A. D. SCOTT.

SYSTEM FOR AUTOVEHICLES.

APPLICATION FILED JUNE 5, 1913.

1,172,909.

Patented Feb. 22, 1916.

2 SHEETS—SHEET 1.

FIG. 1

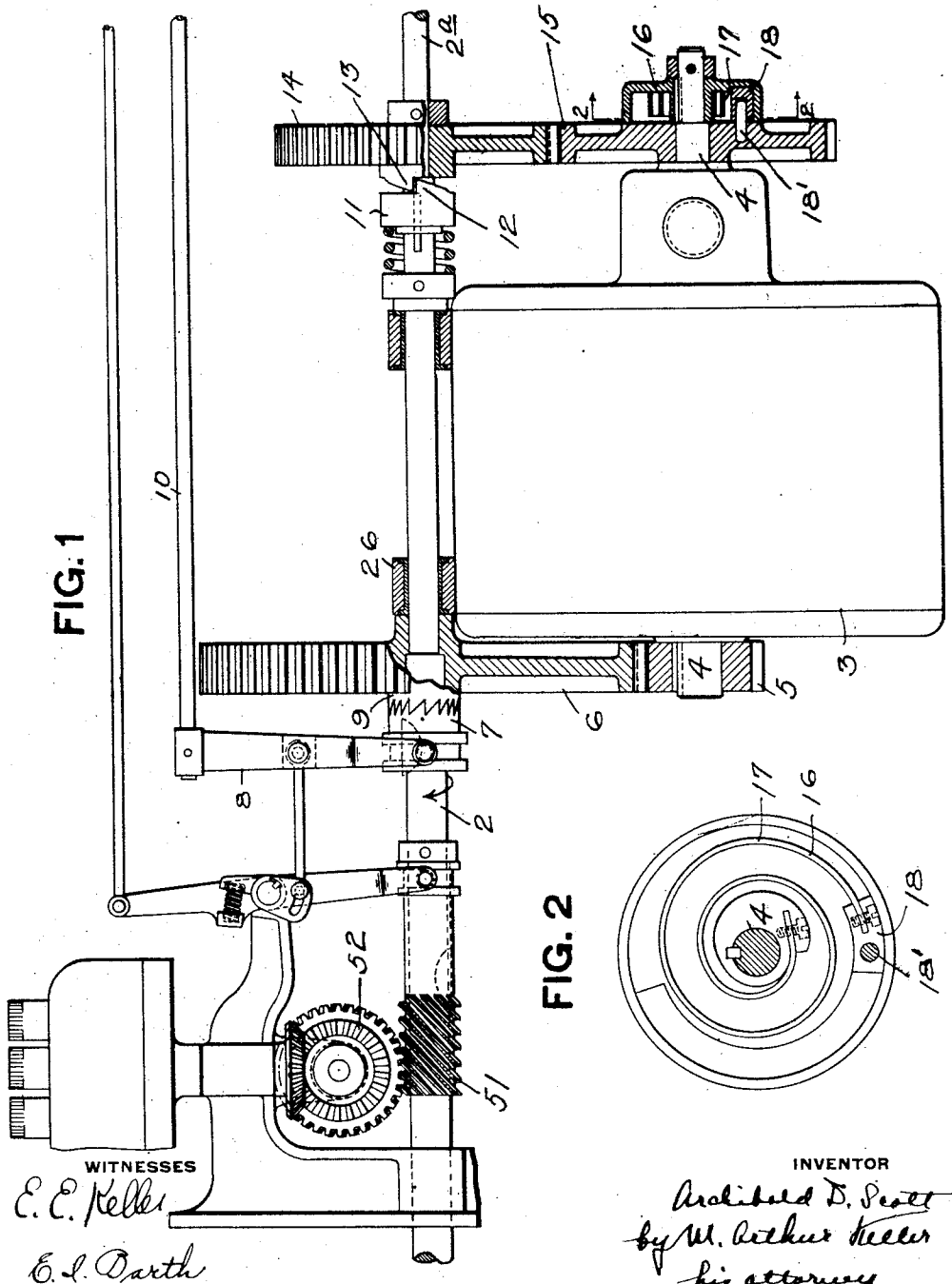


FIG. 2




WITNESSES

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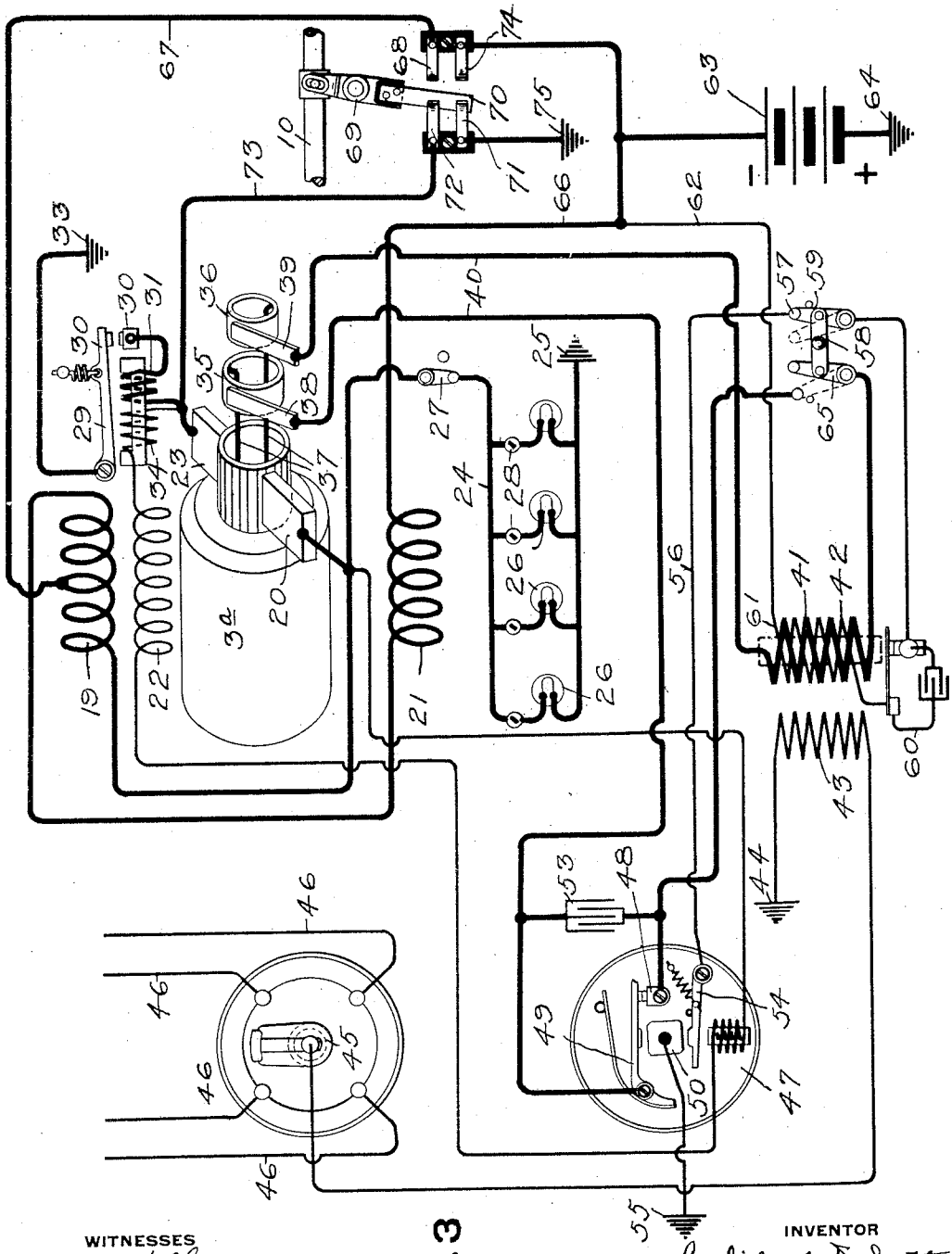

FIG. 3

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# UNITED STATES PATENT OFFICE.

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## SYSTEM FOR AUTOVEHICLES.

1,172,909. Specification of Letters Patent. Patented Feb. 22, 1916.

Application filed June 5, 1913. Serial No. 771,884.

*To all whom it may concern:*

Be it known that I, ARCHIBALD D. SCOTT, a citizen of the United States of America, residing at Jersey City, in the county of Hudson and the State of New Jersey, have invented new and useful Improvements in Systems for Autovehicles, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, which form part of this specification.

This invention relates to electrical equipment adapted for use in connection with combustion engines, and more particularly such engines used on autovehicles, as automobiles, motor boats, etc., and it is directed to the provision of means whereby an ignition element may be brought into synchronism with the engine during self-propulsion thereof, irrespective of any irregular or non-synchronous relationship which may have existed between the engine and ignition element prior to or during starting of the engine.

An advantageous employment of my invention is clearly instanced in the case of an electric starting element associated with the power transmitting shaft of which is a magneto generator adapted to supply current for energizing of the spark plugs of the engine cylinders. Where the power transmitting shaft is driven at a speed different from that of the engine shaft, as in operating torque multiplying mechanism (for starting of the engine), or where a variable clutch connection is employed between the starter mechanism and engine, ordinarily synchronous relationship between the two shafts does not obtain upon termination of starting function, but by my invention there is insured assumption and maintenance of positive predetermined constant driving union between the engine and current generating element after starting of the engine, regardless of such above mentioned preëxisting non-synchronous association.

In the accompanying drawings I show my invention as embodied in and associated with a system in which provision is made for starting of the engine by a dynamo motor, and driving of the dynamo motor is effected through my invention in such manner as to energize spark producing apparatus at a time when the wave of the current used for ignition purposes is at or near its maximum period or point of flow. However, I do not desire to limit myself to the particular construction shown, nor to the embodiment of my invention in apparatus associated with a starting mechanism or a dynamo motor, for it will be premised that the principle of bringing an ignition element into synchronism with the engine, may be associated with other elements of an ignition system, such as the ignition time or controller, interrupter mechanism or the distributer.

Figure 1 is a side elevational view partly in section of apparatus and system adapted for the starting of an engine of an autovehicle and for supplying current for the vehicle equipment, including an ignition element, and embodying my invention; Fig. 2 is a section on the line 2—2 of Fig. 1; and Fig. 3 is a diagrammatic view showing preferable circuit arrangements for the dynamo motor and ignition circuit, to be hereinafter more fully described.

Referring to Figs. 1 and 2, the numeral 2 indicates a power transmitting shaft which may comprise the engine shaft or may be an auxiliary shaft associated with the engine, as hereinafter described, in such manner that the shaft may transmit power to the engine from a motor-generator or dynamo motor element 3, after which said shaft may be driven by the engine for operation of the electric element to store or accumulate and furnish power to the vehicle equipment. The element 3 preferably takes the form of a dynamo motor which may be of any suitable design or construction, but which preferably embodies the arrangement shown in Fig. 3 wherein a generator element is employed, having the characteristics of supplying an ignition current to spark producing apparatus after the engine has become self-propulsive. With respect to this function, *i. e.*, the supplying of an ignition current, my invention is more particularly concerned. Where the ignition current generator is so associated with the moving element (in this case the dynamo motor) between which and the power transmitting shaft a gear reduction obtains, that driving of the shaft of the moving element effects driving of the current instrumentalities at a high speed and out of step or synchronism with the cycles of the engine (with respect to the symmetrical rise and fall of the current wave), such current element must be restored to its nor-

mal or synchronous relationship with the engine after the latter has become self-propulsive and operates to drive the current generator, for energizing of the ignition circuit. I therefore provide the mechanism and system hereinafter described, for bringing the power transmitting shaft into synchronous driving connection with the dynamo motor or ignition element subsequently to starting of the engine.

Referring to Fig. 1, the shaft 4 of the dynamo motor element fixedly carries a pinion 5 meshing with which is a gear 6 normally loosely carried by and held against longitudinal shifting on the shaft 2. Keyed to the shaft 2 is a slidable clutch collar 7 controllable by a shifting yoke 8, for shifting into and out of engagement with a clutch face 9 of the gear 6. This yoke 8 is carried by an operating rod 10 which may lead to the running board of the vehicle and be associated with any suitable manual operating means. Also keyed to the shaft 2 or otherwise fixed thereto so as to be rotatable with the shaft is a longitudinally yieldable or spring pressed clutch member 11 which carries a clutch dog or lug 12 arranged for engagement with a similar dog 13 carried by a gear 14 loosely journaled on the reduced portion $2^a$ of the shaft 2. Meshing with the gear 14 is a companion gear 15 carried by the dynamo motor shaft 4. As shown in Figs. 1 and 2, connection between the shaft 4 and the gear 15 may be effected through the medium of the yieldable coupling 16 comprising a coiled spring 17 fixed to the shaft 4 and having connection with the gear 15 by means of a concentrically slidable block 18 and a pin 18′ carried by the block and gear.

As above stated, the dynamo motor may be of any suitable design or construction, but for the attainment of certain desired ends I may employ the dynamo motor and circuit arrangements diagrammatically indicated in Fig. 3, as illustrative of the principle of my invention. In this Fig. 3 I show mainly a dynamo motor and circuit arrangements such as disclosed in the application of Richard Varley, Serial No. 763,569, and adapted to supply a direct current for the purpose of energizing a light or work circuit and also for alternately energizing an ignition circuit of spark producing apparatus, at or near the maximum points or periods of potential of the current wave generated. This dynamo motor, which is an alternating current-direct current generator and which I will hereinafter abbreviate in terms as the A. C.-D. C. element for convenience of description, is for the purpose of this case hereinafter generally described. Upon one pole piece (not shown) is a field winding 19 connecting at one end to a commutator brush 20, while at the other end of said winding serially connects a field winding 21 which is preferably mounted upon an oppositely disposed field pole (not shown). Adjacent the winding 19 is a shunt winding 22 connected across brushes 20 and 23.

The numeral 24 indicates a lamp circuit connected to brush 20 and having ground connection 25. Lamps 26 are arranged preferably in parallel therein and may be controlled either collectively by a switch 27 or individually by switches 28. A relay 29 has an armature 30 which, when attracted, closes a circuit through relay winding 31, contact 32 and ground 33, as hereinafter described; the relay winding 31 being wound in opposition to a major or larger relay winding 34 connected to brush 23 and shunt winding 22.

The numerals 35 and 36 indicate collector rings, which connect to the winding of the armature $3^a$ of the A. C.-D. C. element by taps 37 leading from said winding preferably at oppositely disposed points or 180 degrees apart so as to cause symmetrical impulses of current to be impressed upon said collector rings in each revolution of the armature, for ignition service. From collector brushes 38 and 39 leads a primary circuit 40 included in which is a primary coil or winding 41 of ignition coil mechanism 42. This primary winding is in inductive relationship to a secondary winding 43 of spark producing apparatus; one end of the said secondary winding being grounded, as at 44, and leading at the other end to a suitable distributer arm 45 of distributer mechanism of spark producing apparatus, leading from which are conductors 46 which connect to the spark plugs in the cylinders of the engine, as is well understood in the art.

Intercalated in the primary circuit and preferably carried by an ignition controller 47 is an interrupter mechanism comprising essentially a fixed contact 48 and a movable contact lever 49 pivoted so as to be rocked or oscillated by a suitable controller cam 50 which is synchronously geared preferably to the shaft 2 (see Fig. 1) by means of worm gear 51 and gearing 52. Connected across said contacts 48 and 49 is the usual condenser 53 which is charged and discharges upon closing and opening of the primary circuit 40. Also carried by the ignition controller 47 is an insulated contact lever 54 arranged for contactual engagement by the cam 50 which is preferably grounded, as at 55. The lever 54 connects by lead 56 with a switch contact 57 of a double armed switch 58, the arm 59 of which operates to connect lead 56 with vibrator or trembler mechanism 60 and its associated primary winding 61 of the coil 42. The opposite end of the winding 61 of the trembler coil connects by lead 62 with a battery or accumulator 63,

which is grounded, as at 64, and the other arm 65 of the double armed switch controls connection of the primary circuit 40; the arrangement of the switch and its contacts being such as to render the primary circuit inoperative during utilization of the vibrator coil mechanism 60 and 61 and to render the last named means and circuit inoperative during use of the primary circuit 40, thereby providing an arrangement affording an effective ignition circuit during starting of the engine and before the current in the armature $3^a$ builds up sufficiently to energize alternately the circuit 40, as hereinafter described.

The field winding 21 of the A. C.-D. C. element also connects with the battery, as by lead 66, while a lead 67 taps the field winding 19 preferably at a median point and connects with a switch contact 68 of switch mechanism 69 operatively controlled by the operating rod or shaft 10 above described. The switch mechanism 69 comprises a pivotal switch blade 70 adapted to complete a field energizing circuit through contacts 71 and 72 and lead 73 and also alternatively part of a battery charging circuit through contacts 68 and 70 and lead 67, as hereinafter described.

It will be seen that upon shifting of the operating rod 10 of the power transmitting mechanism, in such manner as to move the clutch member 7 toward the gear 6, the switch member 70 will be shifted into contactual engagement with its contacts 71 and 72, thereby completing a circuit from battery 63 through switch contact ground 75, lead 73, shunt winding 22 and series field winding 19 and 21 back to battery through lead 66. Resultant energizing of the A. C.-D. C. element will set up (through rotation of the armature $3^a$) driving of the shaft 2 through gears 5 and 6, for starting of the engine, and if it is desired to complete the ignition circuit for energizing of the spark producing apparatus, the double armed switch 58 is shifted to the position shown in Fig. 3, wherein the switch arm 59 connects the vibrator coil mechanism into circuit with the battery 63, so that upon contact of the grounded cam 50 of the controller (which, as is well understood is geared in synchronism with the cycles of the engine) with the lever 54, incident to driving of the shaft 2, the winding 61 of said vibrator coil mechanism will be energized, thus producing inductively a high potential ignition current in the secondary winding 43 and which is distributed to the cylinders of the engine in the usual manner for explosion of the combustible charge or charges therein.

Upon induction of self-propulsion of the engine, the A. C.-D. C. element may be brought out of starting relationship by shifting of the operating rod 10 for declutching of the members 7 and 9. Such shifting of the rod 10 brings the switch blade 70 out of engagement with the contacts 71 and 72, thereby breaking the A. C.-D. C. element energizing circuit, and into engagement with switch contacts 68 and 74 for partial completion of a battery charging circuit established upon closing of the relay armature 30, when the armature $3^a$ has attained such speed as operates for rise of voltage sufficiently to energize the relay and charge the battery; the battery charging circuit leading from the brush 23, through the relay winding 31, contact 32, relay armature 30 and grounds 33 and 64, to battery, the opposite terminal of the battery connecting with a portion of the series field winding 19 (the active portion during driving of the A. C.-D. C. element by the engine) which in turn leads to brush 20. After the engine has become self-propulsive and it is desired to utilize the primary circuit 40, the double armed switch 58 is shifted to the dotted position shown in Fig. 3, whereby the vibrator or trembler battery ignition circuit is broken and a primary circuit established from the collector rings 35 and 36, for periodic opening and closing by the interrupter mechanism, for energizing of the primary winding 41 and inductive energizing of the secondary winding 43.

As stated above, the interrupter mechanism is geared in synchronism with the engine. Therefore upon driving of the engine, closing of the contacts 48 and 49 will be effected at periods coincident with the compression strokes of the engine, and in order that closing of the primary ignition circuit 40 may take place at a time coincident with or at or near the maximum points or periods of potential of the current wave generated by the A. C.-D. C. instrumentality or within the armature $3^a$, I so dispose the above described clutch member 11 on the shaft 2 relatively to the timing position of the gears 14 and 15 and the clutch dog 13 as well as with respect to the phase of polarity or peak of the wave of the current generated in the armature $3^a$ as to always connect the shaft 2 (which preferably has a fixed synchronous relationship to the cycles of the engine) with the gear 14 at a fixed or non-varying point of clutch engagement; *i. e.*, the clutch dog 12 of the member 11 occupying a non-variable position with respect to the shaft 2 and engaging a lug or dog 13 also occupying a definite and non-changing timing relationship with respect to the gear 15 carried by the armature shaft 4.

It will thus be seen that the shaft 4 may be rotated at a high speed for starting of the engine, without regard to maintenance of synchronous relationship between said armature shaft and the power transmitting shaft or the engine, and that subsequently to starting of the engine and disconnection of

the shaft 4 from starting service, the shaft 2 may be so clutched into engagement with the other set of gears as to insure establishment and maintenance of a synchronous drive between the engine and the shaft 4 of the A. C.-D. C. element.

The gears 14 and 15 are preferably so proportioned as to enable the A. C.-D. C. element to be driven at about engine speed; the gears in this instance being shown as of equal diameters, from which it will be understood that the shaft 2 is driven at engine speed. This arrangement follows essentially the power transmitting mechanism and system disclosed in the above mentioned application Serial No. 763,569 of Richard Varley, wherein the ratio between the gears 5 and 6 is such as to afford a large gear reduction for multiplication of the torque of the shaft 4. As the reduced ratio of the gears offers a speed too high for proper driving of the A. C.-D. C. element and also a degree of inertia which cannot be immediately dissipated or overcome upon sudden starting of the engine, the second set of gearing or driving connections 14 and 15 between the engine and the A. C.-D. C. element is employed so that the latter may be driven at a speed more consonant with its character as a generator of current. Therefore it readily will be seen that during starting of the engine, the gear 14 upon the shaft 2 will be driven at a speed equal to that of the shaft 4, with the result that the clutch dog 13 of the gear travels past the companion dog of the clutch member 11. After the engine has become self-propulsive and the speed of the shaft 2 increases, or as the speed of the gear 15 or gear 14 lessens through bringing of the A. C.-D. C. element out of engine starting relationship with the shaft 2, the travel of the shaft 2 will overcome the speed of the gear 14 so that the clutch dog 12 will be brought thereby into engagement with the dog 13 of the gear, setting up rotation of the gear 14 and resultant driving of the A. C.-D. C. element in step with the compression strokes of the engine. It therefore will be seen that as the gear 14 initially is driven at a greater speed than the shaft 2 in starting of the engine, and as the shaft 2 is brought into driving relationship with the gear 14 only upon equalizing of the speeds of the two elements, no shock can be transmitted to the A. C.-D. C. element or the gears upon clutch engagement of the said shaft with the gear 14. However, should there from some abnormal condition, occur any abrupt or impulsive clutching-in of the shaft 2 with the gear 14, the yieldable coupling 16, above described, would guard against transmission of shocks.

The advantages of my invention will be found to reside in a system of the above character which readily lends itself, as shown, to advantageous employment in connection with an electric unit employed for starting of the engine of an autovehicle and for the supplying of an effective ignition current for use at the spark plugs of the cylinders of the engine.

While I have described my invention as employed in connection with a particular form of power transmitting apparatus and also in association with a particular electrical unit, I do not desire to limit myself thereto, for it will be apparent that the principle of establishing a non-varying or synchronous drive relationship between the electric element and the engine, may be greatly varied. For instance, while I have described the shaft 4 as being that of the armature shaft of the A. C.-D. C. element or dynamo motor, the alternating current instrumentality may be associated with the shaft 4 in other ways, as by employing the shaft 4 in connection with a separate starting motor or shaft and employing a separate alternating current generator in synchronous association with said shaft.

As stated above, the shaft 2 may be the engine shaft or a counter shaft having driving connection with the engine and when, in the claims, I refer to this shaft, it is to be so understood as either the engine shaft or an auxiliary shaft.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. In a system of the class described, the combination with a combustion engine, of a shaft for transmitting power to and receiving power from the engine, an alternating current generator, operatively associated with the shaft, means whereby the shaft may start the engine without regard to maintenance of synchronous association of the shaft and alternating current generator, and means whereby the shaft may actuate the alternating current generator always in a certain phase relationship.

2. In a system of the class described, the combination with a combustion engine, of a dynamo forming part of a starting and ignition system and adapted to deliver alternating current, and means for connecting the engine with the dynamo so that the latter may actuate the engine at one ratio of speed and without regard to maintenance of synchronous coupling of engine and dynamo, and the engine may actuate the dynamo at a certain predetermined speed and phase relation.

3. In a system of the class described, the combination with a combustion engine, of a dynamo forming part of a starting and ignition system, and having both alternating and direct current elements, and means for connecting the engine with the dynamo so that the latter may actuate the engine

without regard to maintenance of synchronism between the engine and dynamo, and the engine may actuate the dynamo always in a certain phase relationship.

4. In a system of the class described, the combination with a combustion engine, of a dynamo forming part of a starting and ignition system and having both alternating and direct current elements, and means for connecting the engine with the dynamo so that the latter may actuate the engine at one speed ratio and the engine may actuate the dynamo at another speed ratio and in a certain predetermined phase relationship.

5. In a system of the class described, the combination with a combustion engine, of a shaft adapted to transmit power to and be driven by and in synchronism with the engine, a second shaft for transmitting power to and receiving power from the first shaft, an alternating current generator operatively associated with the second shaft, gearing connection between the two shafts and comprising a large gear associated with the first shaft and a relatively smaller gear associated with the second shaft, whereby the second shaft may drive the first shaft for starting of the engine and without regard to maintenance of synchronous association of the second shaft with the engine, and means for bringing the second shaft into synchronous step with the first shaft after said second shaft has been brought out of starting service, for actuation of the generator always in a certain phase relatively to the engine.

6. In a system of the class described, the combination with a combustion engine, of a shaft adapted to transmit power to and be driven by and in synchronism with the engine, a second shaft for transmitting power to and receiving power from the first shaft, a current generator synchronously connected to the second shaft, spark producing apparatus associated therewith, gearing connection between the two shafts whereby the second shaft may drive the first shaft for starting of the engine and without regard to maintenance of synchronous association of the second shaft with the engine, and means for bringing the second shaft into such receptive driving relationship with the first shaft as to maintain such relative association of the engine and generator as to cause the latter to energize the spark producing means at or near the period of maximum potential of the current wave generated and coincident with compression strokes of the engine.

7. In a system of the class described the combination with a combustion engine, of a shaft adapted to transmit power to and be driven by and in synchronism with the engine, a second shaft for transmitting power to and receiving power from the first shaft, a current generator synchronously connected to the second shaft, spark producing apparatus associated therewith, reducing gears connecting the two shafts whereby the second shaft may drive the first shaft for starting of the engine and without regard to maintenance of synchronous association of the second shaft with the engine, and means for bringing the second shaft into such receptive driving relationship with the first shaft as to maintain such relative association of the engine and generator as to cause the latter to energize the spark producing means at or near the period of maximum potential of the current wave generated and coincident with compression strokes of the engine.

In testimony whereof I have hereunto set my hand.

ARCHIBALD D. SCOTT.

Witnesses:
WILLETT CHADWICK,
J. GEO. MEYERS.