windings may be widely varied in order to secure the desired result without departing from my invention.

I claim:—

1. The combination of an internal combustion engine having a shaft provided with an abutment; a dynamo electric machine having a fixed member immediately adjacent said engine and concentric with the shaft; a rotating member immediately adjacent said fixed member and mounted on the shaft; a driven shaft; a friction clutch immediately adjacent the rotating member and having one of its elements provided by a portion of said member; the second element of said clutch being connected to the driven shaft and having a tubular extension projecting into the rotating member; with a spring acting between said extension and the abutment on the engine shaft.

2. The combination of an internal combustion engine having a shaft, with a dynamo electric machine having its rotatable element connected to said shaft; a clutch member connected to said rotatable element; a driven shaft having a second clutch element placed to coöperate with the first element; an extension from said second clutch element projecting within the body of the dynamo electric machine; and a spring confined between a portion of the engine shaft and the extension from said clutch member.

3. The combination of an internal combustion engine having a shaft provided with an abutment on its outer end; a hollow structure fixed to and overhanging the end portion of said shaft; a dynamo electric machine having one of its elements on the said structure and the other carried by the engine; a driven shaft; a structure rotatably fixed thereto but slidable thereon and co-acting with a part of the structure on the

engine shaft to form a clutch; said structure on the driven shaft including a hollow portion extending into the structure on the engine shaft and providing a spring seat; with a spring mounted between said spring seat and the abutment on the engine shaft.

In testimony whereof, I have signed my name to this specification, in the presence of two subscribing witnesses.

LEWIS W. NELSON.

Witnesses:
WILLIAM E. BRADLEY,
WM. A. BARR.