V. G. APPLE.

ENGINE STARTING APPARATUS.

APPLICATION FILED AUG. 12, 1916.

1,231,983.

Patented July 3, 1917.

3 SHEETS—SHEET 1.

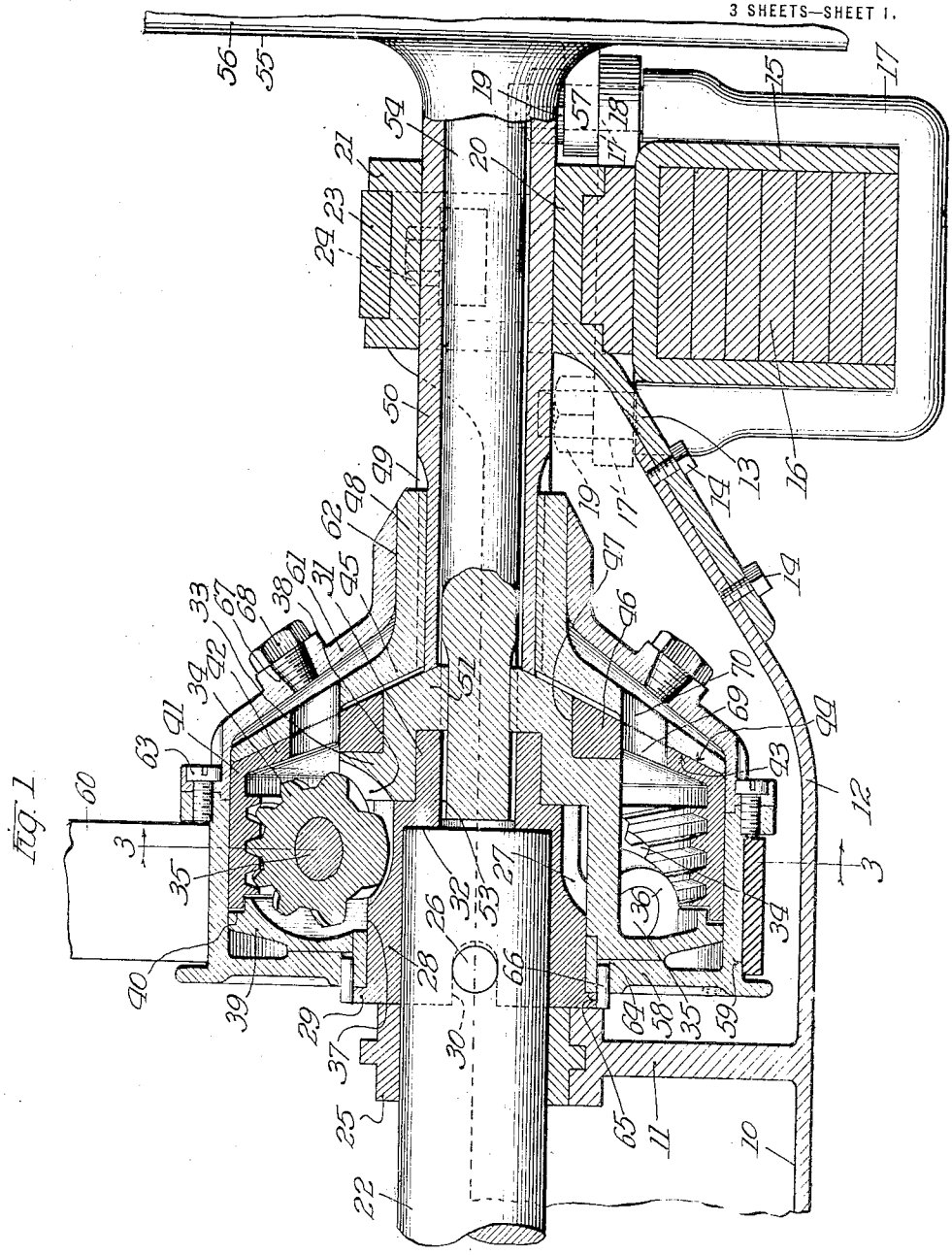


Fig. 1

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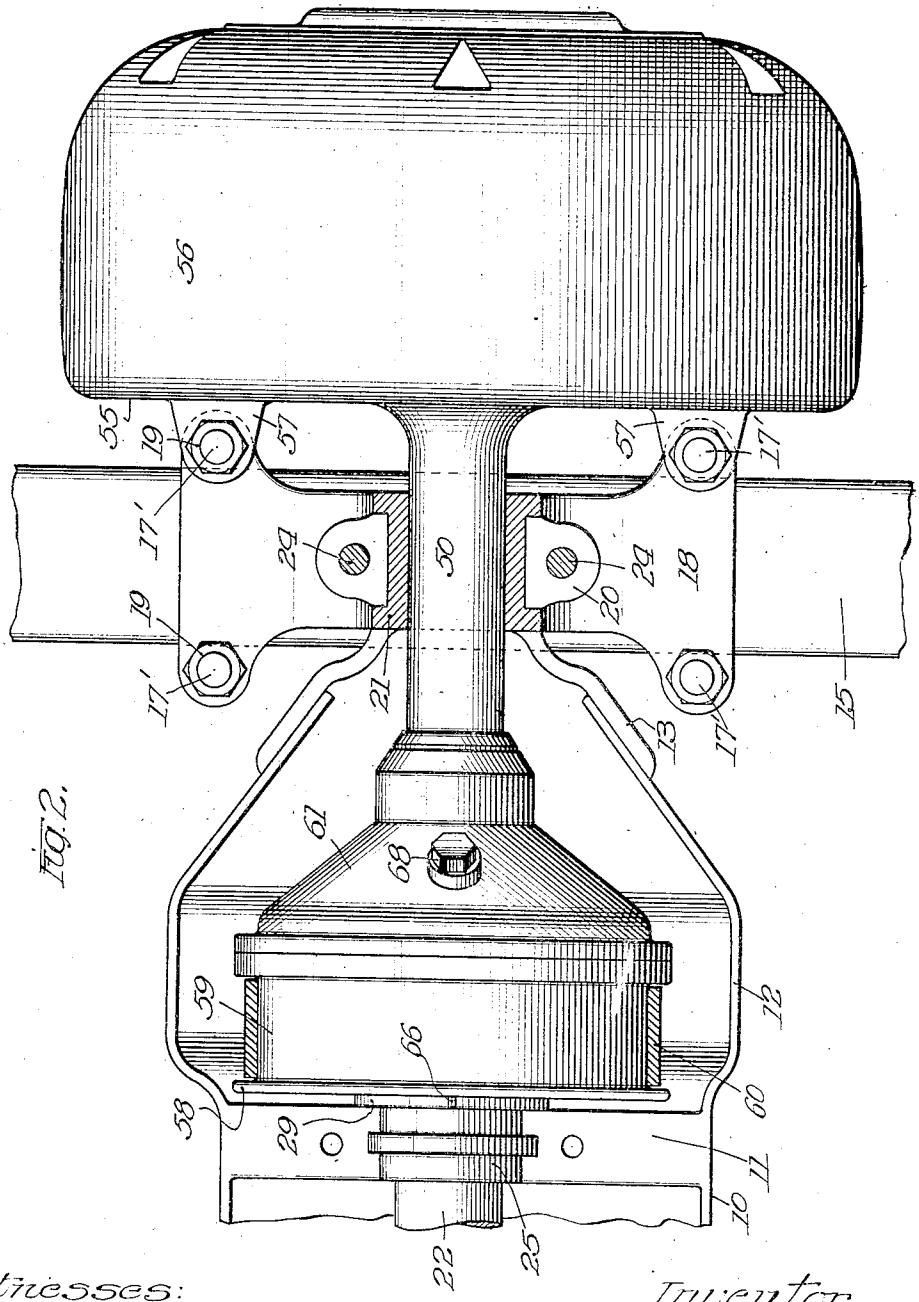


Fig. 2.

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3 SHEETS—SHEET 3.

Fig. 3.

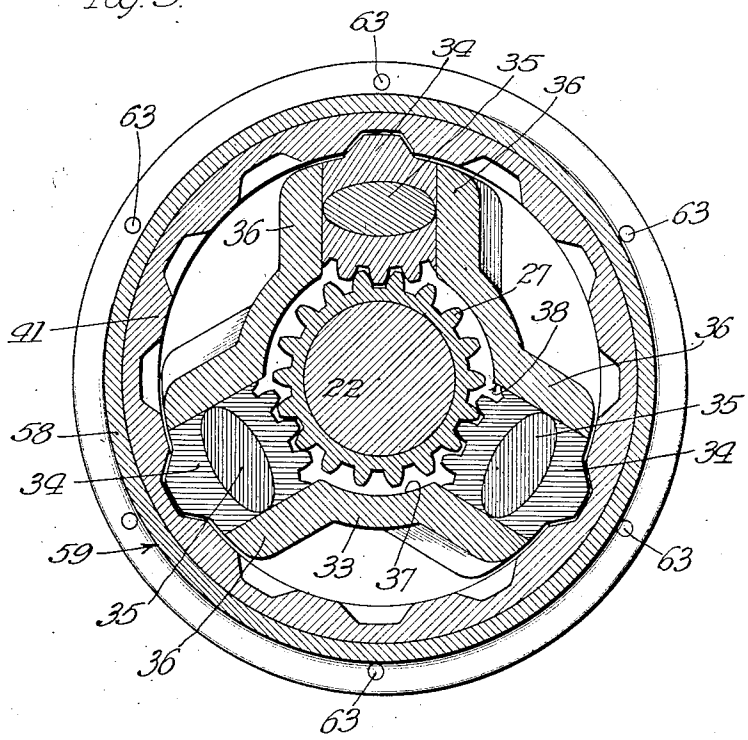
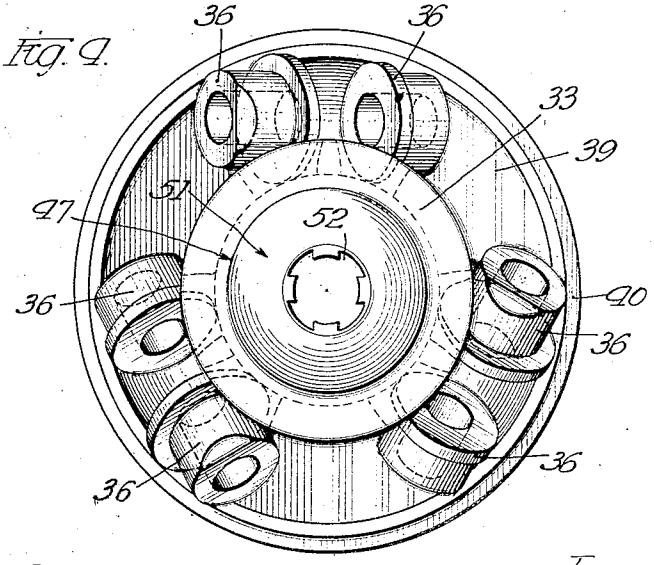


Fig. 4.



Witnesses:
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UNITED STATES PATENT OFFICE.

VINCENT G. APPLE, OF DAYTON, OHIO.

ENGINE-STARTING APPARATUS.

1,231,983. Specification of Letters Patent. Patented July 3, 1917.

Application filed August 12, 1916. Serial No. 114,589.

To all whom it may concern:

Be it known that I, VINCENT G. APPLE, a citizen of the United States, residing at Dayton, in the county of Montgomery and State of Ohio, have invented certain new and useful Improvements in Engine-Starting Apparatus, of which the following is a specification.

This invention relates to improvements in automobile engine starting and current generating apparatus.

More particularly the invention resides in the manner of mounting the dynamo electric machine and its gearing at the front end of the engine to permit its ready attachment to cars already in use.

One of the objects of the invention is to provide an electric starting and current generating unit with its associated gearing which is compact, reliable, efficient and so disposed as to permit its attachment to the front end of an engine without in any way altering the construction of the engine or chassis.

Another object of the invention is to provide an engine starting and current generating unit together with an associated gearing mechanism which displaces the fan belt driving pulley usually mounted at the front end of the engine crank shaft, occupying the space formerly taken by the pulley and having a rim surface for driving the fan belt.

Other and further objects will become apparent to those skilled in the art from a consideration of the following specification and drawings, wherein:—

Figure 1 is a vertical axial sectional view through the front end of an automobile engine and frame showing my improved apparatus applied thereto.

Fig. 2 is a horizontal plan view of the fragmentary parts of a car with my improved apparatus applied thereto as shown in Fig. 1.

Fig. 3 is a transverse sectional view on the line 3—3 of Fig. 1; and

Fig. 4 is an end elevation of the pinion carrying member detached from its associated parts.

In the drawings I have illustrated my invention as applied to the front end of a Ford car, and though it is readily adaptable to other types of machines, for the purpose of a clear disclosure, I will describe it in this association.

The front end of the crank case 10, beyond the bearing supporting web 11 is extended in the form of a shallow, dish-like nose or pan 12, to which the front end supporting hanger 13 is secured, as at 14. The front end cross member of the car which lies beneath the radiator comprises an inverted U-shaped channel 15 within which is positioned the arched central portion 16 of the vehicle supporting spring. The spring is secured in position by a pair of spaced apart U-shaped clips 17 which extend under the frame members 15 and spring 16, with their threaded legs 17′ projecting upwardly through apertures in the hanger plate 18, which overlies the upper face of member 15. Nuts 19 are threaded on the legs 17′ and securely clamp the hanger plate, frame member and spring together. The center portion of the hanger plate is provided with a cradle 20 on its upper surface to receive a tubular extension 21 integral with the hanger 13 and in axial alinement with the engine crank shaft 22. This extension serves as a bearing for the starting crank furnished with this type of car and also as a front end support for the engine. A saddle 23 overlies the tubular extension and when secured in place by the bolt 24 clamps the same in place.

The shaft 22 projects beyond the front end bearing 25 carried in the web 11 a distance sufficient to provide support for a fan belt driving pulley secured thereto by means of a pin 26. The structure thus far described is a part of the standard Ford car and, of course, forms no part of my invention.

In order to attach my apparatus to a car of this type I first remove the starting crank which normally is journaled within the tubular extension 21 and also remove the fan belt driving pulley secured on shaft 22 by pin 26.

The gearing which I employ for connecting the dynamo electric machine to the shaft is similar to and embodies the principles disclosed in the co-pending application of Frederick W. Cotterman for improvements in gearing, filed May 11th, 1916, and serially numbered 96,769. With this form of gearing a reduced speed driving connection is secured when the dynamo functions as a motor for starting the engine, but when the engine takes up its cycle of operation the reversal in direction of drive automatically brings about a one-to-one driving relation

between the crank shaft and dynamo. The principal parts of this type of gearing are the two concentric gear members with relatively diagonally disposed teeth and interposed connecting pinions mounted on axes transverse the axis of the two gear members and meshing therewith.

In the particular form of gearing which I have illustrated, the internal gear member 27 is provided with an axially extending hub 28 bored out to receive the end of the crank shaft 22 and flanged, as at 29, for abutment against the end crank shaft bearing 25. The flanged end of the gear is axially slotted, as indicated in dotted lines at 30, in Fig. 1, for engagement with the pin 26 which passes through the shaft 22 and serves the purpose of holding the fan belt driving pulley in position.

The outer end of the pinion 27 is reduced in diameter, as at 31, to form a shoulder 32 abutting against the end of the crank shaft 22 and provides a bearing for the concentric pinion carrying member 33. This pinion carrying member 33 is adapted to support three diagonally disposed pinions 34, mounted on shafts 35, carried at their ends in the upstanding ears 36. The inner end of the pinion carrier is bored out, as at 37, to overlie the gear 27 and opposite the pinions is cut away, as at 38, to permit inter-engagement between the gear and pinion. The inner end of the pinion carrier is provided with an outwardly projecting annular flange 39 which forms an end abutment 40 for the concentric internal gear member 41, which surrounds the pinions and meshes therewith. The forward end of the internal gear 41 extends inwardly, as at 42, providing an outwardly facing conical surface 43 for engagement with the corresponding inwardly projecting conical surface 44 of the stationary member 45. The inner end of the conical portion 42 of the internal gear 41 is enlarged, as at 46, and finds bearing on the shoulder 47 provided on the outer end of the pinion carrying member 33. The stationary member 45 is provided with a tubular extension 48, the inner wall of which is provided with axial slots for register with the corresponding key ways 49 formed on the periphery of the inner end of the tubular member 50 which projects through and is secured within the tubular nose 21 formed at the front end of the engine crank case.

The outer end of the pinion carrier 33 is provided with an inwardly extending hub 51 in which is formed a plurality of key ways 52 for engagement with the corresponding centers 53 formed on the inner end of the dynamo shaft 54. The tubular stationary part 50 may conveniently form a projection from the end wall 55 of the dynamo casing 56 mounted at the front of the car. As an additional support for the dynamo I have provided a pair of inwardly extending lugs 57 on the end wall 55 of the dynamo, so positioned as to overlie the forwardly extending pair of threaded legs 17′ of the spring clips 17. The gearing mechanism heretofore described is entirely inclosed within a two part casing. One part comprises a radially extending flange member 58 positioned between the flanged end 29 of the gear 27 and the radially extending flange 39 of the pinion carrier. The periphery of this casing member is provided with a pulley belt driving surface 59 for driving the fan pulley belt 60. The front member of the casing is of conical conformation as indicated at 61, to overlie the conical stationary member 45, its inner end being bored out, as at 62, for bearing on the tubular projection 48 of the stationary member. Its peripheral portion is formed for contact with the forwardly extending portion of the pulley drum 59 to which it is secured by means of the screws 63. The flange member 58 of the casing is provided with openings 64 for register with slots 65 formed in the periphery of the flange 29 on the inner gear to receive pins 66 for the purpose of holding the two parts together and insuring rotation of the casing member when the pinion is rotated.

I have provided suitable means for lubricating the gearing by forming tapped openings 67 in the conical casing members 61 into which take threaded removable plugs 68. Apertures 69 and 70 are provided in the conical members 42 and 45, respectively, to permit grease forced into the openings 67 to pass on through to the gearing, as well as to the various bearings.

It will be noted that the two axially extensive parts, namely the dynamo shaft 54 and the stationary tubular part 50 are both axially keyed, at their inner ends, for sliding engagement with the members to which they are connected. This permits the gearing to be mounted upon the end of the crank shaft by first removing the hand crank and belt pulley. The dynamo is then applied from the front of the car with its elongated parts projecting through the tubular hanger member 21, their keyed inner ends sliding into driving engagement with the parts to which they are to be connected. The lugs 57 are then secured on the spring hanger legs 17′, the nuts 19 tightened and the apparatus is in place ready for operation.

Referring now more particularly to the operation of the gearing, it will be apparent that since the teeth on the gear 27 and internal gear 41 are transversely disposed with respect to each other, those on the former being generally axial, whereas those on the latter are generally transverse to the

axis, the bodily rotation of the pinion, or connecting gear 34, rotation of the inner gear 27 being resisted will tend to produce a rotation of the connecting gears about their own axes, which in turn, axially displaces the internal gear 41 until it comes into tight abutment with the conical stationary member 45, the frictional resistance of which is sufficient to stop its rotation. This clutching and consequent stopping of the internal gear 41 from rotation gives the pinion a "toe hold" by means of which their bodily rotary movement also gives them a slow rotation about their own axes, which is transmitted to a slow rotary movement of the inner gear 27.

Thus, it will be apparent, that with the pinion carrier acting as a driver, the engine shaft 22 must be driven at a reduced speed and in the same direction of rotation as the driving pinion carrier 33. Rotation of the pinion carrier is secured through means of the dynamo shaft 54 with its feather key engagement with the inwardly projecting hub 51 of the pinion carrier. Thus the dynamo, serving as a motor, will drive the engine shaft 22 through a reduced speed gearing as desscribed. When, however, the engine "picks up" and begins to drive the shaft 22 at speed, the pinion carrier may be considered as an element to be driven with the armature secured on shaft 54 as its load. The operation is then as follows:

When the shaft 22 acts as a driving member, rotating in the same direction as it was initially driven, the gear 27 rotating with the shaft, tends to drive the pinions 34 in rotation about their individual axes. Consequently the pinions 34 tend in their rotation to shift internal gear 41 axially to the left, and thus into engagement with the rotating peripheral shoulder 40 of the pinion carrier. The pinions 34 being unable to rotate on their own axes, operate simply as a clutch member connecting the internal gear 41 with the inner gear 27 so that the entire mechanism rotates as a unit, thus effecting a one to one drive between the engine crank and the dynamo armature.

The casing, comprising the two members 58 and 61, rotating with the crank shaft of the engine furnishes a constant drive for the fan belt 60.

Whereas I have illustrated and described a single embodiment of my invention, it will be obvious that various changes may be made therein without departing from the spirit and scope of the appended claims.

Having described my invention, what I claim is:—

1. The combination with the forwardly projecting end of the crank shaft of an engine, and the underlying crank case support having a tubular projection in axial alinement with the shaft; of a speed varying gearing mechanism connected to the end of the shaft, a starting motor carried at the front of the support, and a connection extending from the motor rearwardly through the tubular projection for engagement with the gearings.

2. In a motor vehicle the combination with the forwardly projecting end of an engine crank shaft, and the transverse frame member; of a starting motor secured to and positioned ahead of said member, and speed-varying gearing at the rear of said member and connecting the shaft and motor for the transmission of power.

3. In a motor vehicle the combination of the forwardly projecting end of an engine crank shaft, and a transverse frame member; of a starting motor carried by said member, and speed-varying gearing interposed between the frame member and crank shaft and connecting the motor and crank shaft for the transmission of power.

4. In a motor vehicle the combination of the forwardly projecting end of an engine crank shaft, and a transverse frame member; of a starting motor carried by said member at the front thereof, and speed varying gearing interposed between the frame member and crank shaft and supported on said shaft for connecting the motor and crank shaft for the transmission of power.

5. In a motor vehicle the combination with the forwardly projecting end of an engine crank shaft, and a transverse frame member; of a starting motor carried by said frame member at the front thereof, and speed varying gearing mounted on the shaft at the rear of the frame member, and sliding connections between the motor and gearing whereby the gearing and motor may be separated by relative axial movement.

6. In a motor vehicle the combination with the forwardly projecting end of an engine crank shaft and a transverse frame member; of a starting motor carried by said member at the front thereof and speed varying gearing mounted on the front end of said crank shaft and making sliding connection therewith whereby the crank shaft and gearing may be separated by relative axial movement.

7. In a motor vehicle the combination with a forwardly projecting end of an engine crank shaft, and a transverse frame member; of a dynamo electric machine carried by the frame member at the front thereof, a speed varying gearing mounted on the front end of the crank shaft and making axial sliding connection therewith whereby the gearing and shaft may be separated by relative axial movement thereof, and sliding connections between the motor and gearing whereby the motor and gearing may be separated by relative axial movement.

8. In a motor vehicle the combination with

the forwardly projecting end of an engine crank shaft, a crank case having a forwardly extending supporting member, a transverse frame member, and connections between the crank case extension and transverse frame members; of a starting motor carried by the frame member at the front thereof, variable speed gearing, mounted on the end of the crank shaft at the rear of the member, and axially separable connections between the motor and gearing.

9. In a motor vehicle the combination with the forwardly projecting end of an engine crank shaft, and a transverse frame member; of a starting motor carried by said member, and speed varying gearing carried by the end of the crank shaft and connecting the motor and crank shaft for the transmission of power, said speed varying gearing having a fan belt driving surface formed on the periphery thereof.

10. In a motor vehicle the combination with the forwardly projecting end of an engine crank shaft, and a transverse frame member; of a starting motor carried by said member, and speed varying gearing carried by the end of the crank shaft and connecting the motor and crank shaft for the transmission of power, and a rotatable casing inclosing the gearing and having a fan belt driving surface on its periphery.

In testimony whereof I hereunto set my hand in the presence of two subscribing witnesses.

VINCENT G. APPLE.

In the presence of—
CARL L. BAUMANN,
MORRIS P. CROMER.