R. VARLEY.

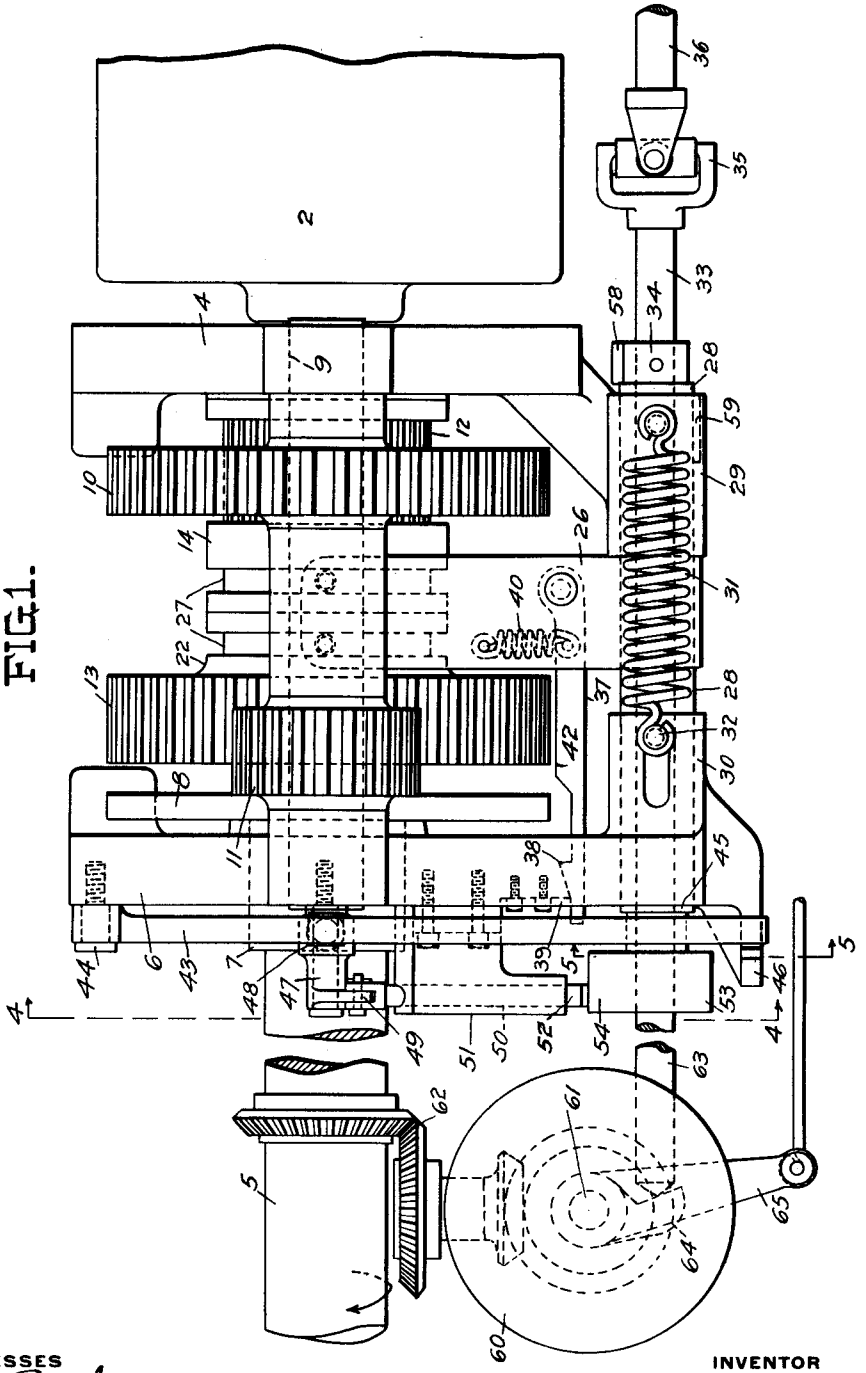
STARTER APPARATUS AND SYSTEM FOR AUTOVEHICLES.

APPLICATION FILED NOV. 14, 1912.

1,072,279. Patented Sept. 2, 1913.

5 SHEETS—SHEET 1.

FIG. 1.



WITNESSES

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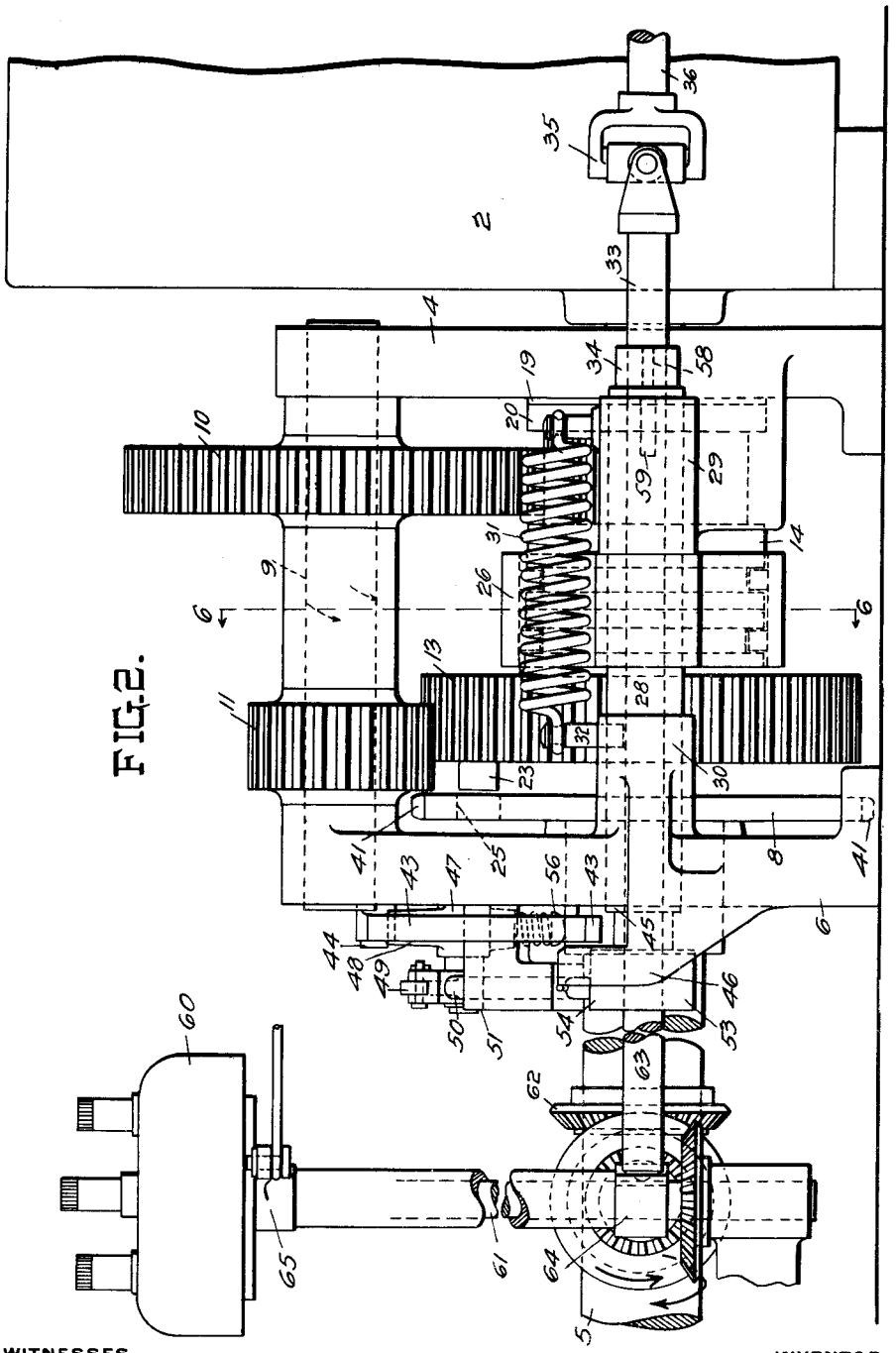
5 SHEETS—SHEET 2.

FIG. 2.



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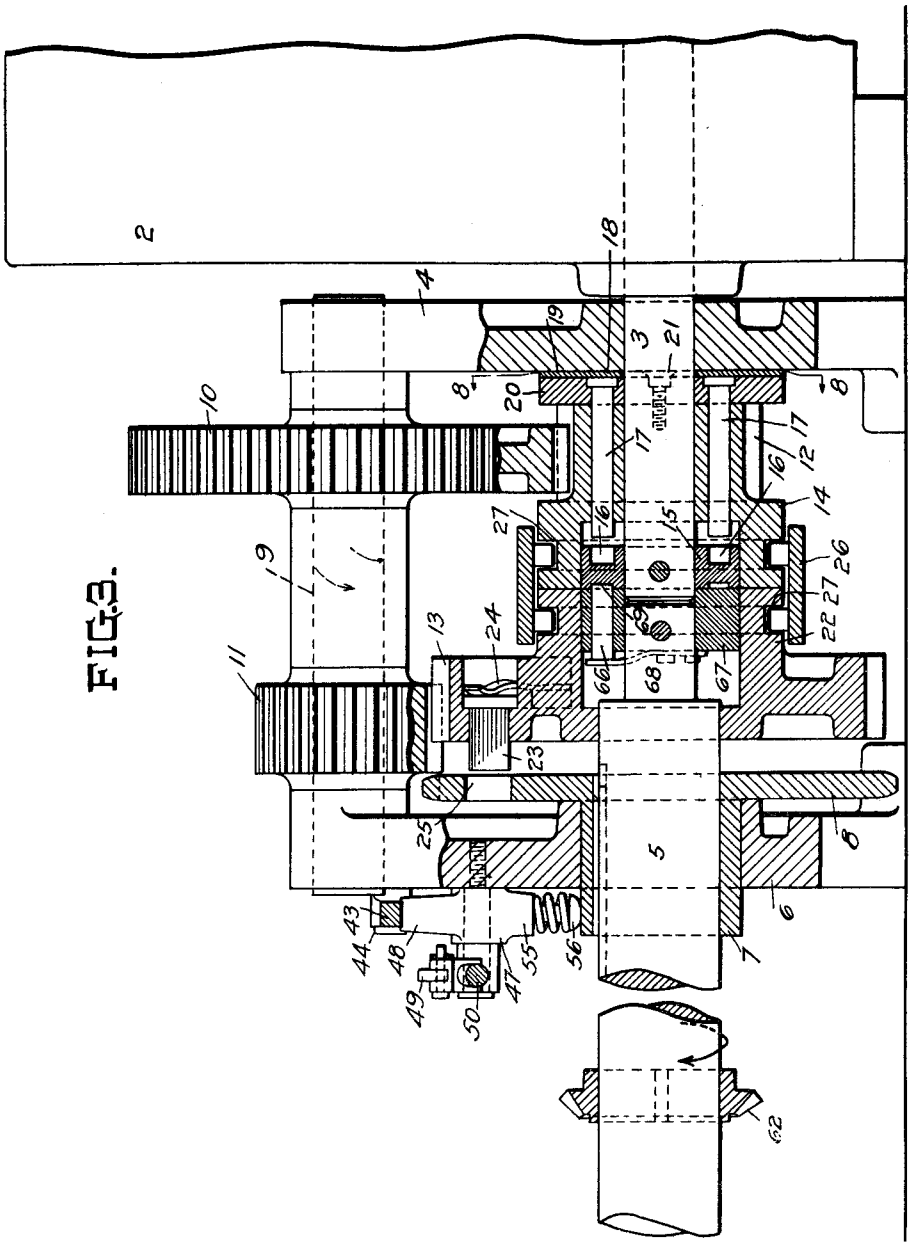
5 SHEETS—SHEET 3.

FIG. 3.



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5 SHEETS—SHEET 4.

FIG. 4.

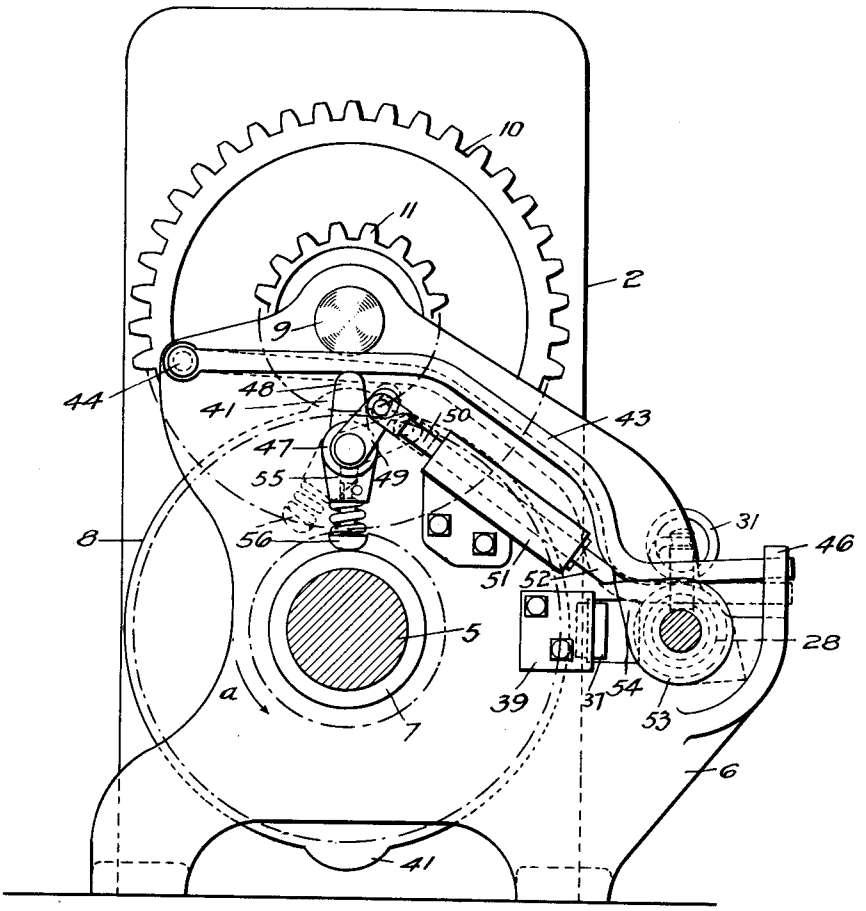
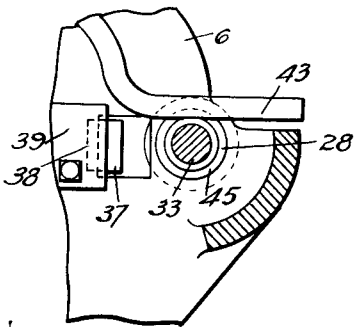


FIG. 5.



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5 SHEETS—SHEET 5.

FIG. 7.

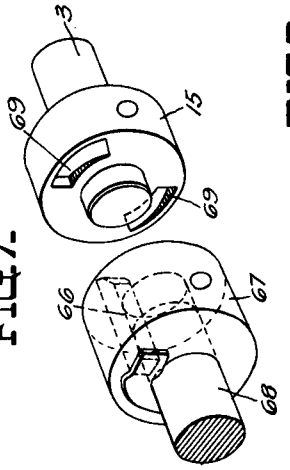


FIG. 9.

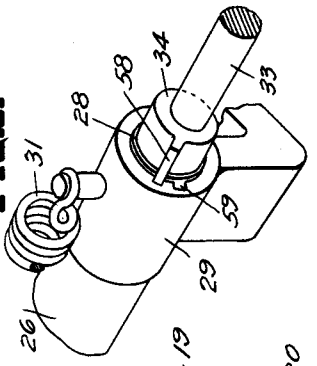


FIG. 8.

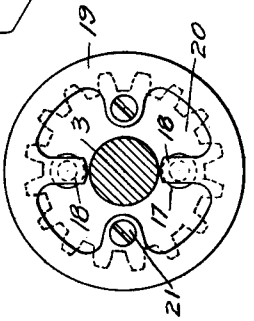
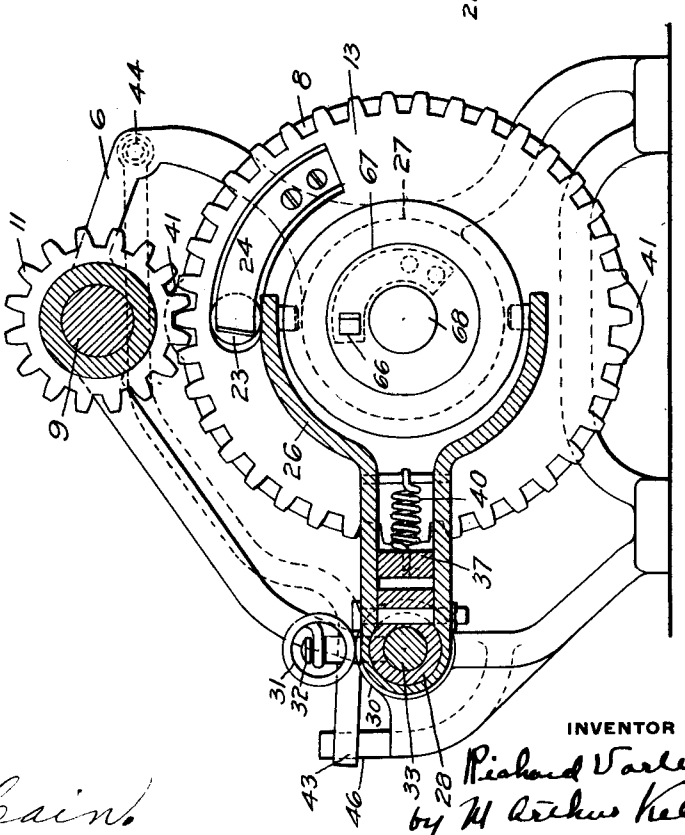


FIG. 6.



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UNITED STATES PATENT OFFICE.

RICHARD VARLEY, OF ENGLEWOOD, NEW JERSEY, ASSIGNOR TO VARLEY DUPLEX MAGNET COMPANY, OF JERSEY CITY, NEW JERSEY, A CORPORATION OF NEW JERSEY.

STARTER APPARATUS AND SYSTEM FOR AUTOVEHI(

1,072,279. Specification of Letters Patent. Patented Sept. 2, 1913.

Application filed November 14, 1912. Serial No. 731,336.

To all whom it may concern:

Be it known that I, RICHARD VARLEY, a citizen of the United States of America, residing at Englewood, in the county of Bergen and State of New Jersey, have invented new and useful Improvements in Starter Apparatus and 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 is an improvement in power transmitting mechanism and systems; involving divisional subject matter of my application filed November 6th, 1912, Serial No. 729,785, and relating more particularly to the starter mechanism and system disclosed therein, whereby the combustion engine of the vehicle may be initially driven or started.

It aims to provide mechanism which is simple and compact in construction and efficient in operation. To that end, in the particular construction shown in the accompanying drawings, and hereinafter described, means are so employed in connection with torque multiplying mechanism, that a driving element or motor may be brought into operative starting relationship with the engine and thereafter out of starter relationship in such manner as to preferably render the torque multiplying mechanism stationary and non-operative during self-propulsion of the engine, thereby affording apparatus in which is absent all wear and tear incident to continuous or extended driving of the parts.

A further object of my invention is to provide starter mechanism so devised as to enable such initial rotation of the engine shaft as shall operate for expulsion or dissipation of the dead or waste gases from the engine cylinders preparatory to energizing of the ignition circuit and spark plugs and firing of the engine, and disconnection or release of such mechanism in a manner preferably substantially coincident or uniactional with said firing and assumption of self-propulsion of the engine, thereby insuring intake of full potential gas charges for the initial explosion or explosions, and overcoming of abortive firing.

Another object of my invention is the provision of means whereby the torque multiplying mechanism can not be brought into starting relationship with and during running of the engine and after being brought out of starter service, thereby removing liability of injury to said mechanism.

Other new and improved features of construction are provided, as will be hereinafter more fully described, and set forth in the claims.

Figure 1 is a top plan view showing apparatus embodying my invention, the power transmitting element or motor being partly broken away; Fig. 2 is a side elevation of the same; Fig. 3 is a longitudinal vertical sectional view; Fig. 4 is a transverse section on the line 4—4 of Fig. 1; Fig. 5 is a fragmentary transverse section on the line 5—5 of Fig. 1, but showing the gear shifting mechanism locked in an inoperative position; Fig. 6 is a section on the line 6—6 of Fig. 2; Fig. 7 is a perspective view showing clutch elements whereby the engine may be brought into reciprocal driving relationship with the motor, as hereinafter more fully described; Fig. 8 is a section on the line 8—8 of Fig. 3; and Fig. 9 is a fragmentary perspective view of the gear shifting mechanism, and showing means for preventing shifting of the gears to engine starting position during self-propulsion of the engine.

The motor element, indicated by the numeral 2, may take the general form of the type disclosed in my above mentioned application, Serial No. 729,785, or may be of any type suitable for the purpose of starting the engine. If desired it may take the form of a motor generator or a dynamo motor in which case, as hereinafter described, means may be provided for driving of the said electric element by the engine, for furnishing current to the battery or accumulator usually employed for energizing the motor, and to other equipment of the vehicle, as is more fully set forth in my above mentioned application.

The shaft 3 of the motor passes through or is journaled in a housing or bearing frame 4 of starter mechanism, and preferably in alinement with the shaft is a shaft 5 which may be the engine shaft or constitute an auxiliary shaft which may have geared connection with the engine shaft. This power transmitting shaft 5 is also supported

by an end frame or housing 6, being more directly journaled therein by means of the hub or sleeve portion 7 of a disk plate 8 keyed or otherwise fastened to the shaft. Paralleling the shafts 3 and 5 and journaled at the top of the housings 4 and 6 is a countershaft 9 fixedly carrying a gear 10 and pinion 11, and meshing with the gear 10 is a pinion 12 loosely mounted on the shaft 3, while the pinion 11 meshes with a gear 13 loosely carried by the shaft 5. As shown in Fig. 3, the pinion 12 has an enlarged head portion or hub 14 bored to harbor a ring or collar 15 fixed to the shaft 3 and having on its inner face recesses 16 arranged to receive spring clutch pins 17 carried by the pinion 12, when said pinion is longitudinally shifted on the shaft, for driving of the pinion, as will be hereinafter more fully described. Referring to Figs. 3 and 8, it will be seen that the clutch pins 17 are preferably headed, so as to limit their outward travel, and are backed up by the resilient fingers 18 of the flat spring ring 19 attached to a mounting disk 20, as by screws 21 which may also serve to secure the disk to the pinion 12. Contiguous to the head 14 of the pinion 12 is a similarly formed head or extension 22 of the gear 13, while also carried by the latter gear is a clutch finger 23 held normally projecting from the face of the gear by a spring 24, and adapted for engagement with a pocket 25 formed in the disk member 8.

The gears 12 and 13 are so mounted on their respective shafts as to be capable of being reciprocably shifted thereon for the purpose of bringing the clutch pins 17 and finger 23 into (and out of) engagement with their respective clutch pockets 16 and 25, when it is desired to drive the shaft 5 by the motor shaft 3, the pinion 12 being driven by the rotating collar 15 and the disk 8 by the clutch finger 23; the torque of the shaft 3 being multiplied through the gear reduction existing between the pinon 12 and the gear 13, sufficiently to drive said shaft 5 with its engine load. To bring about such shifting, a shifting yoke 26 is provided and arranged for operative common association with the peripheral annular grooves or recesses 27 in the hub-like extensions 14 and 22 of the gears. The shifting yoke, as shown in Figs. 1 and 2, is operatively carried by a hollow shaft or sleeve 28 slidably mounted in bearings 29 and 30, preferably extensions of the end frame pieces 4 and 6. Normally, the sleeve 28 and yoke 26 are held in the retracted or inoperative position shown (*i. e.* a position in which the clutch pins 17 and finger 23 are free from engagement with the pockets 16 and 25) by means of a contractile spring 31 anchored at one end to the bearing 29 or other fixed point, and secured at the other end to the sleeve 28 by a stud 32 which passes through a slot in the bearing 30. A shifting rod or shaft 33 is mounted within the bore of the hollow shaft 28 and is provided with a fixed collar 34 lying in abutment with the respective end of the hollow shaft 28. By means of this shaft 33 the shaft 28, and consequently the yoke 26, may be advanced or shifted to move the gears 12 and 13 to engine starting position; said shaft 33 being shown as provided with a universal joint or knuckle 35 by means of which it may be flexibly connected with a manipulating rod or shaft 36 which may pass to the running board of the vehicle.

Pivoted to the yoke 26 is an arm 37 having a latch face 38 arranged for coöperation with a latch plate 39 on the housing 6 to hold the shifting yoke in an advanced position pending release thereof and return of the gears to non-starting position by the action of the spring 31, as hereinafter described, a spring 40 being provided to normally hold the arm 37 in latch engaging position. As shown in Figs. 2 and 4, the disk 8 has a plurality of radial lugs 41 which, when the said plate is rotated by driving of the shaft 5 in either normal or a reverse direction, strike a shoulder portion 42 of the arm 37 and release the latch 38 so that the spring 31 will return the gears to normal position, and, as hereinafter described, said lugs 41 are preferably so disposed as to cause a restoration of the gears to inoperative or non-starting position at a time substantially coincident with initial firing or assumption of self-propulsion of the engine.

To prevent shifting of the gears to engine starting position during self-propulsion of the engine, and resultant liability of injury to the torque multiplying mechanism, I provide means to lock the shaft or sleeve 28 against forward shifting while the engine is running. Referring to Fig. 4, such mechanism comprises a lock bar 43 terminally pivoted at 44 to the frame 6, and extending at the other end across the sleeve or shaft 28. During running of the engine and when the sleeve 28 is in a retracted position, normally the bar 43 lies across and in front of a lock shoulder 45 (see Figs. 1, 2 and 5) on the forward end of the sleeve 28, and back of a stop or shoulder 46 on the frame 6; the shoulder 45 being formed preferably by reducing the shifting sleeve at that point. Means for raising the bar 43 to sleeve unlocking position comprises a pivotal jack 47 the upper finger 48 of which is adapted to be swung against the under side of and lift the bar 43, by means of a crank arm 49 actuated by a slide rod 50. The rod 50 is mounted in the bearing piece 51 attached to or forming part of the end frame and has the terminal portion 52 extending into the path of a bevel nosed shifting cam 53 cam carried by the above described operating shaft 33. By rotating the

shaft 33 the nose 54 of the cam will wipe against the beveled end of and longitudinally shift the rod 50, forcing the finger 48 of the jack to an upright bar unlocking position, as shown in Fig. 4. Such righting of the finger 48 will also swing an oppositely disposed or depending finger 55 of the jack into position directly over the hub portion 7 of the disk 8. The finger 55 has a yielding or spring pressed nose 56 which frictionally engages or wedges against the curved face of the hub 7 when shifted thereover and thereby serves to hold the finger 48 in its upright position. Upon rotation of the hub 7 with the shaft 5 in the normal direction of rotatory travel or that of the arrow *a*, the finger 55 will be kicked outwardly thereby away from the hub, as indicated by the dotted position shown in Fig. 4, in which position it will be held by the weight of the resultantly lowered lock bar 43. The operating shaft 33 may be rotated by the shaft or rod 36 and knuckle joint 35, above described.

To guard against holding of the lifting jack in bar unlocking position by the cam nose 54, against the force of the rotating hub 7 on the spring nosed finger 55, an auxiliary lock is provided which prevents forward shifting of the sleeve 28 until the nose 54 of the cam has wiped past the rod 50, and consists of a lug or stop shoulder 58 on the collar 34, rotatively shiftable with said collar into a position of receptive registry with an internal slot or way 59 of the bearing 29, before the collar can be advanced by the shaft 33 to shift the sleeve 28. The relative positions of the slot 59 and the nose 54 with respect to the lug 58 are such that swinging of the lug 58 into registry with the slot shifts the nose 54 out of the path of the rod 50. It therefore will be seen that should the engine be running and the jack 47 be shifted to bar unlocking position by travel of the nose 54 against and past the end of the rod 50, said jack would be immediately shifted to a reclining inoperative position by the rotating hub 7, and should the cam nose 54 be forcibly held in bar unlocking position during rotation of the hub, such position would be one of non-registration of the lug 58 and slot 59, so that the lug 58 would lock the sleeve 28 against shifting to gear driving position even though the lock bar 43 occupied non-locking position. It will be equally apparent that, with non-rotation of the hub 7, the jack 47 may be shifted to bar unlocking position by travel of the cam nose 54 past the end of the rod 50, and will be held in such upright position by means of frictional engagement of the finger 55 with the non-rotating hub 7, so that the operating shaft 33 may be rotated to a position permissive of reception of the lug 58 by the recess 59 preparatory to advance of the sleeve 28 to engine starting position, without attending dropping of the bar 43.

Referring to Figs. 1 and 2, 60 indicates an ignition timer or controller the shaft 61 of which may be operatively geared in any suitable manner so as to be driven in synchronism with the engine, as is well understood. I have indicated such gear connections 62 between the timer shaft 61 and the shaft 5. The operating shaft 33 has the forward extension 63 in the path of which and adapted to be engaged by said shaft is an arm 64 carried by the timer or controller and by means of which, when the shaft 33 is shifted forward to bring the starter into driving relationship with the engine, the controller may be adjusted or shifted to move the contacts thereof to spark delay or retarding position, as is well understood in the art. The controller is also shown as having a usual shifting arm 65 which may connect with the running board of the vehicle and by means of which spark advance may be obtained. No ignition circuit is indicated, as any suitable or regular circuit may be employed.

It will be understood from the above description, that when it is desired to start the engine, the operating shaft 33 is rotated, as by the member 36, to shift the lock bar 43 to an elevated or sleeve unlocking position, and the lug 58 is brought into registry with the recess 59, thereby permitting the sleeve 28 and yoke 26 to be shifted by the collar 34, forward against the tension of the spring 31. Shifting of the yoke 26 will in turn shift the pinion 12 and gear 13 in such manner as to bring the clutch pins 17 toward the collar 15 and the clutch finger 23 toward the face plate 8. Should the spring pins 17 not directly engage their pockets or recesses 16 they will yield under the shifting travel of the pinion 12, riding on the face of the collar 15 until said collar has rotatively traveled to a position permissive of the pins snapping into the recesses. Resultant rotation or driving of the pinion 12 by the dynamo motor shaft 3, will drive the gear 13 through the medium of the gears 10 and 11, so that the finger 23, if not in direct registry with the pocket 25, will also ride upon the face of the disk member 8 until brought into receptive registry with its pocket. The disk 8, being keyed to the shaft 5, will in turn drive the latter for starting of the engine. Upon advance of the gears to engine starting position, the latch 38 of the arm 37 will engage the latch plate 39, thereby holding the gears in their operative or clutch engaging position pending automatic release thereof by the cam action of a lug 41 wiping past and freeing the arm 37 from its latch. I prefer to so dispose the lugs 41 on the periphery of the

disk 8 as to cause release of the starter mechanism or return of the gears to non-operative position at a period of time substantially coincident with energizing of the ignition circuit of the vehicle, in synchronism with and assumption of self-propulsion of the engine. The advantages of such an arrangement are that the starter may be momentarily manually held against release until the motor has rotated the shaft 5 sufficiently to pump or scavenge all dead or waste gases from the cylinders of the engine, after which and upon closing of the usual ignition circuit, an approaching lug 41 will release the starter or torque multiplying means to non-starting position, coincidently as firing on the first live stroke of the engine takes place; the starter mechanism is not released at a period between compression strokes of the engine and before ignition of the combustible charge takes place, therefore said starter is always effective; and by insuring disconnection of the starter mechanism and engine at a time when the engine is fired, liability to impulsive back-driving at injurious speed through the compounding gears is obviated. It will be noted also that the controller or ignition timer is positively shifted to spark retarding position as the starting mechanism is brought into driving relationship with the engine, but should there, for some other reason, (such as the existence of incandescent particles in the cylinders) occur an advanced or back firing premature explosion, resultant reverse travel of a lug 41 would free such starter mechanism from the engine so that it would be impossible to transmit an extended and injurious reverse drive or back-fire through the gears.

As disclosed in my above mentioned application, Serial No. 729,785, means may be provided whereby the motor, if of the duplex or motor generator type, may be driven by the engine, for the purpose of supplying current to the vehicle equipment, during inactivity of the torque multiplying gears. Such means, as illustrated in Figs. 3 and 7, embodies a spring pressed pawl 66 carried by a collar piece 67 fixedly secured to the reduced end 68 of the shaft 5 and disposed within the bore of the hub extension 22 of the gear 13. This pawl is adapted to engage the ratchet teeth or pocket 69 formed in the abutting face of the first collar piece 15 carried by the shaft 3. During driving of the engine shaft 5 by the motor (dynamo motor), the collar 15, which travels faster than the rotary movement imparted thereby to the shaft 5, carries the ratchet teeth of recesses 69 past the beveled nose or face of the pawl 66. With release of the starter mechanism the pawl engages a ratchet tooth causing the shaft 5 to directly drive the shaft 3.

While I have indicated certain construction embodying my invention, I do not desire to limit myself thereto as the same may be greatly varied by the mechanic or those skilled in the art, without departing therefrom. For instance it will be apparent without necessity of specific illustration that the arrangement of the torque multiplying gears, and also the construction and cooperative association of the shifting mechanism may be greatly varied within the ambit of my invention.

The advantages of the invention will be found to reside in simple, compact, durable and efficient starter mechanism whereby the engine may be started with the minimum degree of power expended by the moving element; the dead or waste gases may be completely scavenged or expelled from the cylinders of the engine preparatory to starting on return of the torque multiplying means to non starting position; in which back firing is guarded against; whereby means are provided for locking the torque multiplying mechanism or starter in a non-operative position during running of the engine, and in which the reducing gears are relieved from travel after operating to start the engine.

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

1. In starter mechanism for combustion engines, a motor, means for connecting the motor and engine whereby said motor may actuate the engine, and means for automatically disconnecting the said elements at a point of time substantially coincident with inauguration of explosion of the combustible charge in the cylinder or cylinders of the engine.

2. In starter mechanism for combustion engines, a shaft for transmitting power to the engine, a motor, a motor shaft, means for connecting the shafts together, whereby the motor may drive the first named shaft, and means for automatically disconnecting the shafts at a point of time substantially coincident with an explosion stroke of the engine.

3. In starter mechanism for combustion engines, a shaft for transmitting power to the engine, a motor, a motor shaft, means for connecting the shafts together, whereby the motor may drive the first shaft, and means for automatically disconnecting the shafts at a point of time substantially coincident with the initial explosion of a combustible charge and assumption of self-propulsion of the engine.

4. In starter mechanism for combustion engines, a shaft for transmitting power to the engine, a motor, a motor shaft, reducing gears, means for so connecting the shafts and gears as to cause the motor to drive the

first shaft, and mechanism for so controlling the said means to effect disconnection of the gears and shafts at a period of time substantially coincident with an explosion stroke of the engine.

5. In starter mechanism for combustion engines, a shaft for transmitting power to the engine, a motor, a motor shaft, reducing gears, means adapted to be manually set, for so connecting the gears and shafts as to cause the motor to drive the first shaft, and mechanism for automatically releasing the said connecting means at a period of time substantially coincident with an explosion stroke of the engine.

6. In starter mechanism for combustion engines, a shaft for transmitting power to the engine, a motor, a motor shaft, means for so connecting the shafts together as to cause the motor to drive the first shaft, a device for holding said means in engine driving position, and mechanism for releasing the said connecting means at a point of time substantially synchronizing with an explosion stroke of the engine.

7. In starter mechanism for combustion engines, a shaft for transmitting power to the engine, a motor, a motor shaft, reducing gears, means for so connecting the shafts and gears as to cause the motor to drive the first shaft, a device for holding said means in engine driving position, and mechanism for releasing the said connecting means at a point of time substantially synchronizing with an explosion stroke of the engine.

8. In starter mechanism for combustion engines, a shaft for transmitting power to the engine, a motor, a motor shaft, reducing gears normally stationary and non-operative during self-propulsion of the engine, and mechanism for so connecting and disconnecting the gears and shafts as to cause the motor to drive the first shaft, and to subsequently render the gears non-operative at a point of time substantially synchronizing with an explosion stroke of the engine.

9. In starter mechanism for combustion engines, a shaft for transmitting power to the engine, a motor, a motor shaft, means for so connecting and disconnecting the shafts as to cause the motor to drive the first shaft, and to subsequently disconnect the shafts, and mechanism controlled by one of the shafts, for causing disconnection of the shafts to occur at a point of time substantially synchronizing with an explosion stroke of the engine.

10. In starter mechanism for combustion engines, a shaft for transmitting power to the engine, a motor, a motor shaft, reducing gears, means for so connecting and disconnecting the gears and shafts as to cause the motor to drive the first shaft, and to subsequently disconnect the gears and shafts, and means associated with one of the shafts, for effecting such disconnection at a period of time substantially synchronizing with an explosion stroke of the engine.

11. In starter mechanism for combustion engines, a shaft for transmitting power to the engine, a motor, a motor shaft, mechanism for connecting the shafts together, whereby the motor may drive the first shaft, an ignition controller, means associated with the connecting mechanism, for setting the controller to spark delay position, and means for automatically disconnecting the shafts at a point of time substantially synchronizing with an explosion stroke of the engine.

12. In starter mechanism for combustion engines, a shaft for transmitting power to the engine, a motor, a motor shaft, reducing gears, an ignition controller, mechanism for so connecting and disconnecting the shafts and gears as to cause the motor to drive the first shaft, means whereby the ignition controller may be shifted to spark delay position upon connection of the shafts and gears, and controlling means whereby the gears may be brought out of engine starting relationship at a point of time substantially synchronizing with an explosion stroke of the engine.

13. In starter mechanism for combustion engines, a shaft for transmitting power to the engine, a motor, a motor shaft, reducing gears, an ignition controller, mechanism for so connecting and disconnecting the shafts and gears as to cause the motor to drive the first shaft, and to subsequently render the gears non-operative, means whereby the ignition controller may be shifted to spark delay position upon connection of the shafts and gears, and controlling means whereby the gears may be brought out of engine starting relationship at a point of time substantially synchronizing with an explosion stroke of the engine.

14. In starter mechanism for combustion engines, a motor, means whereby the motor may actuate the engine, for starting thereof, and means for preventing starting connection of the motor and engine after the latter has become self-propulsive.

15. In starter mechanism for combustion engines, a shaft for transmitting power to the engine, a motor, a motor shaft, reducing gears, means for so connecting and disconnecting the shafts and gears as to cause the motor to drive the first shaft, and to subsequently terminate such driving relationship, and mechanism for preventing operative starting connection of the gears and shafts during self-propulsion of the engine.

16. In starter mechanism for combustion engines, a shaft for transmitting power to the engine, a motor, a motor shaft, reducing gears normally stationary and non-operative during self-propulsion of the engine, means for so connecting and disconnecting the

shafts and gears as to cause the motor to drive the first shaft, and to subsequently render the gears non-operative, and means for preventing operative engagement of the gears and shafts during self-propulsion of the engine.

17. In starter mechanism for combustion engines, a shaft for transmitting powe. to the engine, a motor, a motor shaft, means for connecting and disconnecting the shafts, for starting of the engine, and means for preventing starting connection of the shafts during self-propulsion of the engine, associated with one of the shafts.

18. In starter mechanism for combustion engines, a shaft for transmitting power to the engine, a motor, a motor shaft, reducing gears, means for so connecting and disconnecting the shafts and gears as to cause the motor to drive the first shaft, and to subsequently terminate such driving connection, and means associated with the first shaft, for preventing starting connection of the gears and shafts during self-propulsion of the engine.

19. In starter mechanism for combustion engines, a shaft for transmitting power to the engine, a motor, a motor shaft, reducing gears normally stationary and non-operative during self-propulsion of the engine, means for so connecting and disconnecting the shafts and gears as to cause the motor to drive the first shaft, and to subsequently render the gears non-operative, and means controlled by one of the shafts, for preventing connection of the gears and shafts during self-propulsion of the engine.

20. In starter mechanism for combustion engines, a shaft for transmitting power to the engine, a motor, a motor shaft, means for so connecting the shafts together as to cause the motor to actuate the engine, means for effecting disconnection of the shafts after starting of the engine, means for preventing starting connection of the shafts during self-propulsion of the engine, and an auxiliary device for controlling the last named means.

21. In starter mechanism for combustion engines, a shaft for transmitting power to the engine, a motor, a motor shaft, reducing gears, means for so connecting and disconnecting the shafts and gears as to cause the motor to drive the first shaft, and to subsequently render the gears non-operative, means for preventing operative connection of the shafts and gears during self-propulsion of the engine, and an auxiliary device for locking the last named means.

22. In starter mechanism for combustion engines, a shaft for transmitting power to the engine, a motor, a motor shaft, reducing gears, means for so connecting and disconnecting the shafts and gears as to cause the motor to drive the first named shaft, and to subsequently render the gears non-operative, means for locking the gears to non-operative position and associated with the first shaft, and an auxiliary device for controlling the said locking means.

In testimony whereof I have hereunto set my hand.

RICHARD VARLEY.

Witnesses:

MARY G. BARTH,

E. E. KELLER.