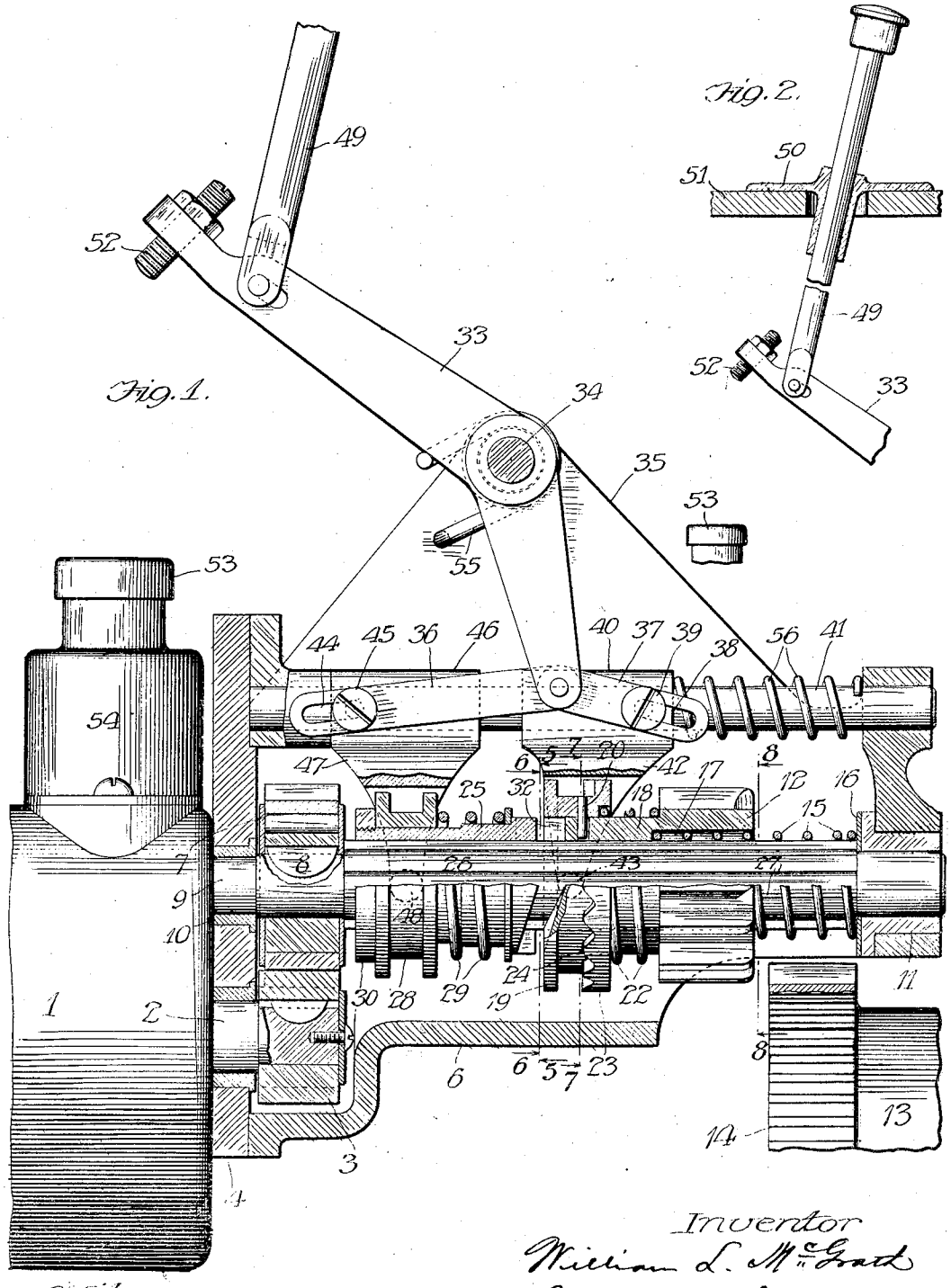
April 2, 1929. W. L. McGRATH 1,707,488

ENGINE STARTER

Original Filed Feb. 28, 1921 3 Sheets-Sheet 1



Witness
Martin H. Olsen.

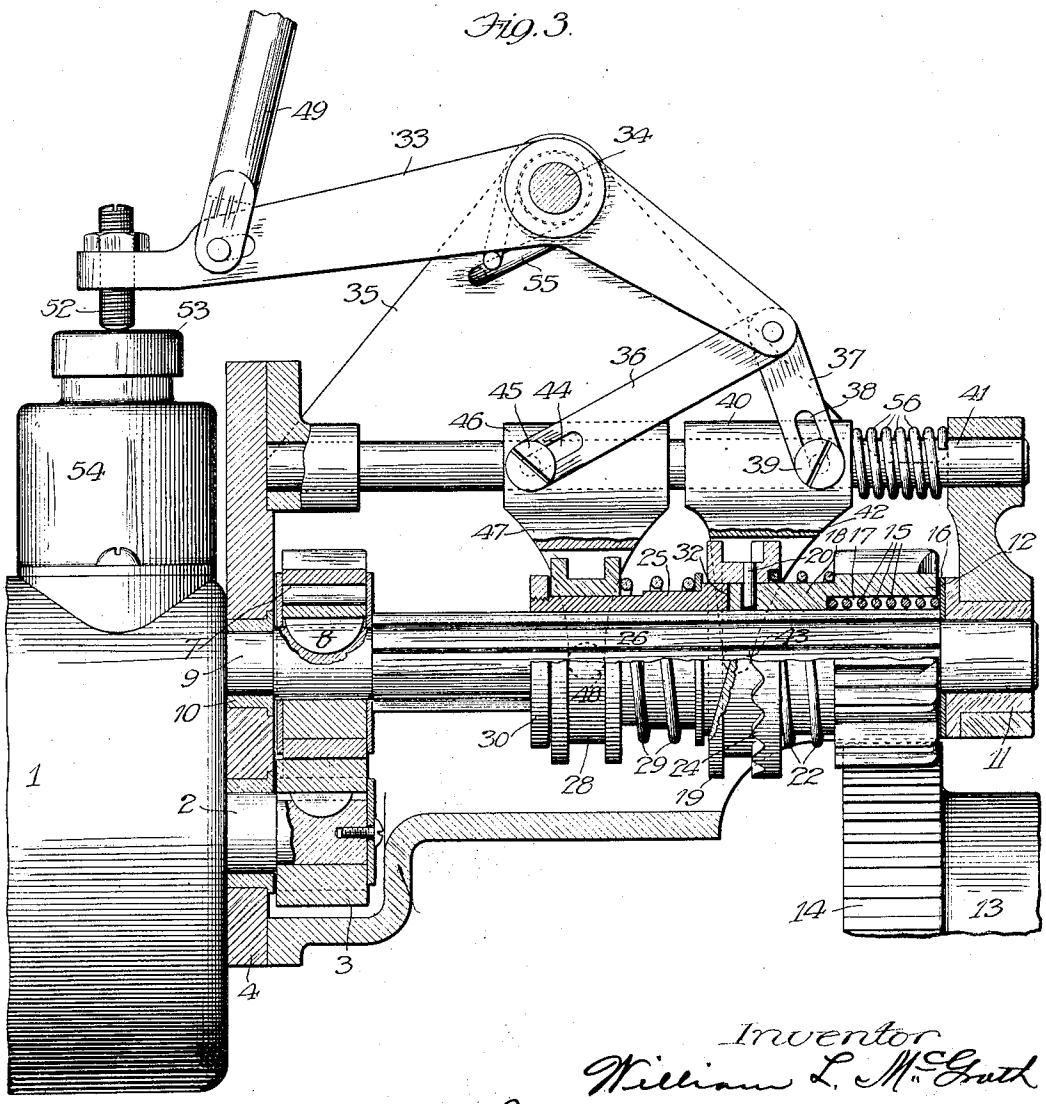
Inventor
William L. McGrath
By Rector, Hibben, Davis & Macauley
His Attys

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ENGINE STARTER

Original Filed Feb. 28, 1921 3 Sheets-Sheet 2

Fig. 3.



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ENGINE STARTER

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Fig. 4

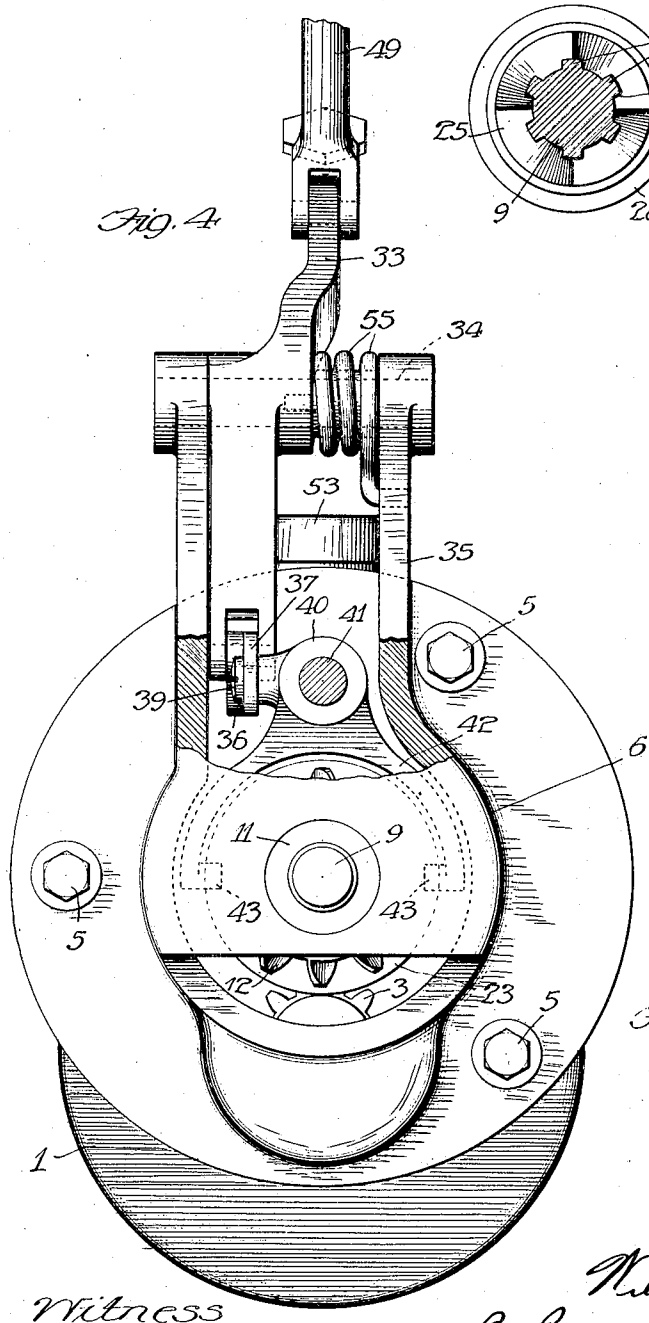


Fig. 5

Fig. 6.

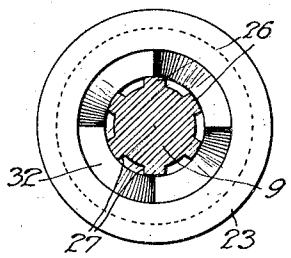


Fig. 7.

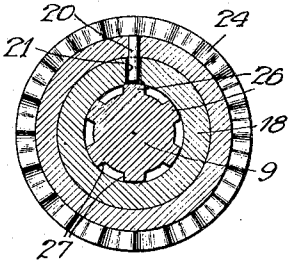


Fig. 8.

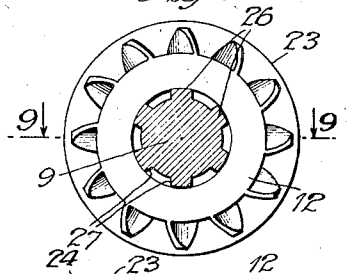
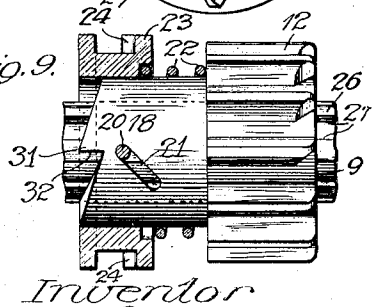


Fig. 9.



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UNITED STATES PATENT OFFICE.

WILLIAM L. McGRATH, OF ELMIRA, NEW YORK, ASSIGNOR TO ECLIPSE MACHINE COMPANY, OF ELMIRA, NEW YORK, A CORPORATION OF NEW YORK.

ENGINE STARTER.

Application filed February 28, 1921, Serial No. 448,298. Renewed August 2, 1928.

My invention has relation to a starter for an engine such as an internal combustion engine and the same pertains more particularly to the drive or transmission of a starter system for operatively connecting the prime mover such as an electric motor with a member of the engine to be started such as the flywheel thereof.

The object of my invention is to provide an efficient and reliable drive or transmission capable of being manually operated for engagement with the engine member, characterized by the provision of a two part driving member mounted on a rotatable shaft, one of said parts being connected with the shaft for rotary movement therewith and the other part being movable longitudinally on such shaft for engagement with a member of the engine to be started. Such drive, in its present embodiment, is further characterized by the provision of means such as manually operated means, for acting upon the said two parts for moving them longitudnally successively into their operating position, the electrical contact being thereafter made.

Other novel and advantageous features of construction and mode of operation will be apparent from the description hereinafter given.

In the drawings Fig. 1 is a sectional elevation of a starter equipment including my drive or transmission; Fig. 2 a detail view of the manual or pedal operative means; Fig. 3 a sectional elevation similar to Fig. 1 but illustrating the operating position of the parts; Fig. 4 an end elevation partly in section of said equipment; Figs. 5, 6, 7 and 8 transfer sections on the corresponding section lines of Fig. 1, and Fig. 9 a sectional elevation on the line 9—9 of Fig. 8.

In the present instance I have shown one of a number of embodiments of my invention particularly in the broader aspect thereof and for the sake of a clear and definite description of my invention I shall describe the details of such embodiment without intention of limiting myself thereto. Moreover, while the drive may be operated manually or pedally it will be understood that for a convenience I shall use the term "manually" as a generic one to cover pedal operation as well. Furthermore, my invention is applicable to the direct type of drive equally with the indirect type herein shown and described.

The prime mover is here an electric starting motor indicated at 1 and provided with an armature shaft 2, to whose outer end there is secured a pinion 3. This shaft has its bearing in end plate 4 secured in suitable manner to the motor and having attached thereto as by means of the bolts 5 a casing 6 which acts both as a housing and a support for the drive and its operating parts.

The pinion 3 meshes with a gear 7 which is preferably although not necessarily of the free-wheel type, that is, the same is provided with an over-running clutch which may be of any conventional form. This gear wheel is secured in suitable manner as by means of the key 8 to a rotatable shaft 9 having bearings 10 and 11 in the plate 4 and casing 6 respectively.

The driving member which is mounted upon the shaft 9 is made in two parts, to wit, a driving member proper which is here in the form of a pinion and an actuating part which is adapted to be operatively engaged with such pinion after the latter has been placed in driving relation with the engine member or flywheel.

The driving member proper which is in the form of a pinion 12 is adapted to engage and rotate the engine member such as the flywheel 13 with whose teeth 14 the pinion 12 meshes. This pinion has a smooth central bore and is mounted for free longitudinal and rotary movements on the shaft 9 and the same is held in its normal disengaged position shown in Fig. 1 both by the manually operated means hereinafter described and also by the coiled spring 15 interposed between the abutment 16 toward the outer end of the shaft and the pinion which is provided with a counterbore 17 to accommodate such spring and to contain the same when the pinion is in operating position as shown in Fig. 3.

The pinion is provided with a hub or extension 18 upon whose inner end there is mounted a flanged shipper-ring 19 adapted to cooperate with the manually operated means hereinafter described and also to cooperate with the pinion hub so as to cause a slight rotation of the pinion for meshing purposes. This ring is mounted on the pinion hub for a limited combined longitudinal and angular movement which is here obtained by the pin and slot connection between said parts, one or more pins 20 being provided in the ring and extending inwardly to engage with angular slots 21 in the pinion hub shown

in Fig. 9. The ring thus has a limited spiral movement on the hub which movement outwardly toward the pinion proper is yieldingly resisted by the coiled spring 22 interposed between the pinion body and the ring. The inner face of the flange 23 of the ring is provided with a series of scallops 24 adapted to be engaged by the manually operated means in the manner and for the purpose hereinafter explained.

The second or actuating part of the driving member is here in the form of a sleeve 25 which is connected with the shaft 9 for longitudinal movement thereon and for positive rotary movement therewith. In the present instance this mounting of the sleeve is through grooves and splines, the splines on the shaft being indicated at 26 and the grooves in the sleeve being indicated at 27. Upon this sleeve there is mounted a shipper-ring 28 capable of a longitudinal movement on the sleeve against the tension of a spring 29 and limited in its inward movement by the ring 30 secured to the inner end of such sleeve. This ring 28 is adapted to cooperate with the manual operating means in the manner and for the purpose hereinafter explained.

The two parts of the driving member are adapted to be operatively engaged with each other at the proper time and in suitable manner. In the present instance this operative engagement is brought about through the medium of a clutch which is here in the form of complementary clutch jaws 31 and 32 provided on the adjacent ends of the pinion hub 18 and sleeve 25 respectively. Normally these clutch jaws are out of engagement but are adapted to be brought into engagement by outward movement of the sleeve after the pinion 12 has been brought into engagement with the flywheel.

Referring to the manually operating means as herein shown, the same is so constructed as to operate successively upon the two parts of the driving member that is, the pinion 12 and the actuating sleeve 25. Such operating means is provided with the additional function of subsequently actuating the switch of the motor for supplying current thereto. As a result the pinion is first brought into engagement with the flywheel, the actuating sleeve is then brought into operative engagement with the pinion and then the motor is operated for the starting of the engine.

Referring to the details of the manual operating means herein shown, a main lever 33 is pivoted intermediate its length upon the cross pin 34 which is mounted in the parallel bracket arms 35. This main lever is in the form of a bell crank with its lower arm pivotedly connected to the inner adjacent ends of two links 36 and 37. The shorter link 37 is provided with a longitudinal slot 38 in which slides a stud 39. This stud is secured to a sleeve 40 adapted to slide upon a stationary shaft 41 mounted at its ends in the casing 6. This sleeve is provided with a depending yoke 42 straddling the drive proper and having inturned projections 43 adapted to engage the shipper-ring 19.

The other link 36 is provided with a longitudinal slot 44 in which travels the stud 45 secured in a second sleeve 46 also mounted to slide longitudinally on the shaft 41. This sleeve is provided with a similar yoke 47 straddling the drive proper and having inturned projections 48 similar to the projections 43 and coperating with the shipper-ring 28.

The lever 33 is operatively connected with any plunger or linkage for operation by hand or foot. In the present instance the same is adapted to be actuated by the plunger 49 extending through a bearing bracket 50 in the floorboard 51 of an automobile or the like and pivotally connected at its lower end with the upper end of the lever 33. This upper or free end of the lever 33 is provided with an adjustable screw 52 adapted to contact and operate the switch button 53 of the switch 54 of the motor.

The parts composing the manual operating means are held in the normal position shown in Fig. 1 in yielding manner as by means of the spring 55 cooperating with the lever 33 and also the coiled spring 56 arranged in the path of outward movement of the sleeve 40 and tending to resist such movement.

The parts including the links 36 and 37 and their slots 38 and 44 are so made and proportioned that the initial movement of oscillation of the main lever 33 will cause the outward longitudinal movement of the pinion 12 and its meshing with the flywheel. It will be noted that when the parts are in the normal position shown in Fig. 1 the inner end of the slot 38 is substantially in contact with the stud 39 so that the initial movement of the lever will be imparted at once to the sleeve 40 and yoke 42 and to the pinion 12 whereupon the latter will be moved longitudinally to the right into mesh with the flywheel. During this initial movement of the main lever there will be no movement of the sleeve 46 or of the sleeve 25 inasmuch as the length of the slot 44 must be taken up before the inner end of such slot can come into contact with the stud 45 and thereupon shift the sleeves 46 and 25.

After the pinion has been placed in mesh with the flywheel and the inner end of the slot has come into contact with the stud 45 the sleeve 46 will thereupon be moved longitudinally to the right, carrying with it the sleeve 25 through the medium of the shipper-ring 28 which is yieldingly connected with the latter sleeve through the spring 29. The clutch jaws of the sleeve 25 will now be placed into engagement with the clutch jaws of the

pinion hub 18. Upon further and final movement of the main lever 33 the switch 54 will be operated and current will be supplied to the motor whereupon the shaft 9 will be rotated and the torque will be thereupon transmitted to the flywheel through the sleeve 25, pinion hub 18 and pinion 12. When the engine has started on its own power and the operator has released his pressure on the main lever the pinion will be disengaged from the flywheel and the parts will resume their normal position shown in Fig. 1 by means of the springs 55 and 56 as well as the spring 15.

In the event that the pinion teeth and flywheel teeth should abut end to end the continued oscillation of the main lever 33 will transmit a pressure upon the shipper-ring 19 tending to move it longitudinally to the right against the tension of the spring 22 and by reason of the provision of the pin and inclined slot connection between such ring and the pinion hub, and as the projections 43 will engage the scallops 24 thus preventing rotation of the ring 19, the pinion hub and its pinion will be caused to slightly rotate and thereby bring about proper register between the pinion teeth and the flywheel teeth. Thus meshing is obtained by continued movebent of the main lever without necessity of releasing the pressure on this lever and starting operation over again.

In case the operator should not release his pressure on the main lever after the engine has started on its own power, no injury will result to the parts even though the pinion 12 is rapidly rotated by the flywheel. I prefer to use a free-wheel 7 inasmuch as under the condition just explained there might be a clashing sound from the clutch teeth. However this free-wheel is not essential and may be dispensed with.

I claim:

1. An engine starter drive including a rotatable shaft, a two part driving member having longitudinal movement thereon and comprising a pinion loosely mounted on the shaft, a sleeve mounted on the shaft for rotary movement therewith and longitudinal movement thereof, said pinion and sleeve having cooperating clutch members, and means acting on the pinion and sleeve separately and successively for moving them longitudinally of the shaft.

2. An engine starter drive including a rotatable shaft, a two part driving member having longitudinal movement thereon and comprising a pinion loosely mounted on the shaft, a sleeve splined on the shaft for rotary movement therewith and longitudinal movement thereof, said pinion and sleeve having cooperating clutch members, and means acting on the pinion and sleeve separately and successively for moving them longitudinally of the shaft.

3. An engine starter drive including a rotatable shaft, a driving member mounted thereon for longitudinal movement to engage a member of the engine to be started, an actuating member also mounted on the shaft for longitudinal movement and adapted to control the movement of the driving member rotarily with the shaft, such actuating member being operatively connected with the shaft for rotation therewith, and means acting upon the driving member and the actuating member for moving them longitudinally separately and successively into operative engagement with each other.

4. An engine starter drive including a rotatable shaft, a driving member mounted thereon for longitudinal movement to engage a member of the engine to be started, an actuating member also mounted on the shaft for longitudinal movement and adapted to control the movement of the driving member rotarily with the shaft, such actuating member being operatively connected with the shaft for rotation therewith, and a single actuating means manually operated and acting upon the driving member and the actuating member for moving them longitudinally successively into operative engagement with each other.

5. An engine starter drive including a rotatable shaft, a driving member mounted thereon for longitudinal movement to engage a member of the engine to be started, an actuating member also mounted on the shaft for longitudinal movement and adapted to control the movement of the driving member rotarily with the shaft, such actuating member being operatively connected with the shaft for rotation therewith, an electric motor operatively connected with the shaft, a switch for the motor, and means acting upon the driving member and the actuating member for moving them longitudinally separately and successively and then acting on the switch to energize the motor.

6. An engine starter drive including a rotatable shaft, a driving member mounted thereon for longitudinal movement to engage a member of the engine to be started, an actuating member mounted on the shaft for longitudinal movement thereon and for rotary movement therewith, said driving member and actuating member having cooperating clutch members for transmission of torque to the driving member, and means acting upon the driving member and the actuating member for moving them longitudinally separately and successively into operative engagement with each other.

7. An engine starter drive including a rotatable shaft, a driving member mounted thereon for longitudinal movement to engage a member of the engine to be started, an actuating member also mounted on the shaft for longitudinal movement and adapted to control the movement of the driving member

rotarily with the shaft, such actuating member being operatively connected with the shaft for rotation therewith, and means acting upon the driving member and the actuating member for moving them longitudinally successively, said means consisting of two yokes acting on the driving member and the actuating member respectively, an operating lever and successively acting connections between the lever and yokes.

8. An engine starter drive including a rotatable shaft, a driving member mounted thereon for longitudinal movement to engage a member of the engine to be started, an actuating member also mounted on the shaft for longitudinal movement and adapted to control the movement of the driving member rotarily with the shaft, such actuating member being operatively connected with the shaft for rotation therewith, and means acting upon the driving member and the actuating member for moving them longitudinally successively, said means consisting of two yokes acting on the driving member and the actuating member respectively, an operating lever and slotted links pivotally connected with the lever and the yokes and successively acting on such yokes.

9. An engine starter drive including a rotatable shaft, a driving member mounted thereon for longitudinal movement to engage a member of the engine to be started, an actuating member also mounted on the shaft for longitudinal movement and adapted to control the movement of the driving member rotarily with the shaft, such actuating member being operatively connected with the shaft for rotation therewith, and means acting upon the driving member and the actuating member for moving them longitudinally successively, said means consisting of two yokes acting on the driving member and the actuating member respectively, an operating lever, projections on said yokes, and links pivotally connected with the lever and having slots cooperating with said projections to cause successive action of said yokes.

10. An engine starter drive including a rotatable shaft, a driving member mounted thereon for longitudinal movement to engage a member of the engine to be started, an actuating member also mounted on the shaft for longitudinal movement and adapted to control the movement of the driving member rotarily with the shaft, such actuating member being operatively connected with the shaft for rotation therewith, means for yieldingly resisting the longitudinal movement of the actuating member, and means acting upon the driving member and the actuating member for moving them longitudinally separately and successively into operative engagement with each other.

11. An engine starter drive including, in combination with a starting motor and its switch and with a gear on the engine to be started, a pinion adapted to be shifted into mesh with the gear, a sleeve driven by the motor and adapted to be shifted for driving the pinion, and an operating means for first shifting the pinion and then the sleeve and finally operating the switch.

12. An engine starter drive including a rotatable shaft, a two-part driving member whose two parts are mounted for independent longitudinal movement thereon, one with respect to the other, said two parts having cooperating engaging driving means which are normally disconnected, the first of said parts being connected with the shaft for rotary movement therewith and the second being movable longitudinally on the shaft for engagement with a member of the engine to be started, said first part being manually shiftable into operative engagement with said second part after the latter has engaged the engine member.

13. An engine starter drive including a rotatable shaft, a two-part driving member whose two parts are mounted for independent longitudinal movement thereon, one with respect to the other, said two parts having cooperating engaging driving means which are normally disconnected, the first of said parts being connected with the shaft for rotary movement therewith and the second being movable longitudinally on the shaft for engagement with a member of the engine to be started and adapted to transmit the torque of the shaft to said engine member, said second part having a yielding longitudinal movement and having a portion which is adapted to drivingly engage said first part, said first part being manually shiftable into operative engagement with said second part after the latter has engaged the engine member.

14. An engine starter drive including a rotatable shaft, a two-part driving member whose two parts are mounted for independent longitudinal movement thereon, one with respect to the other, said two parts having cooperating engaging driving means which are normally disconnected, the first of said parts being connected with the shaft for rotary movement therewith and the second being movable longitudinally on the shaft for engagement with a member of the engine to be started, the adjacent faces of the two parts being provided respectively with cooperating clutch members, said first part being manually shiftable into operative engagement with said second part after the latter has engaged the engine member.

15. An engine starter drive including a rotatable shaft, a two-part driving member whose two parts are mounted for independent longitudinal movement thereon, one with respect to the other, said two parts having cooperating engaging driving means which are

normally disconnected, the first of said parts being connected with the shaft for rotary movement therewith and the second being movable longitudinally on the shaft for engagement with a member of the engine to be started, the adjacent faces of the two parts being provided respectively with cooperating clutch members, and yielding means for resisting said longitudinal movement of said second part, said first part being manually shiftable into operative engagement with said second part after the latter has engaged the engine member.

16. An engine starter drive including a rotatable shaft, a two-part driving member whose two parts are mounted for independent longitudinal movement thereon, one with respect to the other, said two parts having cooperating engaging driving means which are normally disconnected, the first of said parts being connected with the shaft for rotary movement therewith and the second being movable longitudinally on the shaft for engagement with a member of the engine to be started, the adjacent faces of the two parts being provided respectively with cooperating clutch members, said second part being spring-pressed to normal position, said first part being manually shiftable into operative engagement with said second part after the latter has engaged the engine member.

17. An engine starter drive including a rotatable shaft, a two-part driving member whose two parts are mounted for independent longitudinal movement thereon, one with respect to the other, said two parts having cooperating engaging driving means which are normally disconnected, the first of said parts being connected with the shaft for rotary movement therewith and the second being movable longitudinally on the shaft for engagement with a member of the engine to be started, said first part being splined to the shaft and said second part being loosely mounted thereon, said first part being manually shiftable into operative engagement with said second part after the latter has engaged the engine member.

18. An engine starter drive including a rotatable shaft, a two-part driving member whose two parts are mounted for independent longitudinal movement thereon, one with respect to the other, said two parts having cooperating engaging driving means which are normally disconnected, the first of said parts being connected with the shaft for rotary movement therewith and the second being movable longitudinally on the shaft for engagement with a member of the engine to be started, said second part including a shipper device connected therewith for limited rotary movement, one with respect to the other, and operating means connected with said device and with said first one of said parts.

19. An engine starter drive including a rotatable shaft, a two-part driving member whose two parts are mounted for independent longitudinal movement thereon, one with respect to the other, said two parts having cooperating engaging driving means which are normally disconnected, the first of said parts being connected with the shaft for rotary movement therewith and the second being movable longitudinally on the shaft for engagement with a member of the engine to be started, said second part being provided with a shipper device connected therewith for rotary movement by pin and inclined slot connection, and operating means connected with said device and with said first one of said parts.

20. An engine starter drive including a rotatable shaft, a two-part driving member whose two parts are mounted for independent longitudinal movement thereon, one with respect to the other, said two parts having cooperating engaging driving means which are normally disconnected, the first of said parts being connected with the shaft for rotary movement therewith and the second being movable longitudinally on the shaft for engagement with a member of the engine to be started, said second part being provided with a shipper device connected therewith for rotary movement by pin and inclined slot connection, yielding means tending to resist such last mentioned rotary movement, and operating means connected with said device and with said first one of said parts.

21. An engine starter drive including a rotatable shaft, a two-part driving member whose two parts are mounted for independent longitudinal movemnt thereon, one with respect to the other, said two parts having cooperating engaging driving means which are normally disconnected, the first of said parts being connected with the shaft for rotary movement therewith and the second being movable longitudinally on the shaft for engagement with a member of the engine to be started, said first part being provided with a shipper-ring mounted to slide longitudinally thereon, yielding means tending to resist such movement of the ring, and operating means connected with said ring.

22. An engine starter drive including a rotatable shaft, a two-part driving member whose two parts are mounted for independent longitudinal movement thereon, one with respect to the other, said two parts having cooperating engaging driving means which are normally disconnected, the first of said parts being connected with the shaft for rotary movement therewith and the second being movable longitudinally on the shaft for engagement with a member of the engine to be started, said parts being each provided

with a yielding shipper device, and an operating means cooperating with said devices successively.

23. An engine starter drive including a rotatable shaft, a two-part driving member whose two parts are adapted to drivingly engage each other and which comprise a pinion loosely mounted on the shaft and having a hub, a shipper ring movably mounted on said hub, a sleeve mounted on the shaft for rotary movement therewith and longitudinal movement thereof, a shipper-ring movably mounton said sleeve, and means acting on said rings successively for shifting them and the pinion and sleeve longitudinally.

24. An engine starter drive including a rotatable shaft, a two-part driving member whose two parts are adapted to drivingly engage each other and which comprise a pinion loosely mounted on the shaft and having a hub, a shipper ring movably mounted on said hub, a sleeve mounted on the shaft for rotary movement therewith and longitudinal movement thereof, a shipper ring movably mounted on said sleeve, and means acting on said rings successively for shifting them and the pinion and sleeve longitudinally, said rings having a yielding longitudinal movement with respect to the hub and sleeve respectively.

25. An engine starter drive including a rotatable shaft, a two-part driving member whose two parts are mounted for independent longitudinal movement thereon, one with respect to the other, said two parts having cooperating engaging driving means which are normally disconnected, the first of said parts being connected with the shaft for rotary movement therewith and the second being movable longitudinally on the shaft for engagement with a member of the engine to be started and the first being positively movable longitudinally on the shaft to operatively engage said second part, in combination with a motor, and operating connections between the motor and the engine member including a connection for driving in the forward direction of rotation only.

26. An engine starter drive including a rotatable shaft, a two-part driving member whose two parts are mounted for independent longitudinal movement thereon, one with respect to the other, said two parts having cooperating engaging driving means which are normally disconnected, the first of said parts being connected with the shaft for rotary movement therewith and the second being movable longitudinally on the shaft for engagement with a member of the engine to be started and the first being positively movable longitudinally on the shaft to operatively engage said second part, in combination with a motor and the operating connections between the motor and the engine member including a one-way clutch.

27. An engine starter drive including a rotatable shaft, a two-part driving member whose two parts are mounted for independent longitudinal movement thereon, one with respect to the other, said two parts having cooperating engaging driving means which are normally disconnected, the first of said parts being connected with the shaft for rotary movement therewith and the second being movable longitudinally on the shaft for engagement with a member of the engine to be started, said second part being provided with a shipper device having a series of projections, and operating means cooperating with said device to shift said second part longitudinally and with said projections to restrain such device from rotation.

28. An engine starter drive including a rotatable shaft, a two-part driving member whose two parts are mounted for independent longitudinal movement thereon, one with respect to the other, said two parts having cooperating engaging driving means which are normally disconnected, the first of said parts being connected with the shaft for rotary movement therewith and the second being movable longitudinally on the shaft for engagement with a member of the engine to be started, said second part being provided with a ring having a series of scallops, and means cooperating with said ring to shift said second part longitudinally and cooperating with said scallops to restrain such ring from rotation.

29. An engine starter drive including a motor driven shaft, a pinion and a sleeve, one freely mounted on said shaft and the other mounted on the shaft for longitudinal movement thereon and for rotary movement therewith, cooperating clutch means on the sleeve and pinion, said clutch means being normally ineffective, and means for shifting said pinion and sleeve to move the pinion into engagement with a member of the engine to be started and render said clutch means effective.

30. An engine starter drive including a motor driven shaft, a pinion and sleeve, one freely mounted on said shaft and the other mounted on said shaft for longitudinal movement thereon and for rotary movement therewith, cooperating clutch means on the sleeve and pinion, said clutch means being normally disconnected, and manual means for shifting said pinion into engagement with a member of the engine to be started and effecting connection of said clutch means.

31. An engine starter drive including a rotatable shaft, a pinion and a sleeve, one freely mounted on said shaft and the other mounted on said shaft for longitudinal movement thereon and rotary movement therewith, cooperating clutch means on said sleeve and pinion, said clutch means being normally disconnected, and means for first shifting said pinion into engagement with the

member of the engine to be started and then shifting said sleeve to effect connection of said clutch means.

32. An engine starter drive including a rotatable shaft, a pinion freely mounted on said shaft, a sleeve splined on said shaft, clutch means on said pinion and sleeve, said clutch means being normally disconnected, and means for independently shifting said sleeve and pinion on said shaft to shift said pinion into engagement with a member of the engine to be started and render said clutch means effective.

WILLIAM L. McGRATH.

CERTIFICATE OF CORRECTION.

Patent No. 1,707,488. **Granted April 2, 1929, to**

WILLIAM L. McGRATH.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 3, line 91, claim 4, after the word "longitudinally" insert the words "separately and"; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 30th day of April, A. D. 1929.

M. J. Moore,
Acting Commissioner of Patents.

(Seal)