Oct. 14, 1930. J. A. HEANY 1,778,387

ENGINE STARTING MEANS

Original Filed April 25, 1921 3 Sheets-Sheet 1

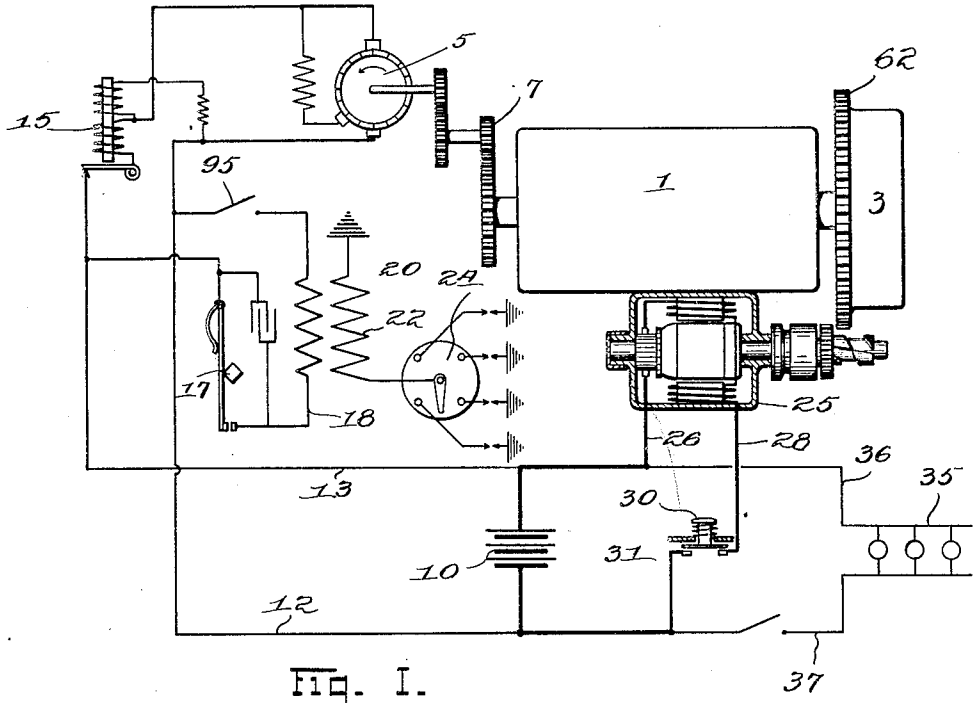

Fig. I.

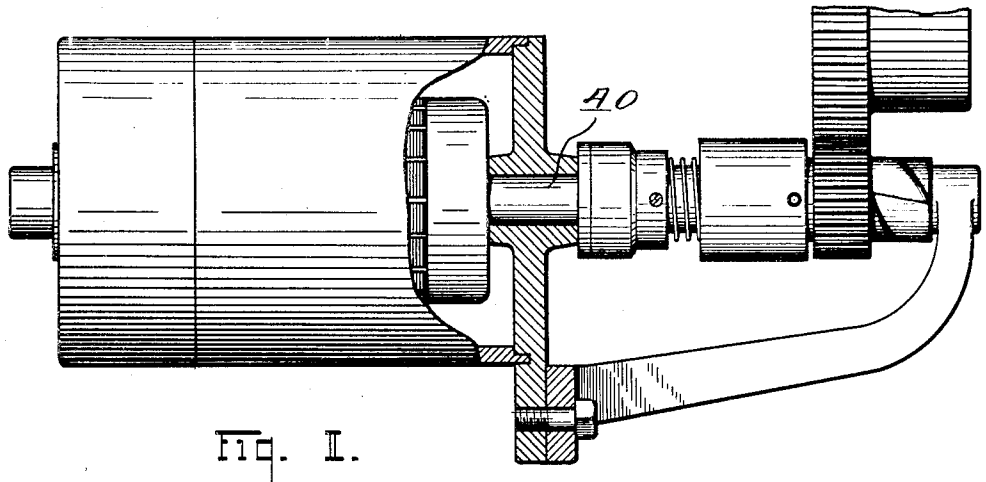

Fig. II.

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ENGINE STARTING MEANS

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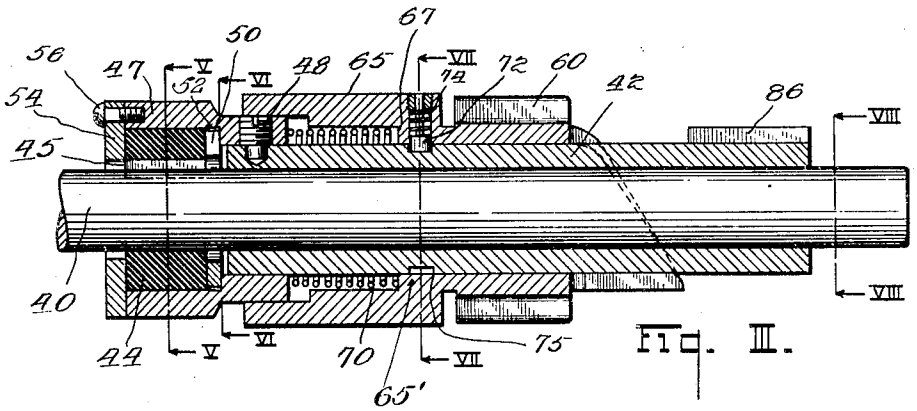

Fig. III.

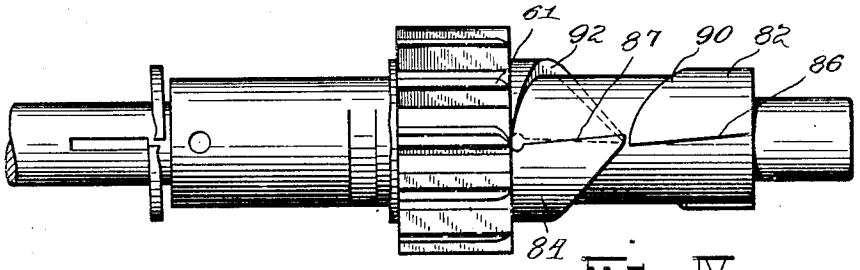

Fig. IV.

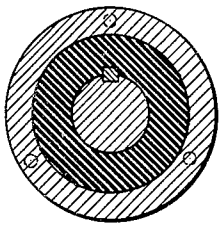

Fig. V.

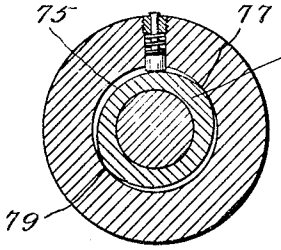

Fig. VII.

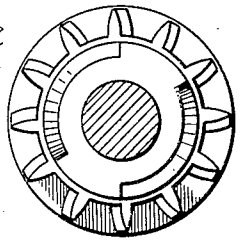

Fig. VIII.

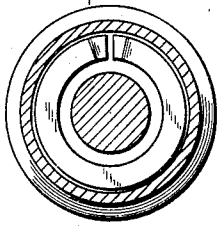

Fig. VI.

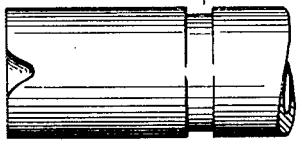

Fig. IX.

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ENGINE STARTING MEANS

Original Filed April 25, 1921 3 Sheets-Sheet 3

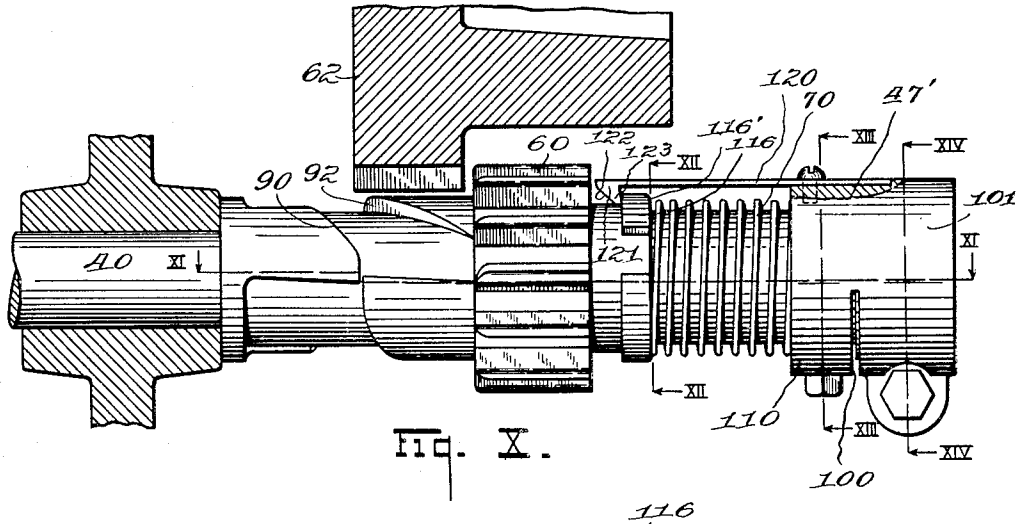

Fig. X.

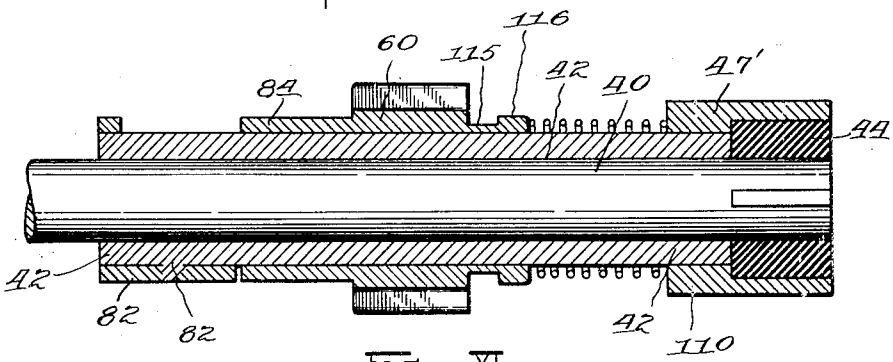

Fig. XI.

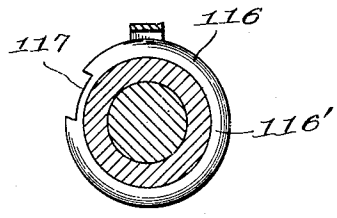

Fig. XII.

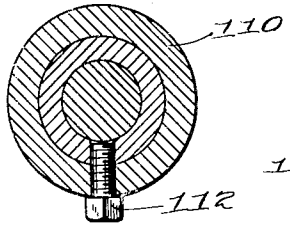

Fig. XIII.

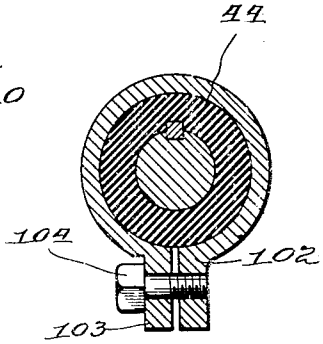

Fig. XIV.

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1,778,387

UNITED STATES PATENT OFFICE

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ENGINE-STARTING MEANS

Application filed April 25, 1921, Serial No. 464,198. Renewed February 7, 1929.

This invention relates to means for starting an engine, particularly an internal combustion engine, and has for an object to provide a novel system therefor, including novel means of connection between a source of starting power and an engine. Thus, the invention comprehends means for establishing a driving relation between a source of power, such as a motor and a gas engine; means for disengaging the driving connection when the engine operates under its own power; and means capable of performing these operations positively, noiselessly and effectively, under immediate control of the operator, forming an apparatus or mechanism with the essential parts thereof reduced to a minimum.

One feature of the invention resides in means for effecting a driving relation between the starting means and engine from means extraneous to the starting means. A further feature is to provide means normally retaining said driving effecting means disengaged with means to release the same when it is desired to start the engine. This invention may also include means for effecting or facilitating establishment of said driving relation from said starting means and may also include an arrangement utilizing a combination of said means. Further features of the invention include provision for a yield or give in the train of torque transmission between the starting means and engine which may be advantageously employed in the mechanism desired, and many structural features involved in the particular mechanism used.

The invention also includes many additional features advantageously contributing to the results desired as will hereafter appear from the particular embodiments shown by way of example and illustrated herein. Thus the invention particularly cooperates in and is adaptable for use in various types of starting systems, particularly electric starting systems.

Referring to the drawings forming a part hereof, Fig. I is a diagrammatic view illustrating the invention in a system including a gas engine, a generator, storage battery, separate starting motor, ignition system and controlling circuits.

Fig. II illustrates the motor and connecting and disconnecting mechanism, partially in section.

Fig. III is a longitudinal section through one embodiment of connecting and disconnecting mechanism.

Fig. IV is an elevation of Fig. III.

Figs. V, VI, VII, and VIII are sectional views taken on the lines V—V, VI—VI, VII—VII, VIII—VIII, of Fig. III.

Fig. IX is a side elevation showing a detail of the structure.

Fig. X is a side elevation partially in section of a modified embodiment of the connecting and disconnecting mechanism.

Fig. XI is a longitudinal section of Figure X with the shaft in elevation.

Figs. XII, XIII and XIV, are sectional views taken respectively on the lines XII—XII, XIII—XIII and XIV—XIV of Fig. X.

In Fig. I there is illustrated a gas engine 1 having a fly wheel 3, which is adapted to be started by the mechanism illustrated herein. There is also illustrated a generator 5 driven through gear connections 7 from the engine 1, adapted to be connected in circuit with a battery 10 through a lead 12 and another lead 13 if desired, one lead passing through means to automatically establish the charging circuit such as a reverse current relay 15. An ignition system for the engine 1 includes a make and break mechanism 17 adapted to be driven in timed relation with the said engine 1, and located in the primary circuit 18 of an ignition induction coil 20, the secondary circuit 22 of which is connected with the distributor 24, which is also driven in proper timed relation and as shown distributes high tension current to four cylinders, although of course, any number of cylinders may be employed. The generator 5 may be of a particular type for use with a variable speed internal combustion engine and the current output thereof may be regulated by either inherent or external regulating means such as by the construction of the generator, with bucking fields, 3rd brush regulation or the like, or by any type of external regulating means.

The starting motor 25 is adapted to be supplied with current from the battery 10, the motor being preferably a series type motor, the circuit between the battery and the motor, being illustrated by the leads 26 and 28, normally opened but adapted to be closed by use of a switch 30, biased to opened position. Any type of switch may be employed and I have illustrated herein a plunger type normally being held in open position by spring 31. The electric lights 35 may be connected by leads 36 and 37 to receive current from the battery 10 or the generator 5 as the case may be.

The present invention contemplates a system of this character wherein when the motor 25 is started, a driving connection between the same and the engine may be automatically effected and automatically disconnected therefrom when the engine operates under its own power.

In the particular embodiment of the connecting and disconnecting means illustrated in Figs. I to IX constituting the preferred embodiment of the types illustrated herein, there is shown a shaft 40 which may be a continuation of the shaft of the motor 25 or a shaft in axial alignment therewith or a separate shaft spaced therefrom as desired, upon which is mounted a sleeve 42, adapted to be driven from the shaft 40. One form of connection between the sleeve 42 and shaft 40 is illustrated as including a friction member 44 keyed at 45 to the shaft 40, the sleeve being provided with a member 47 adapted to be engaged by the friction member 44, the member 47 being fixed to the sleeve 42, as by means of the machine screw 48. As an advantageous and automatically adjusting connection to be employed between the shaft 40 and the sleeve 42 there is illustrated a spring washer 50 resting on a collar 52 of the member 47, tending to constantly urge the friction member 44 into frictional engagement with the overhanging plate 54, fixed to the member 47 by screws 56. The members 47 and 54 might be integral or otherwise connected to provide for means to be engaged by the member 44 and also to provide an automatically adjusting means such as the spring 50, tending to constantly maintain a satisfactory or desired amount of friction between a member connected to the shaft and a member connected to the sleeve 42. By this construction means are provided to protect the apparatus against overload in either direction of transmission of torque between the engine and the starting means.

The sleeve 42, carries in this instance, a sliding gear such as the pinion 60, which may be provided with beveled teeth 61 and which is illustrated in Figs. IV and VIII. This pinion 60 may be moved in rotation as well as longitudinally and as shown is adapted to be moved into engagement with gearing connected with the engine, as with the teeth 62 of the fly wheel 3. The pinion 60 is arranged to be driven from the sleeve 42, and hence from the motor shaft 40. By this invention means are provided which may be external to the source of power for starting the engine, but which will be operative upon the starting of said power, to immediately throw said pinion into enmeshment with said gear. As one embodiment thereof, the pinion 60 is provided with an extending sleeve 65, adapted to form a shoulder 67 against which a spring 70 engages and is adapted to form means to move said pinion longitudinally on said sleeve 42. The spring 70 may be suitably arranged to exert said pressure in the required direction, by butting the end of the member 47, which is fixed to sleeve 42. It will thus be seen that the sleeve 65 also forms a means to enclose the spring 70 protecting the latter in operation.

Normally the pinion 60 is detained in disengaging position by suitable retaining or latching means and as an embodiment thereof there is illustrated a spring catch member 72 located in the shoulder at the end of the sleeve 65. A spring 74 normally urges the member 72 radially toward the center of the shaft 40 into suitably shaped retaining means on the sleeve 42, such as a groove or grooves 75, illustrated in Figs. III and VII. This groove is of variable depth so as to provide a portion flush with the external surface of the sleeve 42, illustrated in Fig. VII at the points 77 and 79. If one groove 75, extending practically around the entire sleeve 42 were used, the same should be tapered to become flush with the exterior surface of the sleeve 42 at one point only. This construction illustrates one means whereby the retaining means 72 may be released when the motor 25 is started, as the sleeve 42 will rotate to bring the latch 72 opposite portions 77 or 79, the inertia of pinion 60 and associated parts holding the same stationary, so that the pinion moving means such as the spring 70 may operate to throw the pinion into mesh with the fly wheel gear 62.

Suitable means may be employed to drive the pinion 60 from the shaft 40, as for example, by means of a dog clutch including a member 82 fixed to the sleeve 42 and the cooperating clutch part 84 associated with the pinion 60. The driving faces 86 and 87 between these members may be straight or parallel with the motor shaft, or may be slightly inclined as indicated, to have a tendency to draw the pinion longitudinally into engagement with the fly wheel gear. The clutch members 82 and 84 are also provided with cam faces 90 and 92, adapted to cooperate in such wise as to throw the pinion 60 out of engagement with the fly wheel when the speed of the engine and consequently that

of the pinion 60 exceeds that of the driving sleeve or shaft.

The operation of the particular embodiments of this invention illustrated herein, will appear from the foregoing. When the operator presses the switch or pedal 30, the motor 25 is energized to rotate the shaft 40. This drives the friction member 44, which in turn drives the sleeve 42 by reason of the frictional engagement between the members 44 and 47, particularly through the end butting surfaces formed by reason of the overhanging member 54. The inertia of the pinion 60 against rotation causes the groove 75 in the sleeve 42 to move relatively to the retaining member 72, as stated, and this immediately permits the spring 70 to rapidly slide the pinion 60 longitudinally into driving relation with the gear 62 on the fly wheel of the engine, the clutch dogs 82 and 84 in the mean time coming into engagement. If the driving faces 86 and 87 thereof are inclined as shown, the rotation of the member 82 with the sleeve 42 may act to facilitate the movement of the gear 60 into driving relation with the fly wheel gear 62. The series motor 25, which develops a powerful starting torque immediately starts the engine 1, the ignition circuit being closed at the switch 95 as will be understood. When the engine picks up speed and the same drives the gear 60 the cam surfaces 92 and 90 immediately throw the gear 60 out of engagement with the gear 62, the retaining member 72 passing over the ridge formed by the edge of the groove 75, thereupon latching the gear 60 in disengaging position.

In the embodiment illustrated in Figs. X to XIV, the motor shaft 40 has the friction member 44 keyed thereto as in the other embodiment, the sleeve 42 being held in frictional driving engagement therewith by means of a collar 47′, which is formed in two parts, by reason of a kerf 100, (Fig. X) one part 101 of the same being slit longitudinally and provided with ears 102 and 103 as illustrated in Fig. XIV, bound together by the bolt 104 to grip the friction member 44. The other member 110 of the collar 47′ is rigidly connected to the sleeve 42 by means of a bolt 112 as illustrated in Fig. XIII. The pinion 60 slides on the sleeve 42 as in the other embodiment and is provided with the clutch part 84 adapted to be engaged and driven from the cooperating clutch 82 fixed to the sleeve 42 as by being spot-welded thereto, as illustrated at 82′. In this embodiment the pinion 60 is provided with an extension 115, terminating in a collar or ledge 116 which is provided with a notch 117 shown in Fig. XII. This collar is provided with a rounded edge 116′. Suitably anchored, as by being secured to the collar 47′ is a spring retaining latch 120, provided with a head 121 with a beveled nose 122 and a latching surface 123 attached to engage over the collar or ledge 116 and normally retain the pinion 60 in disengaging position. The spring 70 in this embodiment is mounted between the collar 110 fixed to the shaft 42 and the collar 116 associated with the sliding gear 60.

The operation of this embodiment will likewise be understood from the disclosure. When the shaft 40 rotates the keyed member 44 turning therewith drives the collar 47′ and consequently quickly rotates the latch 120 until the same comes opposite the notch 117. The spring 70 thereupon immediately throws the gear 60 into engagement with the fly wheel member 62. The transmission of torque from the motor 25 to the engine is thereupon substantially the same as that heretofore described. When the engine operates under its own power the gears 60 is cammed out of engagement therewith by the cam surfaces 92 and 90 and the spring catch member 120 rides over the rounded edge 116′ of the collar 116 into latching position, retaining the parts in normal position.

It will be noted that the various elements shown may be varied widely without departing from the broad various feaures of the invention and also that the several specific elements disclosed have particularly advantageous cooperative relations in the combinations disclosed.

What I claim as my invention and desire to secure by Letters Patent is:

1. In a device of the character described, an engine, a starting motor, a member connected with the engine, a member associated with the starting motor adapted to be moved into driving relation with said engine member and normally retained in disengaged position, means operated by said motor for releasing said driving member from its disengaged position, means independent of said motor for moving said driving member into engagement with said engine member, and mechanism arranged to disconnect said driving relation when the engine operates under its own power.

2. In apparatus of the class described, in combination, an engine, a member driven by said engine, a source of power, means operated by the source of power adapted to be moved into engagement with the engine member to drive the same, additional means independent of said power source for moving the engine driving means into engagement with the engine member, means to normally hold said engine driving means out of engagement with said engine member, and releasing means operated by said power source for releasing said holding means.

3. In apparatus of the class described, in combination, an internal combustion engine, a member driven by said engine, a source of power, a rotatable member, means extraneous to said source of power to move said rotatable

member into operative relation to said first member and means to drive said first member through said rotatable member from said source of power to start the engine, the operation of said extraneous moving means being initiated by said source of power.

4. In apparatus of the class described, in combination, an internal combustion engine, a member driven by said engine, a member mounted for rotation and reciprocation, means operative when released to move said second member rectilinearly into driving engagement with said first member, single means for releasing at will said last mentioned means and for rotating said second member to rotate thereby said first member and said engine, and means for effecting the disengagement of said members automatically when said engine is started.

5. A starter for gas engines and the like comprising in combination with a member operatively connected with the engine, a motor, a driving member operated thereby, and adapted to cooperate with and drive the other member but normally out of engagement therewith, and means controlled by said motor to automatically move said driving member independently of said motor into engagement with said first member upon said motor being started.

6. In apparatus of the class described, in combination, an engine, a source of power, gearing between said engine and said source of power, means for engaging said gearing normally retained against operation, means actuated by said source of power for releasing said last mentioned means simultaneously with the starting of said source of power, and automatic means for preventing the transmission of torque from said engine through said gearing when the engine has started.

7. A starter for gas engines comprising in combination, a motor driven shaft, a sleeve mounted thereon and adapted to be driven thereby, a driving member mounted upon said sleeve and adapted to travel longitudinally thereon, means carried on said sleeve tending to move said member, and means to release said last-mentioned means when said sleeve is rotated.

8. A starter for gas engines and the like comprising in combination a member operatively connected with the engine, and a motor including its shaft, a shaft in line with said motor shaft and driven thereby, a driving member adapted to engage and drive the engine member but normally out of engagement therewith, normally restrained means for advancing the driving member into engagement with the engine member and means operated by said motor for releasing said last mentioned means.

9. An engine starter comprising in combination, with a member operatively connected with the engine, a motor, a driving member operated thereby and adapted to cooperate with and drive the other member but normally out of engagement therewith, means normally restrained for moving said driving member into operative relation with said engine member, means whereby relative movement between the motor and the driving member automatically releases said last mentioned means and a yielding driving connection interposed between the said motor and said engine and operatively connected to said driving member.

10. In apparatus of the class described, in combination an engine, a motor for starting said engine, a gear connected with said engine, a gear associated with said motor adapted to be moved into engagement with said gear on said engine, a spring for moving said last mentioned gear into operative relation with said engine gear, an automatic clutch for driving said second mentioned gear from said motor adapted to be moved into operative relation when said gears are connected, a cam means for disengaging said gearing and clutch when said engine operates under its own power.

11. In apparatus of the class described, a shaft adapted to be rotated from a source of power, a sleeve carried by said shaft, a gear on said sleeve, adapted to be moved into engagement with a member associated with an engine to start the latter, clutch means between said sleeve and said gear adapted to be engaged when said gear is moved into driving relation with the said engine member and means to rotate said sleeve from said shaft and a yielding non-resilient connection between the sleeve and shaft.

12. In apparatus for starting engine mechanism, a shaft adapted to be rotated from a source of power, a sleeve adapted to be rotated by said shaft, a gear member carried by said sleeve adapted to be moved to establish a driving engagement with the mechanism to be started, a means to drive said gear member from said sleeve upon the initiation of said driving engagement and before said engagement has been completed, and a yielding non-resilient connection between the sleeve and shaft.

13. In apparatus of the class described, a shaft operated from a source of power, a sleeve carried by said shaft and operated thereby, a sliding gear member on said sleeve, a spring on said sleeve adapted to slide said gear member, means co-acting between said sleeve and gear member adapted to retain said member in a disengaged position, and means whereby rotating of said sleeve will release said last mentioned means.

14. In apparatus of the class described, a shaft, a sleeve carried by said shaft, a gear member slidable on said sleeve, a spring for sliding said gear, a spring catch for holding said gear in a disengaged position, and a

groove in said sleeve of varying depth arranged transversely thereof and terminating in a portion flush with the surface of said sleeve with which said catch member cooperates.

15. In starting mechanism for engines, the combination of a source of power, normally disconnected gearing between the engine and source of power, means for moving the gearing into operative driving relationship, means for holding said gear moving means normally in inoperative condition, and means actuated by said source of power for releasing said gear moving means.

16. In starting mechanism for engines, the combination of an engine, a motor, normally disconnected gear connections between the engine and motor, and separate normally restrained means for causing operative engagement of said gears, the release of said means being actuated by the motor.

17. In an engine starting mechanism, the combination of an engine member, a motor having a shaft in contiguous relationship with said member, a sleeve axially and rotatably mounted on said shaft, a clutch element positioned on one end of said sleeve, a second cooperating clutch element on said shaft, a gear fixed to said sleeve, said gear being adapted to engage said engine member, a groove cut in said sleeve, resilient means tending to move said sleeve to bring about engagement between the gear engine member, and a spring plate fixed to said shaft, one end of said plate having a depending hook adapted to engage within the groove formed on the sleeve and maintain said spring under compression and means for releasing said springs.

18. An apparatus of the class described, comprising an engine member; a driven shaft; a driving member mounted on said shaft and slidable thereon into and out of engagement with said engine member; intermediate means between said shaft and said driving member adapted to yieldingly turn said driving member with said shaft when said driving member is in engagement with said engine member; means cooperating with said driving member and said intermediate means to normally urge said driving member into engagement with said engine member and means also cooperating with said driving member and said intermediate means to retain said driving member out of engagement with said engine member, said intermediate means being adapted to release said retaining means upon relative movement between said driving member and said intermediate means.

19. An apparatus of the class described, comprising a gear to be driven, a driven shaft, a pinion mounted and slidable on said shaft into and out of mesh with said gear, means to yieldingly drive said pinion with said shaft when said pinion is in mesh with said gear, means tending to move said pinion into mesh with said gear, means for restraining such movement of the pinion, and means for releasing said restraining means upon relative movement of said pinion and shaft, said means being automatically actuated by the initial rotation of the shaft.

20. An apparatus of the class described, comprising a gear to be driven, a driven shaft, a pinion slidable on said shaft into and out of mesh with said gear, means tending to move said pinion into mesh with said gear, means for restraining movement of the pinion into mesh with the gear, means for automatically releasing said restraining means by the initial rotation of the shaft, and means for transmitting torque from the shaft to the pinion, said means being normally disconnected and automatically connected by movement of the pinion into mesh with the gear.

21. An apparatus of the kind described, comprising a gear to be driven, a driven shaft, a pinion slidable on said shaft into and out of mesh with said gear, means continuously tending to move said pinion into mesh with said gear, means whereby movement of the pinion into mesh with the gear is normally restrained and automatically permitted on the initial rotation of the shaft, and cooperating clutch members carried by the shaft and pinion and automatically brought into operative relation upon movement of the pinion into mesh with the gear.

22. An apparatus of the class described, comprising a gear to be driven, a driven shaft, a pinion slidable on said shaft into and out of mesh with the gear, means tending to move the pinion into mesh with the gear, means for restraining such movement of the pinion, said means being released by initial rotation of the shaft, means for transmitting torque from the shaft to the pinion, said means being normally disconnected and automatically connected when the pinion meshes with the gear, and said means being such as to automatically move the pinion out of mesh with the gear when the speed of rotation of the pinion exceeds that of the shaft.

23. An apparatus of the class described, comprising an engine member, a driven shaft, a source of power connected to said shaft, driving means movable on said shaft into and out of engagement with the engine member, means tending to move said driving means into engagement with said engine member, means normally restraining movement of the driving means into engagement with the engine member, such means being released by rotation of the shaft, and a non-resilient slip connection between the driven shaft and the source of power.

24. An apparatus of the class disclosed comprising an engine member; a shaft; a sleeve carried by said shaft; a driving mem-

ber carried by said sleeve; friction means connecting said sleeve to said shaft; means for normally holding said driving member in disengaged relation with said engine member; and means including a resilient member whereby relative movement between shaft and driving member positively engages said driving member with said sleeve for driving said engine member.

25. An apparatus of the class disclosed comprising an engine member; a motor shaft; a sleeve carried by said shaft; a driving member mounted on said sleeve; friction means connecting said sleeve to said shaft; means for normally holding said driving member in disengaged relation with said engine member; means including a resilient member whereby relative movement between sleeve and driving member establishes driving relation between said sleeve and said engine member; and means including a cam for disengaging said driving member from said engine member when the speed of the engine member exceeds that of the driving member.

In testimony whereof, I affix my signature.

JOHN ALLEN HEANY.