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March 15, 1927.

1,620,747

F. ALLISON

STARTING SYSTEM FOR INTERNAL COMBUSTION ENGINES

Filed June 19, 1922

3 Sheets-Sheet 1

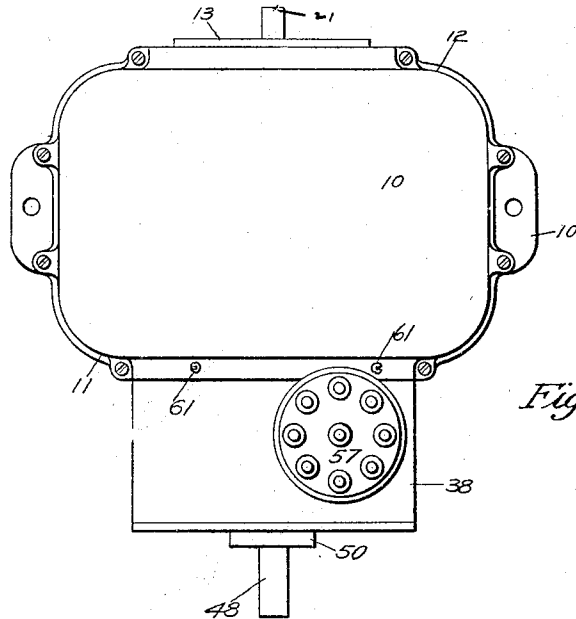


Fig. 1.

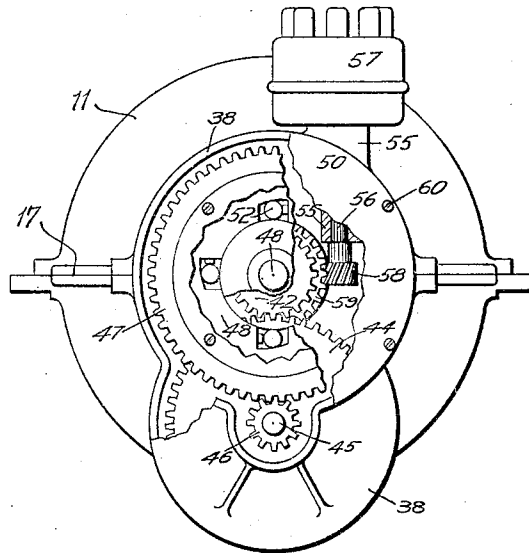


Fig. 2.

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3 Sheets-Sheet 2

Fig. 4.

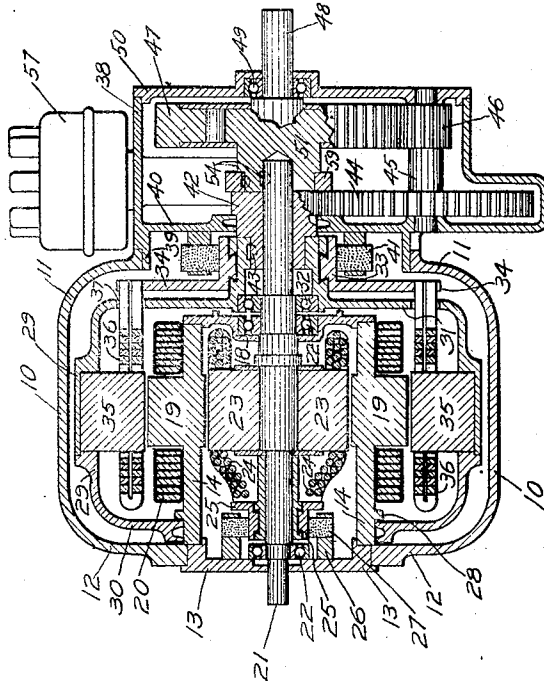
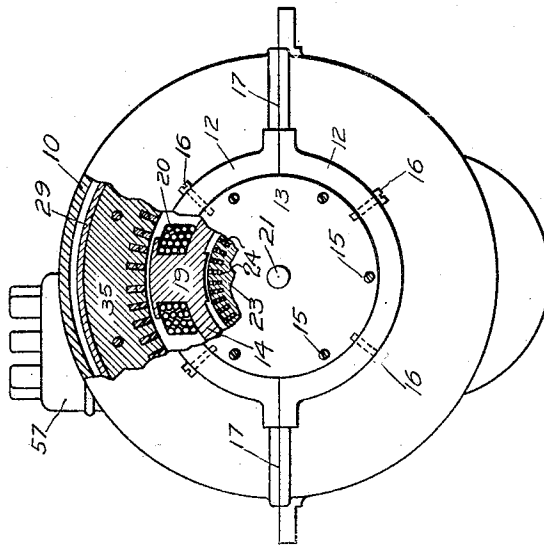


Fig. 3.



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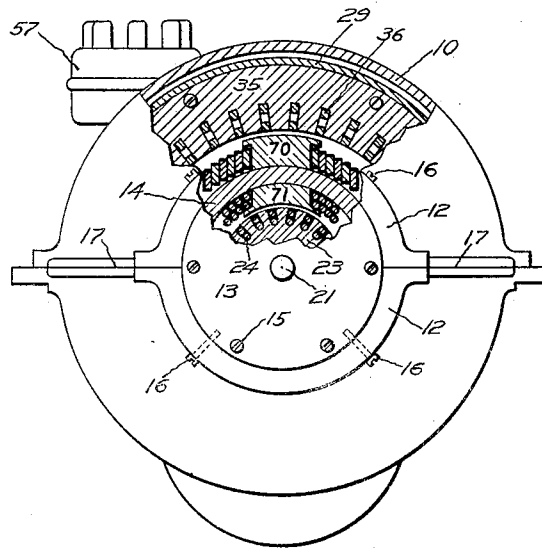
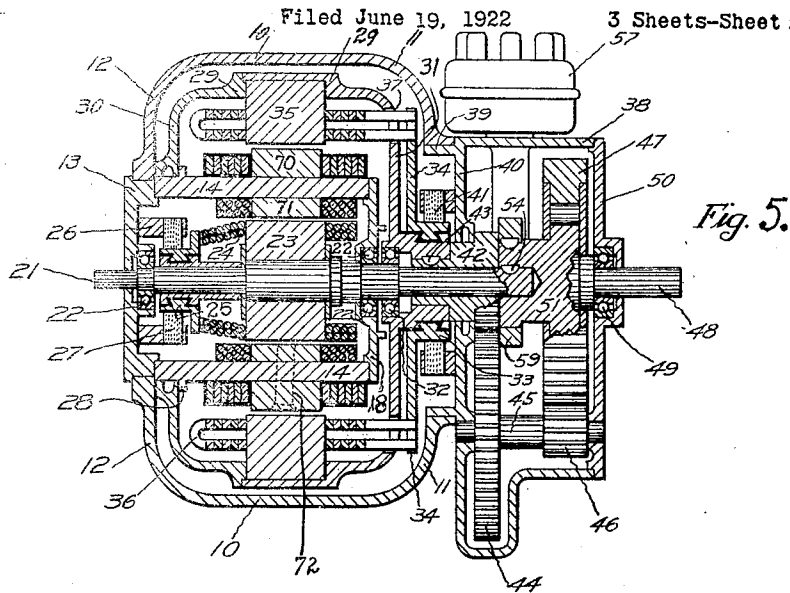
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STARTING SYSTEM FOR INTERNAL COMBUSTION ENGINES

Filed June 19, 1922

3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE.

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STARTING SYSTEM FOR INTERNAL-COMBUSTION ENGINES.

Application filed June 19, 1922. Serial No. 569,542.

The object of my invention is to provide improvements in a starting system for internal combustion engines, of simple, durable, and inexpensive construction.

5 A further object of my invention is to provide a starter and generator device for internal combustion engines which is designed to form a unitary structure having all the advantages of a two unit structure
10 while retaining the advantages of a single unit structure. In this connection, it should be explained that heretofore there have been two general types of starting devices for internal combustion engines, one type being
15 known as the "two unit type" where the starting motor and the generator were built separately and installed on an engine in position spaced from each other; and there was also the single unit type where the same
20 electrical unit served as both starter and generator for the starting system. Each of these systems have presented in the past certain definite disadvantages, and it may be mentioned in passing that the two unit
25 type of systems are subject to the objection that there are two attachments to the engine to get out of order, and the weight thereof is considerably greater than in connection with a single unit starter. The single unit
30 type of starter is advantageous in that it is more compact, but it ordinarily does not give a thoroughly satisfactory torque for starting and generating current fully adequate to keep the battery charged due to
35 the fact that the size and complication of the structure must be reduced to a minimum.

With this explanation in view, it is a further object of my invention to provide a combined starting motor and generator unit
40 in a unitary structure so that the advantages of the two unit efficiency may be retained while the compactness and lightness of the single unit structure may also be retained.

Still a further object of my invention is
45 to provide an electrical device having such a construction that it may readily be attached to the crank shaft of an engine thereby making gearing between the generator and crankshaft unnecessary.

50 A further object of my invention is to provide a structure forming a combined generator and motor where the field windings for the two portions of the device are supported on the same shell and which has
55 the motor armature encircling the field

windings and the generator armature received within the lines of the field windings whereby a relatively large torque may be secured for the motor portion of the device, and the generator portion of the device may
60 nevertheless be efficiently actuated.

Still a further object of my invention is to provide a combined supporting frame and closure device whereby an appropriate support may be secured for the various parts
65 of the device, while a housing therefor is maintained to protect such portions of the device as should be enclosed.

Still a further object of my invention is to provide a casing designed to compactly
70 and efficiently house the motor and generator elements, a reduction gearing, an over-running clutch construction, and a distributor drive in addition to forming a support for
75 these various units and a distributor.

With these and other objects in view, my invention consists in the arrangement, combination and construction of the various parts of my improved device, as described in the specification, claimed in my claims, and
80 shown in the accompanying drawings, in which:

Figure 1 shows a top or plan view of my improved device.

Figure 2 shows an end elevation thereof, 85

Figure 3 shows an elevation taken from the end opposite that illustrated in Figure 2.

Figure 4 shows a vertical, sectional, central view of my improved device whereby the construction of the parts is more clearly
90 illustrated.

Figure 5 shows a longitudinal, vertical, central, sectional view thru a slightly different form of my improved device, and

Figure 6 shows an end elevation of the device illustrated in Figure 5, parts being
95 broken away to better illustrate the construction.

Referring to the accompanying drawings, and more particularly to Figure 4, it will be
100 noted that I have provided a relatively large cylindrical shell 10 which has inturned flanges 11 and 12 at either edge and which is provided with a closure cap 13 designed to
105 co-act with the flange 12.

Within the casing 10 and fixed relative thereto, is a field supporting member 14 which is, generally speaking, of cylindrical shape and of approximately the diameter
110 of the opening between the edges of the

flange 12. This field supporting cylinder is secured from movement by screws 15 which extend thru the cap 13 into the shell 14 to hold the latter from rotation. Screws 16 are also passed thru the edge of the flange 12 into the cap 13 to hold the cap 13 from rotation relative to the shell.

In this connection it will be noted that the shell 10 is divided along its horizontal center line, as at 17, whereby the upper half shell, 10, may be lifted off to permit inspection of the motor generator units while they are being run and at the same time the screws 15 and 16 in the lower half of the shell and cap will hold the field shell from rotation. At the right hand or inner end of the shell 14, as illustrated in the Figure 4, a combined field support bearing retainer and closure member 18 is provided. This member 18 has a shoulder adjacent to its outer edge and on its inner face designed to fit closely against the inner edge of the inner end of the field shells 14 whereby said shell and the shell supporting member 18 may be properly aligned. Suitable means such as screws, are provided for fastening the outer edge of this supporting member 18 to the inner end of the field shell 14. It will be noted, at this time, that the field supporting member 18 has an offset portion adjacent to the opening at the central portion thereof designed to receive and support the outer ring of a ball race.

The field supporting shell is provided with projecting core members 19 at intervals around its periphery which are designed to enter and support the field coils of my improved generator motor unit. In the form of device illustrated in Figures 3 and 4 these core members 19 project or extend outwardly from the field shell 14 and both the motor and generator field windings are wound upon the same core outside of the field shell 14. In the form of device illustrated in Figures 5 and 6, separate cores 70 and 71 are provided for the motor and generator fields; the motor field cores being disposed outside of the shell 14 and the generator cores being disposed inside of the shell 14. These cores are preferably arranged so that the motor and generator cores are directly opposite each other on the shell 14 so that bolts or screws 72 may be passed through the shell for securing these cores in places in pairs so that the same bolts or screws will serve to fasten both the generator and motor core in place in each case. In this connection it may be suggested that I have found the structure illustrated in Figures 5 and 6 to be preferable to that illustrated in Figures 3 and 4 in view of the fact that it is easier to assemble and furnishes a slightly more efficient electrical design.

Extended through the cap 13 and the field support 18, which will hereinafter be called the "inner cap" is a shaft 21. Ball races 22

are associated with both the cap 13 and the inner cap 18 for aligning the shaft with the field shell 14. Mounted on the shaft 21 is a laminated armature core 23 upon which are generator armature windings or coils 24 which terminate in a commutator member 25 disposed adjacent to the cap 13, or outer cap. Supported on this outer cap 13 by any suitable supports 26, are brushes 27 designed to take off the current generated in the generator armature. The field supporting shell 14 is provided with an outwardly extending annular shoulder 28 adjacent to its outer end and to the flange 12. A hollow cylindrical motor armature shell 29 is of sufficient size so that it may encircle the field windings 20 on the field shell 14, and is provided with inwardly extending flanges at either end. One of these flanges 30 is designed to be received in the channel formed between the shoulder 28 on the field shell 14 and the flange 12 of the casing 10 whereby an aligning bearing may be provided for the outer end of the motor armature shell 29. The inner flange 31 of the motor armature shell is extended to position adjacent to the inner end of the shaft 21 where a ball race 32 provides a journal and alignment between the motor armature shell and the shaft 21. In this connection it will be noted that at certain times the motor armature rotates at different speeds from the generator armature and at other times the motor armature remains stationary when the generator armature is revolving. Hence the motor armature forms an additional bearing and alignment for the generator armature under the latter condition; and under the former condition free rotation of the two relative to each other is permitted by means of this bearing 32. At the inner edge of the flange 31 of the motor armature shell and adjacent to the bearing 32 the flange 31 is extended laterally to form a cylindrical thimble upon which are mounted the commutator members 33 for a motor armature. These parts 33 have radial extensions 34 thereon designed to extend to position to make connections with the motor armature coils. Disposed within and supported by the motor armature shell are core members 35 which receive the motor armature windings 36 which extend through openings 37 in the flange 31 of the motor armature shell and connect with the extensions 34 from the commutator segments 33 on the motor armature housing.

It will be noted that the armature shell 29 is divided in a transverse plane whereby the core members 35 may be assembled into the inner half or portion of the motor armature shell and then the outer portion of the motor armature shell may be placed in juxtaposition with the inner portion and the core members to thereby lock the core members in place and complete the assembly of the

armature shell and core. Screws may be provided for securing these two portions of the motor armature shell together.

The inner end of the housing 10, as has been previously described, terminates in a flange 11. This leaves an opening at the end of the electrical unit housing and I provide a combined bearing, casing, and closure member for this opening to which I have given, generally, the reference numeral 38, and which I will hereinafter refer to as the "gear housing" or "casing". The inner end of this casing 38 is provided with a laterally extending annular flange 39 designed to enter and engage the opening at the inner edge of the flange 11 of the electrical unit housing so that the gear housing and the electrical unit housing may form the equivalent of a unitary structure. Adjacent to the flange 39 in the casing 38 is a transverse web 40 which forms a main portion of the closure for the electrical unit housing 10 at the inner end thereof and which supports, in any suitable manner, the motor armature brushes 41 in position to contact with the commutator segments 33 of the motor armature. Wires are connected to these brushes and the current conducted thereto by any suitable means which are not here shown. The gear housing 38 receives the inner end of the armature shaft 21 of the generator portion of my electrical unit. Rotatably mounted on the inner end of this shaft 21 and within the gear casing 38 is a combined sleeve and gear member 42 which is keyed at 43 to the commutator supporting sleeve at the inner end of the flange 31 of the motor armature shell. It will, therefore, be seen that this combined sleeve and gear member 42 connects the motor armature with the interior of the gear casing 38 and as it is rotatably mounted on the shaft 21 it permits rotation of the motor armature independent of the rotation of the generator armature. The gear 42 serves another function in that an oil tight, or substantially oil tight, connection is made between a portion of this gear and the web 40 of the casing 38 whereby the gear casing 38 may be packed with grease which, however, will be prevented from reaching the interior of the electrical unit casing by the partition 40 and the gear 42. The teeth on the gear 42 engage a large gear 44 mounted on a jack shaft 45 disposed adjacent to the lower portion of the casing 38. A similar gear 46 is also fixed to the jack shaft 45 and co-acts with the teeth of a large ring gear 47. A shaft 48 is journaled, as by a ball race 49, in an end cap 50 which closes the outer end of the gear housing 38.

It may be mentioned in passing that the shaft 48 is an extension, or is designed to be the equivalent of an extension, from the crankshaft of an internal combustion engine.

Affixed to the portion of the shaft 48, which I will hereinafter term the "engine shaft" is a combined gear clutch member and coupling member to which I have given the numeral 51. This member 51 is associated with the ring gear 47 to form an over-running clutch assembly which will cause these two members 51 and 47 to be locked from movement relative to each other when the parts are rotated in a certain direction, and to be free from each other when the parts are rotated in another direction.

In the form of device here illustrated, balls or rollers 52 are set into tapered notches in the inner edge of the ring gear 47 and these rollers 52 are held in place by retaining plates 53 at either side of the ring gear 47, these plates serving to journal the ring gear relative to the coupling member 51 and at the same time to retain the rollers 52. The coupling member 51 is keyed at 54 to the generator shaft 21.

The parts heretofore described are all operatively connected, as has been brought out, with the engine shaft of an internal combustion engine—viz the shaft 48.

From the description of the construction of the parts hereinbefore mentioned it will be seen that the engine shaft 48 is keyed to a coupling member 51 which in turn is keyed to the generator shaft 21 whereby the generator armature must rotate at all times at the same speed as the engine shaft rotates so that the generator will generate current whenever the engine shaft 48 is rotating at sufficient speed.

Now, in case the engine to which the shaft 48 belongs may be stopped for any reason and it is desired to start such engine in the manner well known in connection with internal combustion engines, the engine shaft 48 will be rotated by the following means: Circuits will be closed thru the starter motor armature brushes 41 thereby rotating the motor armature shell 29 which in turn rotates the gear 42 thereby in turn actuating the reduction gearing comprising gears 42, 44, 46, and 47. Actuation of the ring gear 47 in the direction in which it is urged by the motor armature when the engine shaft 48 is at rest causes the over-running clutch device to engage the ring gear 47 with the coupling member 51 and thereby with the engine shaft 48 so that rotation of the motor armature will impart rotation to the engine shaft 48 thru reduction gearing. When, however, the engine starts then the shaft 48 will rotate at a greater speed than the gear 47 which automatically releases the over-running clutch mechanism and permits the disengagement of the shaft 48 from the motor armature. This engagement and disengagement of the engine shaft from a starting motor armature is generally well known in the art hence is not more fully described

here. The gear casing 38 is provided with a sleeve 55 which is hollowed out to form a bearing and support for the distributor shaft 56 which has a distributor device 57 of ordinary construction operatively connected therewith at the point outside the casing 38. The lower end of this shaft 56 has a gear 58 secured thereto which engages with the gear 59 which may be formed as part of the coupling member 51 or keyed thereto.

From the foregoing description it will be seen that whenever the engine shaft 48 rotates then the gear 59 on the coupling member 51 will impart rotation to the distributor shaft 56 thereby in turn actuating the distributor mechanism 57. It has heretofore been mentioned that the casing 38 is closed with an end cap 50 and this latter is secured in place by screws 60 whereby gears may be packed with grease inside this gear casing 38 so that the parts therein may be substantially noiseless in operation and may require substantially no attention throughout the life and use of the device. It will also be noted that I have provided long-lived bearings for the electrical units comprising ball bearings so that they may also run for long periods of time without attention. Attention should also be called to the accessibility of the various portions of my improved device, as for instance the generator brush and commutator assembly may be readily inspected or repaired by moving the end cap 13. The motor, commutator, and brush assembly may be readily inspected or repaired by removing the gear casing 38 from the electrical unit housing which is accomplished by simply sliding the flange 39 out of the flange 11 after the retaining screws 61 (see Figure 1) therefor have been removed. The over-running clutch device, or reduction gearing for the starting motor, or the distributor drive, may all be inspected or repaired by simply removing the screws 60 which hold the cover plate 50 in place. In this connection it will be noted that there is a sliding key-way construction between the coupling member 51 and the shaft 21, and also between the motor armature housing 10 and the gear 42 so that the gear 42 and coupling member may simply slide off their respective associated parts when the gear housing 38 is removed.

The main advantages arising from the use of my improved structure have already been mentioned but it may be well to specifically point out again that my starter and generator drive structure is so arranged first that it might be connected directly to the engine shaft of an internal combustion engine; and, secondly, a crank for such internal combustion engine may be connected to the protruding end of the generator shaft 21 thereby making it possible to crank an internal combustion engine by hand, if desired, with

a minimum amount of additional equipment. Moreover, the electrical units of my improved starting system and gearing therefor are removable as a unit, and the portions of the unit are each readily removable relative to each other so that any desired or necessary portion of the gearing or electrical units are readily accessible and removable for inspection and repair.

Some changes may be made in the arrangement and construction of the various parts of my improved device without departing from the spirit of the invention therein, and it is my intention to cover by my claims such changes as may be reasonably included within the scope thereof.

I claim as my invention:

1. In a device of the class described, the combination with a housing composed of separable sections, an electric generator and an electric motor disposed within said housing, a shaft passing through said housing, a generator armature on said shaft, a concentrically disposed shell extending around said shaft and enclosing said generator armature, a second concentrically disposed shell surrounding said first shell, a concentrically arranged starter core carried by said second shell, commutators for both the generator and the starter, a motor shaft, reduction gearing connecting said motor shaft with said armature shaft, overrunning clutch mechanism in said gearing, and a housing for said gearing.

2. In a device of the class described, the combination with a housing composed of separable sections, an electric generator and an electric motor disposed within said housing, a shaft passing through said housing, a generator armature on said shaft, a concentrically disposed shell extending around said shaft and enclosing said generator armature within said housing, a generator core within said shell, a second concentrically arranged shell within said housing, a starter core carried by said second shell, commutators for both the generator and the starter, a motor shaft, reduction gearing connecting said motor shaft with said armature shaft, overrunning clutch mechanism in said gearing, a housing for said gearing, in combination with a distributor, and a driving means for said distributor cooperating with said gears.

3. In a device of the class described, an electrical unit housing comprising a substantially cylindrical member provided with inwardly extending flanges at either end thereof, a concentrically arranged field shell supported within said housing in position adjacent to the edges of one of said flanges, a closure member for the opening formed by said flange, and removably secured thereto, a gear housing having an annular laterally extending flange thereon adapted to be

removed and to be secured to the edge of the other flange of the electrical housing to thereby complete the electrical housing, a sealing partition extended across said gear housing 5 adjacent to said flange, and a closure cap removably secured to the gear housing whereby said gear housing portion of the structure may be packed with grease which will be withheld from the electrical portion of the structure and whereby the portions 10 of the electrical and gearing units housed in the entire structure may each be readily accessible.

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