Aug. 14, 1945. R. M. NARDONE 2,381,982

BRUSH ASSEMBLY

Original Filed Dec. 17, 1941 2 Sheets-Sheet 1

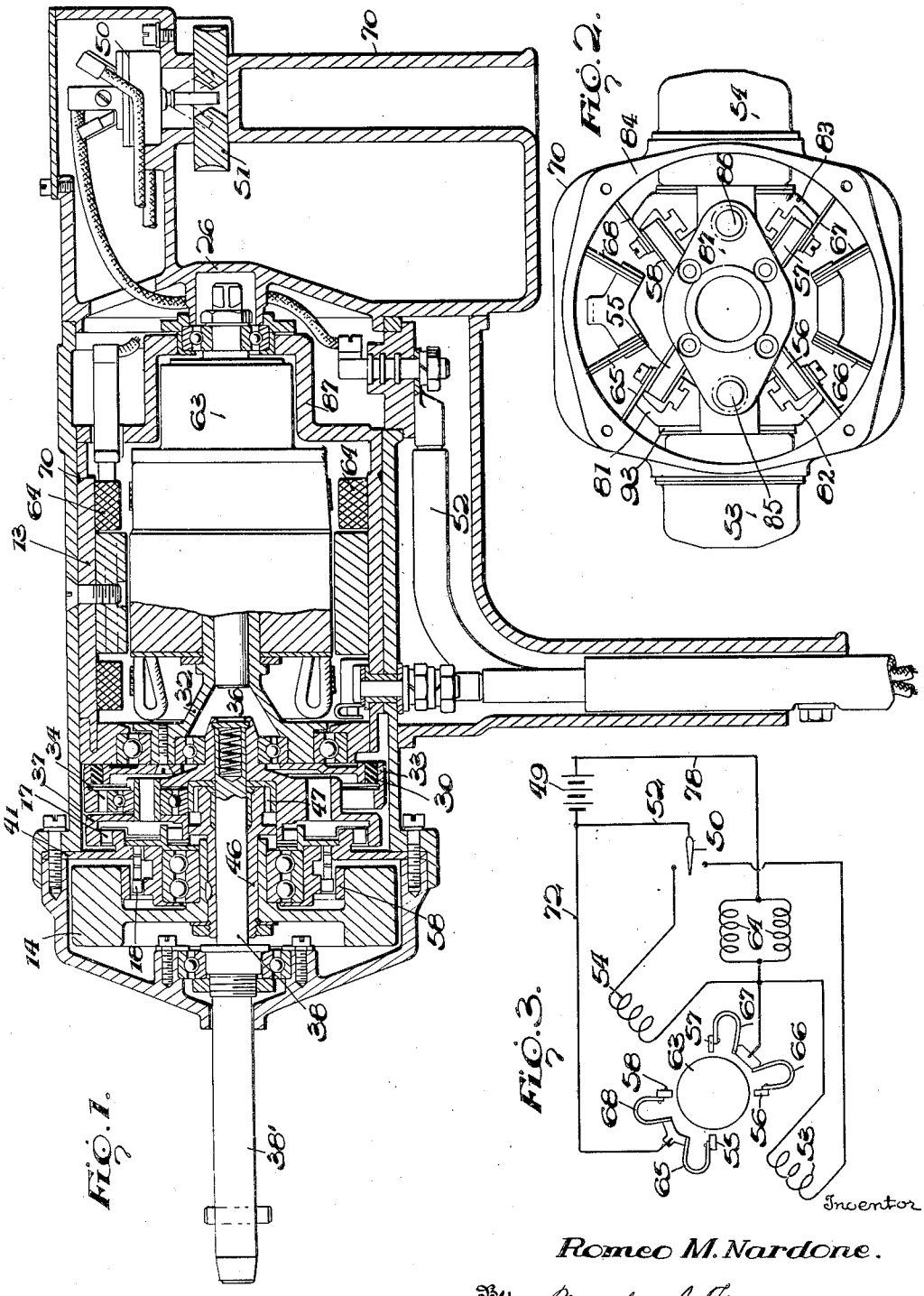


FIG. 1.

FIG. 2.

FIG. 3.

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FIG. 4.

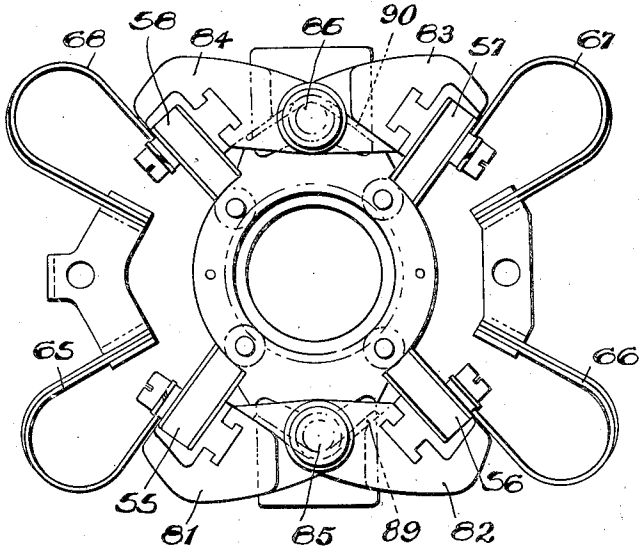


FIG. 5.

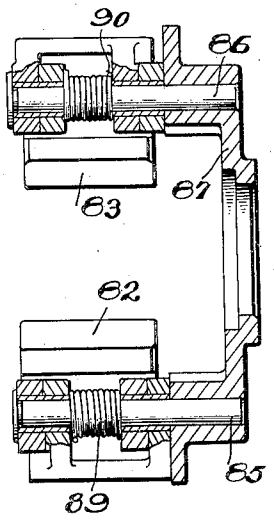
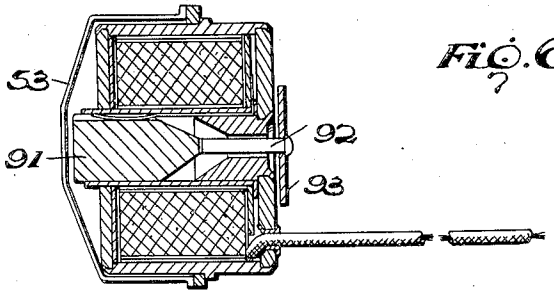


FIG. 6.



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BRUSH ASSEMBLY

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Original application December 17, 1941, Serial No. 423,375, now Patent No. 2,332,163, dated October 19, 1943. Divided and this application May 5, 1943, Serial No. 485,771

11 Claims. (Cl. 171—324)

This invention relates to brush assemblies, and particularly to a type utilized in conjunction with the portable portion of an engine starting mechanism.

An object of the invention is to provide, in a portable starter unit of the motor-driven type, novel means for securing, at the output end of the unit a speed in excess of that of the driving motor.

Another object is to provide, in an inertia type of portable starter, novel means for controlling the acceleration of, and subsequent discharge of energy from, the inertia element.

A further object of the present invention is to provide a brush assembly of a novel construction which permits the foregoing and other objects hereinafter made apparent to be readily achieved.

These and other objects of the invention will become apparent from inspection of the following specification when read with reference to the accompanying drawings wherein is illustrated the preferred embodiment of the invention. It is to be expressly understood, however, that the drawings are for the purpose of illustration only, and are not designed as a definition of the limits of the invention, reference being had to the appended claims for this purpose.

In the drawings:

Fig. 1 is a sectional view of a device embodying the invention;

Fig. 2 is an end view of the brush actuating assembly;

Fig. 3 is a diagram of the electrical connections;

Fig. 4 is a larger view of certain of the parts shown in Fig. 2;

Fig. 5 is a view at right angles to Fig. 4; and

Fig. 6 is a sectional view of one of the two solenoids shown in outline in Fig. 2.

In Fig. 1 the motor 13 (with series field windings 64) is shown as drivably associated with the inertia element 14 by means of driving connections 26 and 32 to a gear train of the planetary type, including an annulus gear 33 and a planet carrier, or "spider," 37 which is held against rotation during operation of the motor in one direction, as in my Patent No. 2,316,122, issued April 6, 1943. It is to be understood that elements 26, 32, and 33 (Fig. 1) are integrated with each other in any suitable manner, as are the corresponding elements 26, 32, and 33 of my patent, just referred to.

Likewise, as in my patent, annulus gear 33 meshes with a planetary idler pinion 34 rotatably carried on the "spider" 37, and said spider has a hub 36 keyed to a centrally disposed shaft 38 which is rotatable relatively to the shaft 26—32, and terminates in a threaded socket which receives the correspondingly threaded end of the coupling shaft 38' which coupling shaft 38' has a transverse pin for driving engagement with the end socket (not shown) which projects exteriorly of the outer surface of the aircraft or other vehicle, and serves to transmit the drive to the remainder of the starting mechanism. Surrounding shaft 38 is a sleeve 46 that is keyed to the hub of flywheel 14; said sleeve 46 having teeth 47 which constitute the "sun" gear of the planetary system, of which planetary system the gear elements 33 and 34 are cooperating parts. These gear elements 33, 34 and 47 may be identical in structure and mode of operation to the similarly designated elements 33, 34 and 47 of my Patent No. 2,316,122, above referred to; but, as shown, gear 33 is in two parts, with rubber material 30 interposed therebetween, as in Waseige Patent No. 1,946,956.

Secured to the housing is a stationary element 41 in the form of an annular plate with projecting ledges which constitute, in effect, the inner races of overrunning clutch assemblies whose rollers are shown at 17 and 18. Rollers 17 engage spider 37, and rollers 18 engage an outer race 58 constituting an integral part of flywheel 14. Rollers 17 function in the same manner as pawls 52 of my Patent No. 2,316,121, issued April 6, 1943, and rollers 18 function in the same manner as pawls 57 of my said patent. To achieve such functioning, the cage 37 and the flywheel member 58 are provided with conventional means—corresponding in their action to the bent springs 23 of Patent No. 1,997,370, granted to H. J. LeVesconte on April 9, 1935—to cause the rollers 17 and 18, respectively, to grip the respective adjacent flat sides of the respective ledges which project from either side of stationary member 41 (see Fig. 4 of my Patent No. 2,316,122) when urged in one rotational direction, while permitting free rolling action when the rollers are urged in the opposite rotational direction. Thus rotation of cage 37 will be possible in one direction only, and the same will be true of flywheel 14. Hence the operation is as follows: During flywheel acceleration, planetary spider 37 is held stationary (by engagement of rollers 17 with member 41) and therefore shaft 38 does not rotate; but after proper flywheel speed is achieved and the motor rotation is reversed (by operation of switch 50, to be described) the re-

sulting reaction causes spider 37 to rotate (the rollers 17 overrunning) and spider 37 in turn causes shaft 38 and all parts driven thereby to rotate.

A two-way snap action switch 50 is incorporated in the motor grip and it is operated by push button 51. This switch is connected up to the battery cable 52 and also to the two solenoids 53 and 54 (see Fig. 3) which act upon the brush rigging. Each solenoid operates to move two brushes (55, 56 or 57, 58) into contact with commutator 63. The brush holders 81, 82 and 83, 84 (of "Bakelite" or equivalent) are hinged on pins 85 and 86, (see Figs. 4 and 5), pressed into an aluminum casting 87. The torsion springs 89, 90 act upon these brush holders to normally hold the brushes (55, 56; 57, 58) a slight distance away from the surface of the commutator 63, but upon energization of one of the two solenoids—say, 53—its plunger 91 (Fig. 6) moves pin 92 and plate 93 outwardly to swing brush holders 81 and 82 toward the commutator, thus engaging brushes 55 and 56, and sending current through the armature to rotate it in the predetermined direction. For opposite rotation, solenoid 54 is energized, whereupon brushes 57 and 58 engage the commutator and send current through the armature in the opposite direction. Of course, the solenoid 53 is de-energized before the solenoid 54 is energized; both solenoids being under the control of the single control switch 50. (See Fig. 3.) Hair-pin shaped flexible leads 65 to 68 connect the positive and negative lead terminals with the brushes 55 to 58, respectively.

In operation, output shaft 38 is connected up to the starter drive shaft in the airplane and the proper solenoid is energized by the pushing of button 51 forward, that is, toward the left. Current now flows through the armature and field windings in series, to rotate the motor in the flywheel accelerating direction. During this period, spider 37 remains stationary as does also output shaft 38 which is splined to it. After the flywheel has been brought up to normal speed, (say, 30,000 R. P. M.) button 51 is released and then pushed toward the right to reverse the setting of switch 50, and thereby cause the motor to reverse its direction of rotation. As soon as the motor speed starts to decrease, output shaft 38 starts to rotate and drive the engaged parts (not shown) on the aircraft. The flywheel speed plus the motor speed add up to increase the rotational speed of output shaft 38 beyond that of the motor alone. Thus is produced a cranking action which is rotationally faster than could be produced by use of a direct-connected motor, or a geared-down motor, as in the prior art. After the energy stored in the flywheel has been completely expended, the cranking may nevertheless be continued (if the engine has not "started" in the meantime) by reason of the direct driving relationship that exists all the way from the motor shaft 26 to cranking shaft 38'. This direct drive may be maintained indefinitely, so long as the circuit to the motor remains closed at the switch 50.

When "starting" of the engine has been achieved, the switch 50 is returned to the middle ("off") position.

This application is a division of my copending application No. 423,375, filed December 17, 1941, now Patent No. 2,332,163, dated October 19, 1943.

What is claimed is:

1. In a brush assembly, a plurality of circumspaced brushes having adjacent brushes arranged in paired relation for selective commutator engagement of the pairs, the brushes of each pair when electrically energized being of opposed polarities and electrically connected to the brushes of coincident polarities of the other pair respectively, and means connected to the pairs and operable for effecting said engagement selectively and thus permit either one of said pairs to be rendered effective and the remaining pair ineffective coincidentally upon said engagement by one of said pairs.

2. In a brush assembly, a plurality of circumspaced brushes having adjacent brushes arranged in paired relation for selective commutator engagement of the pairs, the brushes of each pair when electrically energized being of opposed polarities and electrically connected to the brushes of coincident polarities of the other pair respectively, and means including electromagnetic means connected to the pairs and operable for effecting said engagement selectively and thus permit either one of said pairs to be rendered effective and the remaining pair ineffective coincidentally upon said engagement by one of said pairs.

3. In combination with a motor commutator, a plurality of brushes having circumferentially adjacent brushes arranged about the commutator in paired relation for selective engagement with the commutator, the brushes of each pair when electrically energized being of opposed polarities and electrically connected to the brushes of coincident polarities of the other pair respectively, and means connected to the pairs and operable for effecting said engagement selectively to permit either one of said pairs to be rendered effective and the remaining pair ineffective coincidentally upon said engagement by said one of said pairs.

4. In combination with a motor commutator, a plurality of brushes having circumferentially adjacent brushes arranged about said commutator in paired relation for selective engagement with the commutator, the brushes of each pair when electrically energized being of opposed polarities and electrically connected to the brushes of coincident polarities of the other pair respectively, and means including electromagnetic means connected to the pairs and operable for effecting said engagement selectively to permit either one of said pairs to be rendered effective and the remaining pair ineffective coincidentally upon said engagement by said one of said pairs.

5. In a brush assembly, a plurality of circumspaced brushes having adjacent brushes arranged in paired relation for selective commutator engagement of the pairs, the brushes of each pair when electrically energized being of opposed polarities and electrically connected to the brushes of coincident polarities of the other pair respectively, a brush holder secured to each of said brushes and with the holders of each of said pairs being pivoted together for movement in unison, electromagnetic means engageable with said holders for operating the holders of either one of said pairs into brush commutator engaging position upon energization of said electromagnetic means, and spring means connected to said holders and coacting with said electromagnetic means for maintaining the remaining pair of brushes out of commutator engagement.

6. In combination with a commutator, a plurality of brushes disposed about said commutator and having circumferential adjacent brushes arranged in paired relation for selective engage-

ment with said commutator, the brushes of each pair being of opposed polarities and electrically connected to the brushes of coincident polarities of the other pair respectively, a brush holder secured to each of said brushes and with the holders of each of said pairs being pivoted together for movement in unison, electromagnetic means engageable with said holders for operating the holders of either one of said pairs into commutator engaging position upon energization of said electromagnetic means, and spring means connected to said holders and coacting with said electromagnetic means for maintaining the remaining pair out of engagement with the commutator and for maintaining all of said brushes out of engagement with the commutator upon deenergization of said electromagnetic means.

7. In a brush assembly, a plurality of circumspaced brushes having adjacent brushes arranged in paired relation for selective commutator engagement, the brushes of each pair being of opposed polarities and electrically connected to the brushes of coincident polarities of the other pair respectively, a brush holder secured to each of said brushes and with the holders of each of said pairs being pivoted together for movement in unison, electromagnetic means engageable with said holders for operating the holders of either one of said pairs into commutator engaging position upon energization of said electromagnetic means, and spring means connected to said holders and coacting with said electromagnetic means for maintaining the remaining pair out of said position and for maintaining all of said brushes out of said position upon deenergization of said electromagnetic means.

8. Current supply means for an electric motor comprising, in combination with a motor commutator, sets of brushes circumferentially disposed about and engageable with said commutator, the brushes of each set being arranged in successive order and of different polarities, a positive lead terminal, a negative lead terminal, means connecting each terminal with one brush of each set of brushes, means for pivotally mounting each set of brushes for movement about diametrically opposed pivot pins, electromagnetic means individual to each set of brushes for swinging said brushes about said pins, in one direction, and resilient means coiled about said pins to swing the brushes in the opposite direction.

9. Current supply means for an electric motor comprising, in combination with a motor commutator, sets of brushes circumferentially disposed about and engageable with said commutator, the brushes of each set being arranged in successive order and of different polarities, a positive lead terminal fixed in a position midway between said brush-sets, a negative lead terminal fixed in a position diametrically opposite to the first terminal, means connecting each terminal with one brush of each set of brushes, means for pivotally mounting each set of brushes for movement about diametrically opposed pivot pins, electromagnetic means individual to each set of brushes for swinging said brushes about said pins, in one direction, and resilient means coiled about said pins to swing the brushes in the opposite direction.

10. Current supply means for an electric motor comprising, in combination with a motor commutator, sets of brushes circumferentially disposed about and engageable with said commutator, the brushes of each set being arranged in successive order and of different polarities, a positive lead terminal, a negative lead terminal, hair-pin shaped flexible leads connecting each terminal with one brush of each set of brushes, means for pivotally mounting each set of brushes for movement about diametrically opposed pivot pins, electromagnetic means individual to each set of brushes for swinging said brushes about said pins, in one direction, and resilient means coiled about said pins to swing the brushes in the opposite direction.

11. Current supply means for an electric motor comprising, in combination with a motor commutator, sets of brushes circumferentially disposed about and engageable with said commutator, the brushes of each set being arranged in successive order, and of different polarities, a positive lead terminal fixed in a position midway between said brush-sets, a negative lead terminal fixed in a position diametrically opposite to the first terminal, hair-pin shaped flexible leads connecting each terminal with one brush of each set of brushes, means for pivotally mounting each set of brushes for movement about diametrically opposed pivot pins, electromagnetic means individual to each set of brushes for swinging said brushes about said pins, in one direction, and resilient means coiled about said pins to swing the brushes in the opposite direction.

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