July 15, 1924. 1,501,519

W. A. CHRYST

ENGINE STARTING DEVICE

Filed Jan. 28, 1920 3 Sheets-Sheet 1

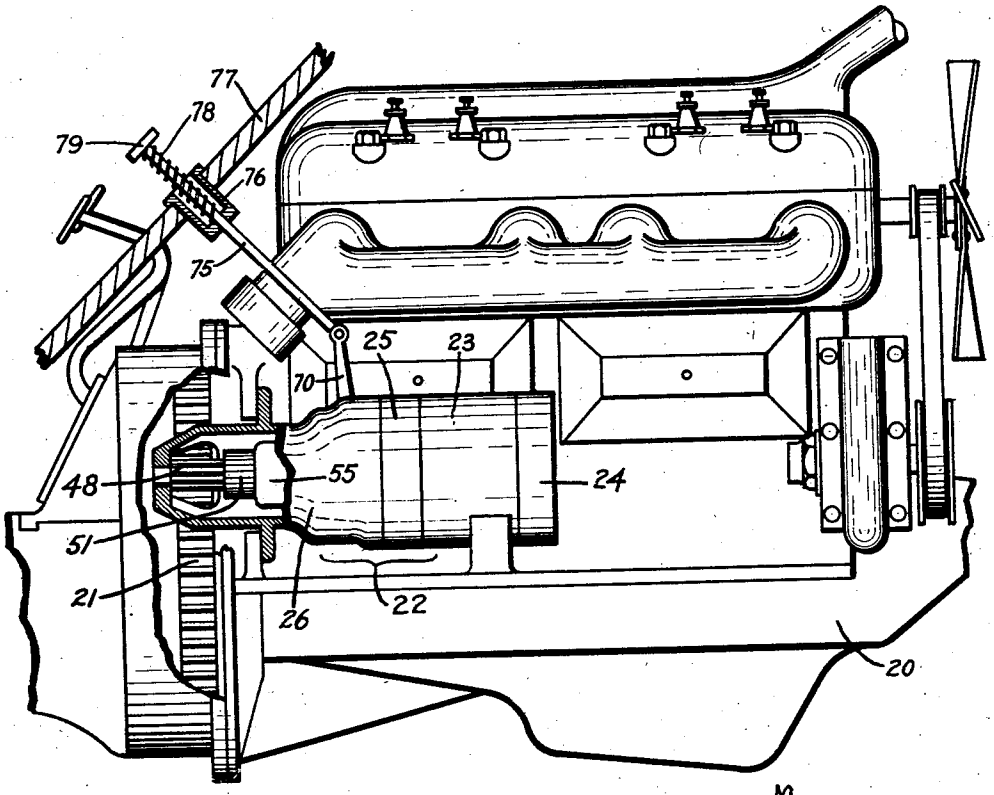


Fig. 1.

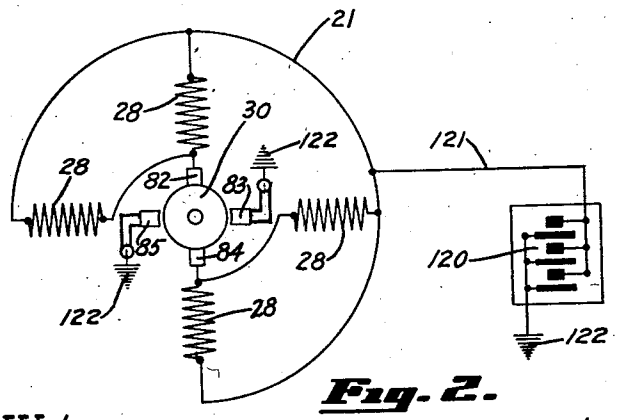


Fig. 2.

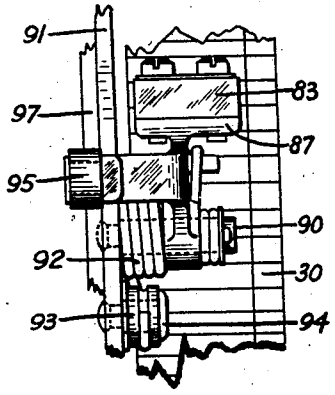


Fig. 3.

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ENGINE STARTING DEVICE

Filed Jan. 28, 1920 3 Sheets-Sheet 2

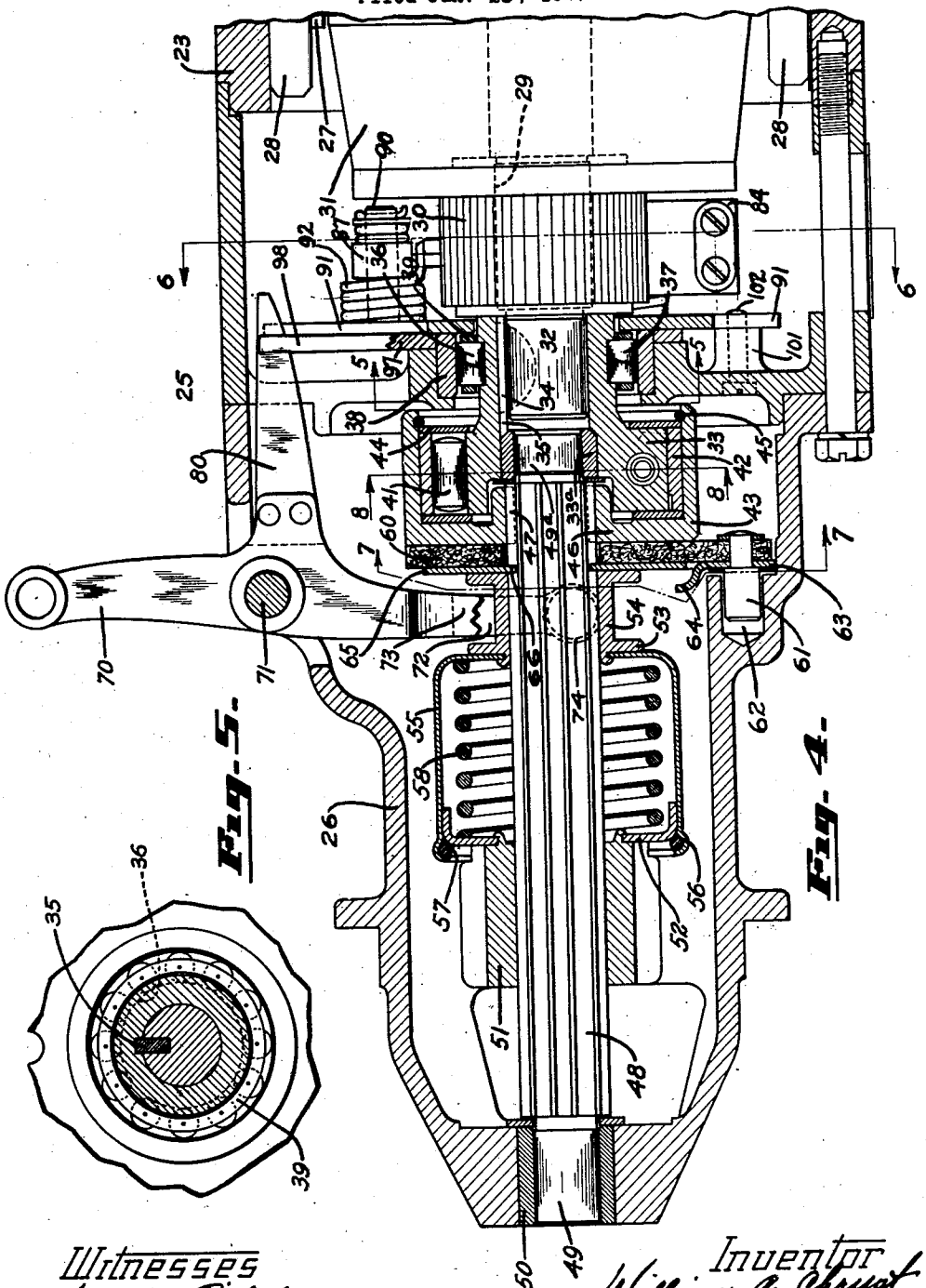


Fig. 4.

Fig. 5.

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ENGINE STARTING DEVICE

Filed Jan. 28, 1920 3 Sheets-Sheet 3

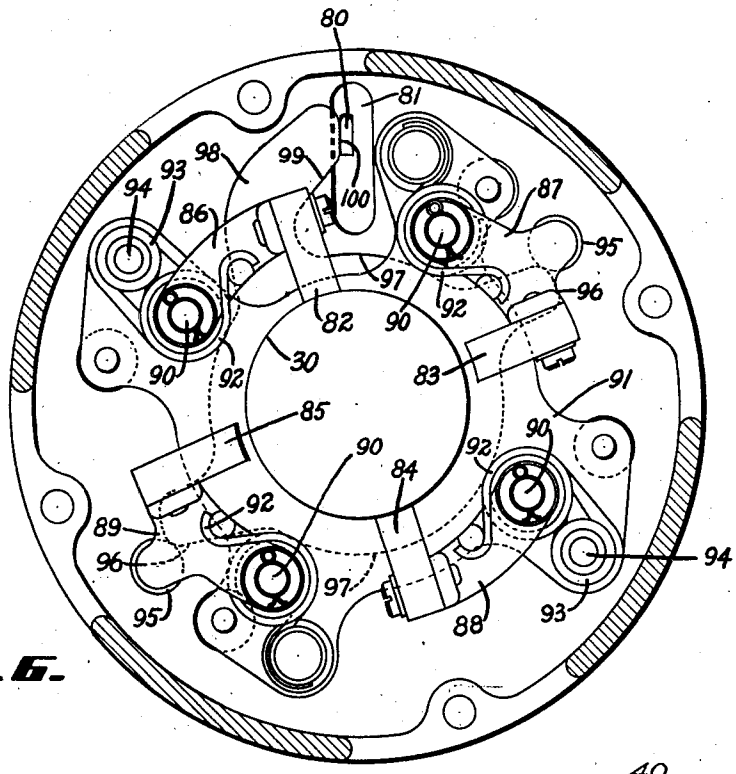


Fig. 6.

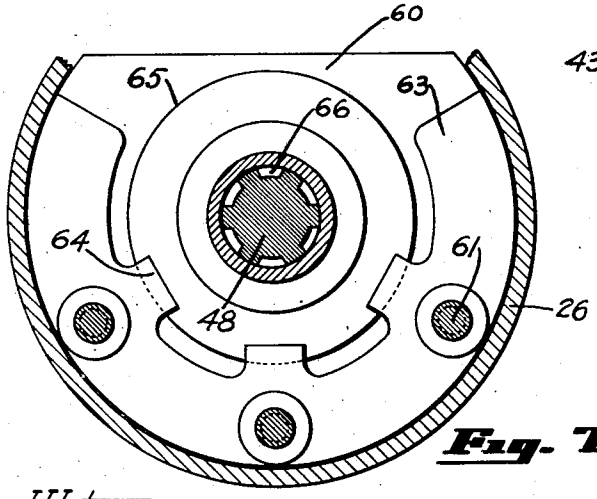


Fig. 7.

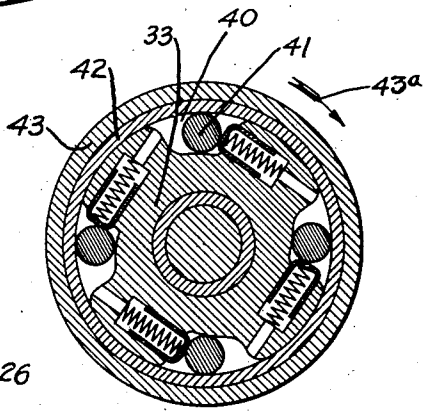


Fig. 8.

Witnesses
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Patented July 15, 1924. 1,501,519

UNITED STATES PATENT OFFICE.

WILLIAM A. CHRYST, OF DAYTON, OHIO, ASSIGNOR TO THE DAYTON ENGINEERING LABORATORIES COMPANY, A CORPORATION OF OHIO.

ENGINE-STARTING DEVICE.

Application filed January 28, 1920. Serial No. 354,658.

To all whom it may concern:

Be it known that I, WILLIAM A. CHRYST, a citizen of the United States of America, residing at Dayton, county of Montgomery, and State of Ohio, have invented certain new and useful Improvements in Engine-Starting Devices, of which the following is a full, clear, and exact description.

This invention relates to starting devices for internal-combustion engines, and particularly to devices which include an electric motor and positively actuated means for connecting the motor with the engine.

The present invention constitutes improvements in the apparatus described and claimed in my copending application Serial No. 296,393, filed May 12, 1919.

In the application referred to the starting device comprises an electric motor and driving connections including a slidably mounted pinion which is moved positively into driving engagement with the flywheel gear of the engine. The device for shifting the motor pinion is connected with a brush operating structure which is constructed to lower certain of the brushes into engagement with the motor commutator in order that the motor may be rendered operative for starting purposes. The said device also includes a braking element for the purposes of bringing the motor quickly to rest after the starting operation has been performed so that the starting device may be operated again immediately without damage to the gearing in case the engine should fail to continue to be self-operative.

It is an object of the present invention to provide improvements in the brush operating mechanism and to provide improvements in the braking device.

A further object of the invention is to provide a starting device which will be simple in construction whereby to reduce the cost of manufacture while at the same time preserving a construction and arrangement which will facilitate making repairs.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein preferred embodiments of the present invention are clearly shown.

In the drawings:

Fig. 1 is a side elevation partly in section showing a starting device embodying the present invention;

Fig. 2 is a wiring diagram showing the motor circuits;

Fig. 3 is a fragmentary plan view of a portion of the brush operating structure;

Fig. 4 is a fragmentary longitudinal sectional view of the starting device shown in Fig. 1;

Fig. 5 is a sectional view taken on line 5—5 of Fig. 4;

Fig. 6 is a sectional view taken on line 6—6 of Fig. 4;

Fig. 7 is a sectional view taken on line 7—7 of Fig. 4; and

Fig. 8 is a sectional view taken on line 8—8 of Fig. 4.

Referring to the drawings, an internal-combustion engine 20 is provided with a flywheel gear 21, and the frame of the engine supports a starting device 22 in any suitable manner.

The starter 22 includes the motor field frame 23, end frames 24 and 25 and a gear housing 26. The field frame is provided with pole pieces one of which is shown at 27 and with the field windings which are indicated by numeral 28. Armature shaft 29 supports commutator 30 and armature 31, and is journalled at one end in bearing not shown provided in the end frame 24. The end 32 of shaft 29 shown in Fig. 4 is connected with clutch cam 33 by means of a key 34 fitting into a slot 35 provided in clutch cam 33. Clutch cam 33 is provided with an annular groove 36 which forms the inner race for bearing rollers 37 which are supported by outer race 38 mounted in the end frame 25. Bearing rollers 37 are held in annularly spaced relation by retaining rings 39 which are held in laterally spaced relation in any suitable well known manner.

The clutch cam 33 is provided with notches 40 in which are located clutch rollers 41 which cooperate to provide a driving connection between the clutch cam 33 and a hardened ring 42 secured within a clutch cup 43, when the cam 33 is rotated clockwise as indicated by arrow 43ª in Fig. 8. The clutch elements are maintained in assembled relation by means of washer 44 and a split ring 45. The hub 46 is internally broached as indicated by numeral 47 to provide a driving connection with the splined pinion

shaft 48. The end portion 49ª of shaft 48 is journalled in bearing 33ª carried by clutch cam 33, and the end portion 49 is journalled in bearing 50 provided in the outer end of gear housing 26.

Motor pinion 51 is internally broached to provide a sliding driving connection with the splined shaft 48, and carries a dished washer 52. Collar 53 provided with a groove 54 is slidably mounted upon shaft 48 and carries a spring housing 55, the outer edge of which is formed to provide an annular groove 56 for the reception of a retaining ring 57. A coiled spring 58 is interposed between spring housing 55 and washer 52, and, by virtue of its initial compression, said spring 58 normally tends to maintain the washer 52 in position against the retaining ring 57.

Braking member 60 is apertured to loosely fit over the shaft 48 and carries one or more locating studs 61 adapted to project into holes 62 provided in the gear housing 26, and carries a brake washer retaining plate 63 which is preferably secured to the brake member 60 by means of the stud 61. Brake washer 65 is interposed between the brake member 60 and the collar 53 and is internally broached as indicated by numeral 66 to provide a driving connection with the motor pinion shaft 48. The movement of brake washer 65 with respect to brake member 60 is limited by means of the projection 64 formed preferably integrally with the retaining plate 63. A pinion shifting lever 70 is pivotally mounted upon shaft 71 supported by the gear housing 26. Said lever 70 is bifurcated at its lower end to provide yoke arms 72 and 73 each carrying at its lower end a stud 74 which cooperates with the groove 54 of collar 53. Lever 70 is connected at its upper end with a push rod 75 mounted to slide through a member 76 supported by the floor board 77 of the automobile. A spring 78 interposed between the push rod pedal 79 and the member 76 serves normally to maintain the push rod 75 and lever 70 in position as shown in the drawings.

Lever 70 is provided with an arm 80 projecting through a slot 81 provided in the end wall of end frame 25, for a purpose to be described. The motor is provided with stationary brushes 82 and 84 and with movable brushes 83 and 85. Brushes 82 and 84 are mounted upon brush arms 86 and 88, respectively, which are pivotally mounted upon studs 90 supported by brush bracket 91 but insulated therefrom in any suitable manner. Springs 92 are coiled around the hubs of brush arms 86 and 88, and one end of each of said springs 92 bears against these brush arms, while the other end bears against a grooved washer 93 secured to the brush bracket 91 by means of stud 94. Brushes 83 and 85 are carried by brush arms 87 and 89, respectively, which are also pivotally mounted upon studs 90 supported by brush bracket 91. Each of these arms 87 and 89 cooperates with a spring 92 in the manner described in connection with brush arms 86 and 88, said springs 92 tending to move the brushes 83 and 85 toward the commutator. Arms 87 and 89 are provided with rollers 95 arranged to be engaged by lugs 96 provided on brush shifting plate 97 which is pivotally mounted concentrically with the armature shaft. Lugs 96 tend normally to maintain rollers 95 in position shown in Fig. 6 thereby maintaining brushes 83 and 85 out of engagement with commutator 30. Brush cam plate 97 is provided with an extension 98 having a camming surface 99 obliquely disposed relative to the retaining surface 100 which is normally engaged by the extension 80 carried by the gear shifting lever 70.

The brush bracket 91 is centrally apertured so as to clear the clutch cam 33, and is mounted concentrically with respect to the armature shaft 29 upon bosses 101 provided in end frame 25, by means of screws 102 extending through apertures in said bosses 101 and having screw threaded engagement with said bracket 91. The brush cam plate 97 is located between brush bracket 91 and the end frame 25 and is journalled upon the outer bearing race 38.

The operation of the invention is as follows:

To start the engine the driver presses his foot upon pedal 79 thereby imparting downward motion to the push rod 75 against the compression of spring 78, and imparting clockwise motion to the lever 70. Assuming that the pinion teeth are in alignment with the spaces of the motor gearing teeth, the pinion 51 will slide outwardly into engagement with the flywheel gear 21 without appreciable compression of the spring 58. After the pinion has moved a certain distance, the arm 80 of lever 70 will have moved sufficiently downwardly to begin to clear the retaining surface 100 of the extension 98. As further movement of the lever 70 takes place the arm 80 will move away from the retaining surface 100 permitting the clockwise movement as viewed in Fig. 6 of brush cam 97 due to the pressure exerted by springs 92 through rollers 95 to the lugs 96. By the time the pinion 51 is in substantially full engagement with the teeth of flywheel gear 21, the brushes 83 and 85 will have moved in engagement with the commutator 30 thereby establishing the motor circuit which is as follows:

Referring to Fig. 2 the motor circuits include battery 120, wire 121 to which the motor field windings are connected in parallel. Each of the brushes 82 and 84 are connected with a pair of field windings 28, and

the brushes 83 and 85 are grounded. The motor circuits are completed through ground connection 122 when the brushes 83 and 85 are brought into engagement with the commutator 30.

After the engine has become self-operative a pedal 79 is released, whereupon spring 78 effects counter clockwise movement of lever 70 to the position shown in Fig. 4 thereby disengaging pinion 51 and causing the arm 80 to move along the camming surface 99 and into engagement with the retaining surface 100 of the brush cam 97 whereupon the motor will cease to be operative.

As the engine becomes self-operative and before the pedal 97 is released the engine will drive the pinion 71 at a high rate of speed. By reason of a one way clutch provided the engine cannot operate the motor armature shaft therefore any disastrous effects on the motor are eliminated. However, after the pinion has been disengaged in the manner described it will continue to rotate due to its own momentum and the momentum of the mechanism connected with the pinion shaft 48. This motion is quickly arrested, since the spring 78 forces the rotating brake disc 65 against the fixed brake member 60 and in turn against the clutch cup 43. Both sides of the brake member 60 are therefore exposed to the rubbing action of members 43 and 65. Any suitable braking material may be used in the construction of the mmber 60, however it may be mentioned that a material known as "Rabestos" has been found satisfactory for the purpose.

It will be apparent from the foregoing description that the disassembling of the starting device for purposes of repair is facilitated. When the gear housing 26 is removed from the frame 25, the lever 70, the shaft 48 and all parts supported thereby except the clutch cup 43 will be removed with it, since the end 49^a of the shaft 48 may be disengaged from its bearing 33^a within the clutch cam 33, and the driving connection betwen the shaft 48 and clutch cup 43 may be readily disengaged. By removing frame 25 from frame 23 all parts supported thereby can be removed leaving the end 32 of the armature shaft 29 unsupported. After the brush bracket 91 has been removed from the frame 25 the brush cam 98 may be easily removed from its bearing upon the roller bearing race 38. The clutch members may be easily removed from the bearing 38 simply by moving the same to the left or frame 25 as viewed in Fig. 4. In this manner the clutch can be removed with its parts in assembled relation carrying with it the assembly of bearing rollers 37.

In case the teeth of pinion 51 should collide with flywheel gear teeth when pinion 51 is shifted, immediate enmeshment of the gearing will be prevented. Further movement of lever 70 will place spring 58 in a state of increased compression before the motor brushes are permitted to engage the commutator. Then, when the motor turns the pinion 51 a distance sufficient to permit enmeshment the spring 58 will quickly force the pinion 51 into engagement with the flywheel gear. This operation has been described and claimed in the copending application referred to.

While the form of mechanism herein shown and described constitutes a preferred form of embodiment of the invention, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What I claim is as follows:

1. In a starting device for internal-combustion engines, the combination with an engine having a gear, and a motor having a brush movable toward and away from the motor commutator; of a motor driven shaft located adjacent the commutator end of the motor and coaxial with the commutator; a pinion slidable on said shaft; a cam member for moving the said brush; a lever acting directly on the cam member and connected with the pinion for moving both the brush and pinion; and a pedal directly attached to the lever.

2. In a starting device for internal-combustion engines, the combination with an engine having a gear, and a motor having a brush movable toward and away from the motor commutator; of a motor driven shaft located coaxially with the commutator; a pinion slidable on said shaft; a rotatable cam plate movable coaxially of the commutator for moving the brush; and a control lever acting directly on the cam member and connected with the pinion for moving both the brush and pinion.

3. In a starting mechanism for an internal-combustion engine having a gear, a unitary structure including a housing, a motor, a commutator, a motor brush movable to make or break the motor circuit, a motor driven shaft and a pinion on said shaft located within the housing and coaxial with the commutator, a cam member for moving the brush, and a control lever mounted on the housing and acting directly on said cam member to move the brush and connected with the pinion for moving the pinion into mesh with the engine gear prior to the starting of the motor.

4. In a starting device for internal-combustion engines, the combination with an engine having a gear, and a motor having brushes adapted to move toward and away from the commutator to make or break the motor circuit; of means pivotally supporting said brushes upon the motor frame; springs urging said brushes toward the commutator; a brush cam plate pivotally

mounted axially of the motor and cooperating to retain said brushes out of engagement with the commutator, said brush cam plate having a retaining surface extending substantially radially thereof and an obliquely disposed camming surface; a shaft operated by the motor; a pinion slidably connected with said shaft; pinion shifting means including a lever pivotally mounted transversely to the motor axis and having a portion adapted to cooperate with the brush retaining and oblique camming portions of the brush cam plate, and means yieldingly maintaining the lever in inoperative position and in engagement with the brush retaining portion of the brush cam plate.

5. In a starting device for internal-combustion engines, the combination with an engine having a gear, and a motor having an end frame; of a brush bracket mounted thereon; a plurality of brush arms carrying brushes and pivotally mounted on said bracket; springs urging said brush arms toward the motor commutator; rollers provided on certain brush arms; a brush cam plate pivotally mounted on said end frame concentrically of said motor and provided with cams cooperating with said brush arm rollers to move said brush arms to inoperative position, and provided with a substantially radially extending brush arm retaining portion and an obliquely disposed brush cam portion; a shaft operated by the motor; a pinion slidably connected with said shaft; a pinion shifting lever pivotally mounted transversely to the motor axis and having a portion adapted to cooperate with the brush-retaining and oblique camming portions of the brush cam plate, and means yieldingly maintaining the lever in inoperative position and in engagement with the brush retaining portion of the brush cam plate.

6. In a starting device for internal-combustion engines, the combination with an engine having a gear, and a motor; of a shaft operated by the motor; a pinion slidably connected with said shaft and normally disconnected from the engine gear; a brake for said shaft; and manual means for releasing said brake and for shifting said pinion into engagement with said gear.

7. In a starting device for internal-combustion engines, the combination with an engine having a gear, and a motor; of a shaft operated by the motor; a pinion slidably connected with said shaft and normally disconnected from the engine gear; a brake for said shaft; and manual means for releasing said brake and for shifting said pinion into engagement with the engine gear and for rendering the motor operative.

8. In a starting device for internal-combustion engines, the combination with an engine having a gear, and a motor; of a pinion driven by the motor and normally disconnected from the engine gear; a brake for the pinion; and manual means for releasing the brake and for shifting said pinion into engagement with the engine gear.

9. In a starting device for internal-combustion engines, the combination with an engine having a gear, and a motor; of a pinion driven by the motor and normally disconnected from the engine gear; a brake for the pinion; and manual means for releasing the brake and for shifting said pinion into engagement with the engine gear; and for rendering the motor operative.

10. In a starting device for internal-combustion engines, the combination with an engine having a gear, and motor; of a pinion shaft; companion clutch elements connected, respectively, with the motor and pinion shaft and forming a one way drive from the motor; a pinion slidably connected with said shaft; means slidably connected with said shaft; means slidable on said shaft for transmitting sliding motion to said pinion; a brake located between said motion transmitting means and the shaft clutch element; manual means for moving said motion transmitting means to release said brake; and a spring for restoring said manual means to braking position and said pinion to inoperative position.

11. In a starting device for internal-combustion engines, the combination with an engine having a gear, and a motor; of a pinion shaft; companion clutch elements connected, respectively, with the motor and pinion shaft and forming a one way drive from the motor; a pinion slidably connected with said shaft; means slidable on said shaft for transmitting sliding motion to said pinion; a brake located between said motion transmitting means and the shaft clutch element; said brake comprising a portion of the shaft clutch element, a metallic member slidably connected with said shaft, and a nonrotatably but slidably mounted friction member located between the metallic member and the clutch element; manual means for moving said motion transmitting means to release said brake; and a spring for restoring said manual means to braking position and said pinion to inoperative position.

12. In a starting device for internal-combustion engines, the combination with an engine having a gear, and a motor; of a shaft operated by the motor, a pinion slidably connected with the shaft; means for moving said pinion including a member slidable along said shaft; a brake for said shaft including a member rotatably connected with said shaft and a friction member nonrotatably mounted with respect to said shaft; and means for moving said slidable member to disengage said pinion from the

fly-wheel gear and to cause said friction member to be gripped between said slidable member and said member rotatably connected with the shaft.

13. In a starting device for internal-combustion engines, the combination with an engine having a gear, and a motor; of a shaft operated by the motor, a pinion slidably connected with the shaft but normally disengaged from the engine gear; means for moving said pinion into engagement and out of engagement with the engine gear including a member slidable along said shaft; a brake for said shaft including a member rotatably connected with said shaft and a friction member non-rotatably mounted with respect to said shaft; spring means yieldingly maintaining the slidable member in pinion disengaged position and for causing said friction member to be gripped between said slidable member and said member rotatably connected with the shaft; and manual means for moving said slidable member into pinion enmeshing position and for releasing said brake.

14. In a starting device for internal-combustion engines, the combination with an engine having a gear, and a motor; of a shaft operated by the motor, a pinion slidably connected with the shaft; a brake for said shaft including a member rotatable with said shaft and a friction member non-rotatably mounted but slidable axially of the shaft; and means for causing said friction member to be moved against said member rotatable with said shaft, and for disengaging the pinion from the engine gear.

15. In a starting device for internal-combustion engines, the combination with an engine having a gear, and a motor; of a shaft operated by the motor; a pinion slidably connected with the shaft; a brake for said shaft including a member rotatable with said shaft and a friction member non-rotatably mounted but slidable axially of the shaft; and spring means for causing said friction member to be moved against said member rotatable with said shaft, and for disengaging the pinion from the engine gear; and manual means for releasing said brake and for moving said pinion into engagement with the gear.

16. In a starting device for internal-combustion engines, the combination with a motor having an armature shaft; of a pinion shaft axially alined with said armature shaft; companion clutch elements connected respectively with the said shafts to provide a one-way drive from the motor, the armature shaft clutch element providing a journal for one end of the armature shaft, and supporting a bearing for one end of the pinion shaft; bearings for the outer ends of the said pinion and armature shafts; an intermediate bearing for the armature shaft clutch element; and a pinion connected with the pinion shaft.

17. In a starting device for internal combustion engines the combination with a motor having an armature shaft; of a pinion shaft axially alined with said armature shaft; companion clutch elements connected respectively with said shafts, the armature shaft clutch element providing a journal for one end of the armature shaft; bearings for the outer ends of the pinion and armature shafts; and an intermediate bearing for the armature shaft clutch element, said bearing including an outer race and roller bearings, the armature shaft clutch element being constructed to provide the inner bearing race and journaled for the armature shaft.

18. In a starting device for internal combustion engines, the combination with a motor field frame; of an armature shaft carrying an armature and commutator; means carried by said field frame for supporting the outer end of said armature shaft; an end frame attached to said field frame and carrying the following associated elements:— motor brushes and brush supporting means, a bearing, and companion clutch elements, one of which is keyed to said armature shaft and provides a journal therefor within said bearing; and a gear housing attached to said end frame and carrying the following associated elements:—a bearing, a pinion shaft having its outer end journalled within said bearing and its inner end supported by said armature shaft clutch element, said shaft being keyed to the other clutch element, a pinion slidably connected with said pinion shaft, and pinion shifting means; whereby the gear housing together with its associated elements may be removed from the end frame, and the end frame together with its associated elements may be removed from the field frame.

19. In a starting device for internal combustion engines, the combination with a motor field frame; of an armature shaft carrying an armature and commutator; means carried by said field frame for supporting the outer end of said armature shaft; an end frame attached to said field frame and carrying the following associated elements:— motor brushes and brush supporting means including movable brush arms, a brush arm cam device, a bearing, and companion clutch elements one of which is keyed to said armature shaft and provides a journal therefor within said bearing; and a gear housing attached to said end frame and carrying the following associated elements:—a bearing, a pinion shaft having its outer end journalled within said bearing and its inner end supported by said armature shaft clutch element, said shaft being keyed to the other clutch element, a pinion slidably connected with said pinion shaft, and pinion shifting

means including means cooperating with said brush arm cam device; whereby the gear housing together with its associated elements may be removed from the end frame, and the end frame together with its associated elements may be removed from the field frame.

20. In a starting device for internal combustion engines, the combination with a motor field frame; of an armature shaft carrying an armature and commutator; motor brushes; means carried by said field frame for supporting the outer end of said armature shaft; an end frame attached to said field frame and carrying the following associated elements:—a bearing and companion clutch elements one of which is keyed to said armature shaft and provides a journal therefor within said bearing; and a gear housing attached to said end frame and carrying the following associated elements:—a bearing, a pinion shaft having its outer end journalled within said bearing and its inner end supported by said armature shaft clutch element, said shaft being keyed to the other clutch element, a pinion slidably connected with said pinion shaft, and pinion shifting means; whereby the gear housing together with its associated elements may be removed from the end frame, and the end frame together with its associated elements may be removed from the field frame.

21. In a starting device for internal combustion engines, the combination with a motor field frame; of an armature shaft carrying an armature and commutator; motor brushes; companion clutch elements one of which is keyed to said armature shaft and provides a journal therefor; bearing members attached to said field frame, one supporting one end of said armature shaft, and the other supporting said clutch elements; and a gear housing attached to said frame, and carrying the following associated elements:—a bearing, a pinion shaft supported at one end by said bearing, and at the one end by said armature clutch element and keyed to the other clutch element, a pinion slidably connected with said pinion shaft, and pinion shifting means.

22. In a starting device for internal combustion engines, the combination with a motor field frame; of an armature shaft carrying an armature and commutator; motor brushes; a shaft connecting device including a part keyed to said armature shaft; bearing members attached to said field frame and supporting, respectively, the outer end of said armature shaft and said shaft connecting device; and a gear housing attached to said frame and carrying the following associated elements:—a bearing, a pinion shaft supported at one end by said bearing and having a keyed connection at its other end with said shaft connecting device, a pinion slidably connected with said pinion shaft, and pinion shifting means.

In testimony whereof I affix my signature.

WILLIAM A. CHRYST.

Witnesses:
F. J. HARDMAN,
LEE T. HOLLEN.