Dec. 20, 1932. W. S. CEABLOM 1,891,868

ENGINE STARTING DEVICE

Filed April 1, 1931

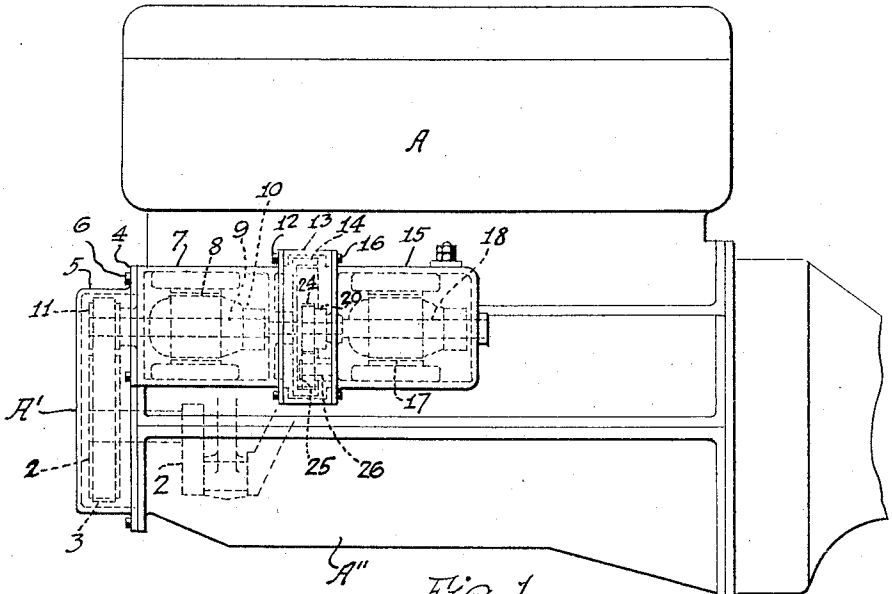


Fig. 1.

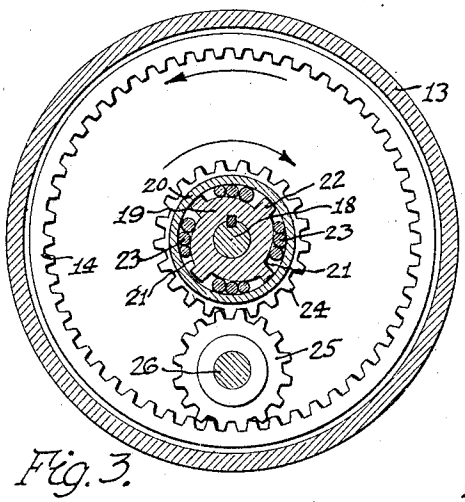


Fig. 3.

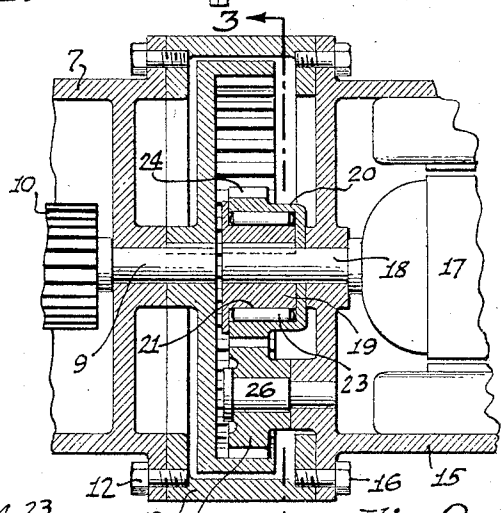


Fig. 2.

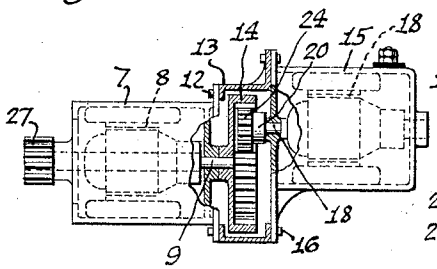


Fig. 5.

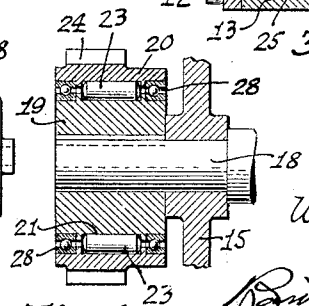


Fig. 4.

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UNITED STATES PATENT OFFICE

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ENGINE STARTING DEVICE

Application filed April 1, 1931. Serial No. 526,984.

This invention relates to an electric starter-generator for internal combustion engines, and an object is to provide a construction which is such as to make the same especially adaptable for attachment to the crank case of an engine, conserving space, presenting a very neat appearance, and providing a compact and efficient arrangement of motor and generator including connecting driving means therebetween which is such as to effect a driving connection only when the speed of the motor is greater than the speed of the generator, and said motor is always free to lag in speed behind that of the generator or to stop, said connecting means being always operative to effect a driving connection whenever the motor is operated at a higher speed than that of the generator, said connecting means being compact and efficient in operation and not liable to get out of order.

With the above and other ends in view, the invention consists in the matters hereinafter set forth and more particularly pointed out in the appended claims, reference being had to the accompanying drawing in which

Fig. 1 is a side elevation of a starter-generator illustrative of the invention and illustrating the application thereof to an internal combustion engine;

Fig. 2 is an enlarged longitudinal section through adjacent end portions of generator and motor casings and interposed connecting means for transmitting motion from motor to generator;

Fig. 3 is a transverse section substantially upon the line 3—3 of Fig. 2;

Fig. 4 is a longitudinal, sectional detail showing a modified construction of clutch device; and

Fig. 5 is a side elevation with parts broken away and in section, of a slightly modified construction of starter-generator, drawn to a reduced scale.

As shown in the drawing, A indicates an internal combustion engine of the usual vertical cylinder type and construction, the same being provided with the usual pulley casing A′ on the forward end of its crank case A″ and enclosing a pulley 1 on the forward end of its crank shaft 2 and a driving belt 3 engaging said pulley.

Firmly secured to a flange 4 a laterally extending portion 5 of said casing A′ by bolts 6, is the casing 7 of a generator 8 indicated in dotted lines in Fig. 1. This generator is mounted upon an axial shaft 9 which is mounted in bearings in the ends of said casing 7 and upon this shaft is secured the armature 10 (shown in Fig. 2) of said generator. The forward end of this shaft 9 is extended into the offset portion 5 of the casing A′ where it is provided with a pulley 11 over which the belt 3 runs to transmit motion to or from the engine crank shaft 2, to or from said generator shaft 9.

The generator casing 7 is thus supported at its forward end only by the flange 4 of the offset portion of the casing A′ and extends parallel with one side of the motor rearwardly from said casing and the opposite or rear end of said casing 7 is flanged outwardly for the securing thereto by bolts 12, of a second or intermediate clutch casing 13 into which the rear end of the shaft 9 extends and has rigidly secured thereto, an internal gear 14 of large diameter. A motor casing 15 is secured at one end to the opposite end of the casing 13, by bolts 16 and in this motor casing is an electric motor 17 having a shaft 18 mounted in bearings in the ends of said casing with said motor shaft in longitudinal axial alignment with the generator shaft 9, but not directly connected thereto.

Keyed to said motor shaft 18 within the casing 13, is the inner or cam member 19 of an over-running clutch, the outer or sleeve member 20 of which is free to turn upon said shaft and is formed with a cylindrical or sleeve portion overlying a series of eccentric surfaces 21 formed upon the exterior of the inner or hub member 19 of the clutch, said surfaces being formed between longitudinal ribs 22 on said member, thus forming between said ribs, longitudinal recesses in the exterior of said member, the bottom surfaces 21 of which recesses are formed eccentric to the axis of rotation of said hub or cam member with said surfaces approaching said axis at their forward sides in the direction of nor-

mal rotation of said member. These recesses between the ribs are therefore deeper at their forward than at their rear sides so that a series of rollers 23 in each recess will, when urged toward the shallow side of the recess by the forward turning of said cam member, be caught between the sleeve and cam surface of the bottom of each recess and transmit motion from said hub or cam member through said rollers to said sleeve 20, which sleeve is formed with external gear teeth 24 in mesh with the teeth of an idler gear 25 mounted to rotate freely upon a stud 26 carried by the end wall of the motor casing 15, and which idler is in constant mesh with the internal gear teeth of the large gear 14 keyed to the generator shaft 9.

Therefore, with this arrangement, when the cam or hub member 19 on the motor shaft 18, is rotated by said motor at a higher rate of speed than that at which generator shaft 9 is turning, power will be transmitted from the motor 17 by the overrunning clutch, to the internal gear 14 and generator shaft 9 and through the driving belt 3 to the engine crank shaft to turn the engine over in starting. When the engine has started, it will drive the generator through the belt 3 and when the speed of the generator so driven, exceeds the speed of the motor, the sleeve member 20 of the clutch will roll the rollers 23 back into the deep sides of the recesses in the member 19 and out of frictional engagement with said sleeve, permitting the motor 17 to turn freely, independently of said generator or to stand still while the motor A is running and driving the generator.

By securing the generator and electric motor together in endwise alignment and connecting them at their adjacent ends by a casing containing the overrunning clutch, a very compact arrangement is secured and an arrangement which is particularly adaptable for application to an internal combustion engine of the usual construction, the forward end of the generator casing being bolted to the usual casing at the forward end of the engine crank case, by extending this casing laterally to form a chamber for the pulley 11 and also a support for said generator which extends rearwardly alongside the engine and carries the clutch casing and electric motor casing connected endwise thereto.

A modified construction of overrunning clutch is shown in Fig. 4, the hub or cam member 19 being keyed directly to the shaft 18 as before and formed with the external cam surfaces 21 for the rollers 23. The sleeve 20, however, instead of rotating upon the shaft 18, is sleeved over and carried by the member 19, there being interposed between said sleeve and said cam member, two annular ball bearings 28, one at each end of said sleeve member, so that said sleeve member will turn freely and be guided upon said cam member, the cam surfaces of which cam member function the same as before to release the rollers when said cam member lags behind the speed of the sleeve member, and to cause said rollers to wedge in between said cam member and sleeve when said cam member is rotated at a speed greater than that of the sleeve.

As illustrated in Fig. 5 of the drawing, the idler gear 25 may be dispensed with if so desired, by offsetting the motor casing 15 relative to the clutch casing 13 so that the sleeve member 20 having the external gear teeth 24, will engage directly with the internal gear 14. Also instead of employing pulleys and belt to form a driving connection between engine crank shaft and generator shaft, a gear 27 may be provided on the end of said generator shaft to mesh with a large gear, (not shown) substituted on the crank shaft for the pulley 1.

Obviously other changes may be made in the construction and arrangement of parts, without departing from the spirit of the invention, and I do not therefore wish to limit myself to the particular construction and arrangement shown.

Having thus fully described my invention, what I claim is:—

1. In an electric starter-generator for an internal combustion engine a casing at the forward end of said engine and having an offset portion extending laterally beyond the side of said engine, gearing in said casing for transmitting power to and from the crank shaft of said engine, a generator casing secured at one end to said offset portion of said casing on said engine to extend rearwardly therefrom alongside the engine, a generator in said generator casing having a shaft to extend into said offset portion of said casing on said engine for operative connection with said gearing, a motor casing, an electric motor in said motor casing having a shaft extending from said casing, a clutch casing interposed between the adjacent ends of said motor and generator casings for rigidly connecting the same and of a diameter substantially equal to the diameter of said casings, and overrunning clutch mechanism in said clutch casing for transmitting motion between said motor shaft and said generator shaft.

2. In an electric starter-generator, the combination of a generator casing, a generator in said generator casing having a shaft projecting from said casing at its ends, an overrunning clutch casing secured at one end to an end of said generator casing in axial alignment therewith, with an end of said generator shaft extending into said clutch casing at the axis thereof, a motor casing secured at one end to said clutch casing at the side thereof opposite that at which it is secured to said generator casing, a motor in said motor casing having a shaft extending into said clutch

casing, an internal gear on said generator shaft in said clutch casing and of a diameter and width substantially equal to the internal diameter and length of said clutch casing, a small gear on the end of said motor shaft within said internal gear at the axis thereof, an idler gear for transmitting motion between said internal gear and small gear on said motor shaft, all within said internal gear, and one way driving clutch mechanism in said gear on said motor shaft.

3. In an electric starter-generator, the combination of a generator casing, a generator in said generator casing and having a shaft, with one end projecting from the end of said generator casing, a clutch casing secured to the opposite end of said generator casing and supported thereby, a motor casing secured to the side of said clutch casing opposite that at which said clutch casing is secured to said generator casing and supported wholly by said clutch casing, a motor in said motor casing having a shaft mounted in bearings in the ends of said motor casing with one end of said shaft extending into said clutch casing, a large internal gear on the end of said generator shaft within said clutch casing, a small gear on the end of said motor shaft within said clutch casing to turn freely thereon, a cam member on said motor shaft and having cam surfaces opposing the inner surface of said small gear, and rollers between said cam surfaces and inner surface of said gear to wedge therebetween when said motor shaft is rotated faster than said generator shaft.

In testimony whereof I affix my signature.

WENDELL S. CEABLOM.