

Sept. 12, 1933.

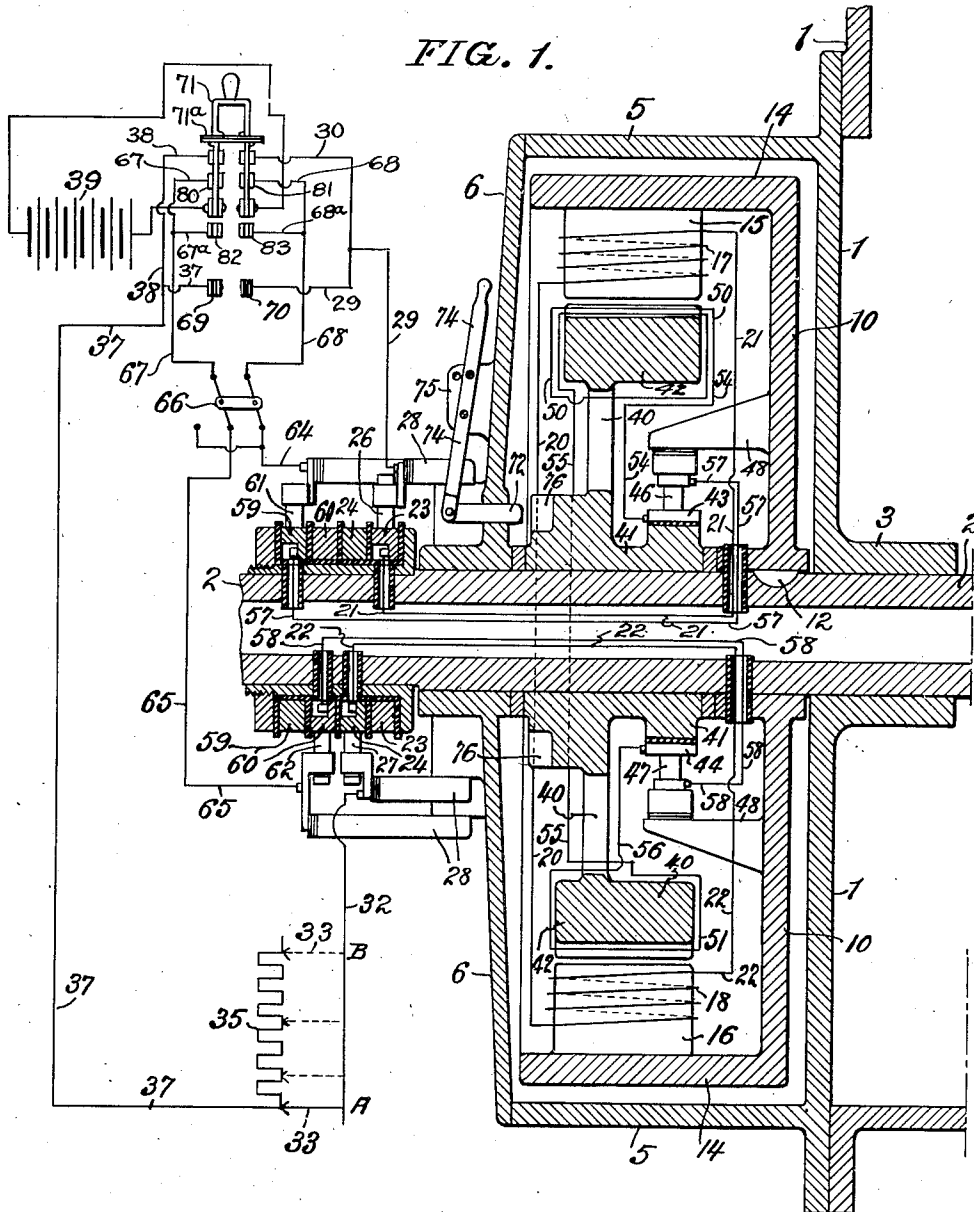
T. D. BOWES

1,926,029

ELECTRIC MAGNETIC INERTIA STARTER

Filed Feb. 26, 1931

2 Sheets-Sheet 1



Inventor:
Thomas David Bowes
By J. Dellitt Goodwin
Attorney

Sept. 12, 1933.

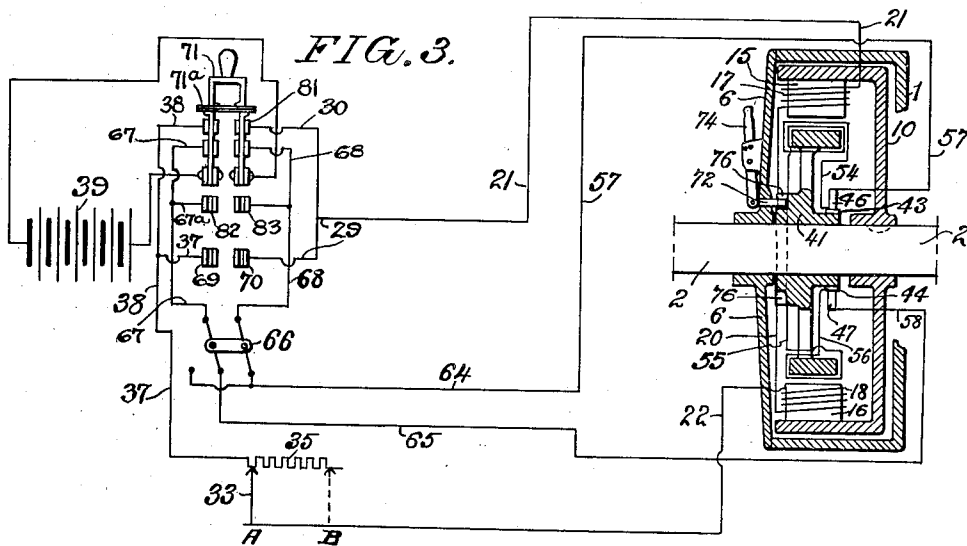
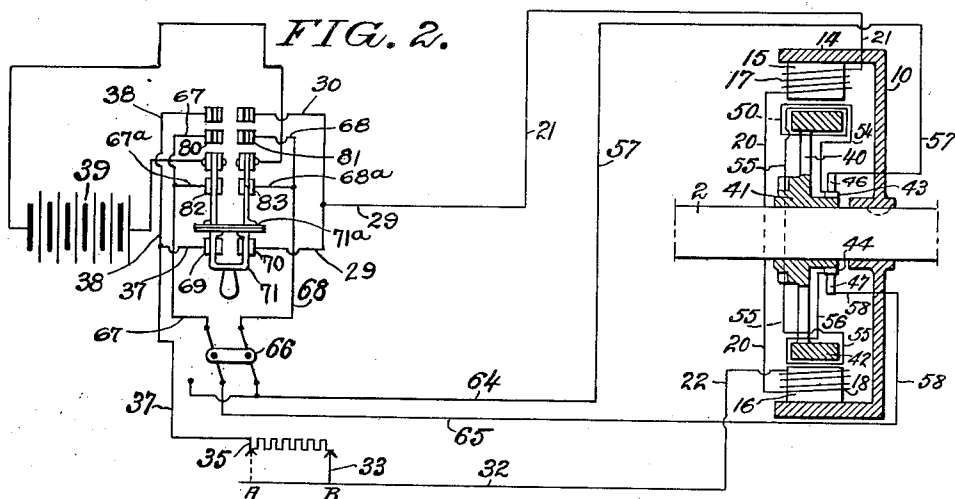
T. D. BOWES

1,926,029

ELECTRIC MAGNETIC INERTIA STARTER

Filed Feb. 26, 1931

2 Sheets-Sheet 2



Inventor:
Thomas David Bowes
By *H. DeWitt Goodwin*
Attorney

UNITED STATES PATENT OFFICE

1,926,029

ELECTRIC MAGNETIC INERTIA STARTER

Thomas David Bowes, Cynwyd, Pa.

Application February 26, 1931. Serial No. 518,368

12 Claims. (Cl. 290—31)

My invention relates to an electric magnetic inertia starter for engines and other mechanism to which initial motion is to be imparted, and my invention particularly relates to a starter for large internal combustion engines such as engines of the Diesel type.

The object of my invention is to provide a starter in which electrical energy is utilized for rotating a freely movable part at a high rate of speed and providing means for magnetically coupling the freely rotating part with the engine, or other mechanism, for rotating the same by the action of the inertia stored in the rotating part; a further object of my invention is to construct the starter with parts forming an electric motor, one of the motor parts being associated with the mechanism which is to be set in motion, such as the flywheel of the engine, and the other motor part being rotatably mounted relatively to the mechanism, or the flywheel of the engine; a still further object is to provide the electric circuit including a source of power and said motor parts, with an adjustable resistance whereby the speed of the freely rotating motor part may be gradually increased until the inertia stored therein is sufficient to cause the other motor part, which is mounted upon the mechanism, or engine, to be rotated; a still further object of my invention is to provide the circuit for magnetically coupling the motor parts with an adjustable resistance by means of which the freely rotating motor part may be gradually locked magnetically with the motor part to which motion is to be imparted; a still further object is to provide mechanical means for locking the motor part, which is freely rotatable, with the fixed casing or housing for holding said motor part against rotation, so that after the engine, or mechanism, is started the motor parts will form a dynamo electric machine for generating current which may be utilized for recharging the battery or for other purposes as desired; a still further object is to provide means for magnetically interlocking the motor parts when one thereof is mechanically locked with the casing, thus forming means for braking or retarding the rotation of the engine; a still further object is to provide means for starting the engine in either direction by the inclusion of a pole changer in the electric circuit, so that the engine may be started rotating in either direction, making the starter particularly adaptable for marine engines and especially of the Diesel type. These together with various other novel features

of construction and arrangement of the parts, which will be more fully hereinafter described and claimed constitute my invention.

Referring to the accompanying drawings Fig. 1 is a vertical longitudinal sectional view of my novel starter and partially showing a casing of an engine, and also showing the electrical circuits diagrammatically; Fig. 2 is a diagram showing the electrical circuits closed for interlocking, or short circuiting, the motor parts for coupling the same together magnetically; Fig. 3 is a view similar to Fig. 2 showing the circuits arranged to form a generator for generating current, and showing mechanical means for locking one of the motor parts to the casing.

In the accompanying drawings in which like reference characters refer to like parts, 1 represents the casing of an engine having a crank shaft 2 rotatably mounted in bearings 3 upon the casing. The engine may be of any desired type and therefore is not shown in the drawings.

The casing 1 is provided with an extension 5, having a removable cover 6, enclosing a flywheel 10, secured upon the shaft 2, by means of a key 12. The flywheel is provided with electric motor, or dynamo, parts, comprising cores or poles 15 and 16, arranged upon the peripheral flange 14. Upon the cores 15 and 16 are wound coils 17 and 18 connected by a conductor 20. The coils 17 and 18 are connected in a circuit including conductors 21 and 22 extending through the hollow portion of the shaft 2 and connected with rings 23 and 24 secured upon the shaft 2. Brushes 26 and 27 are mounted upon supports 28 secured upon the casing cover 6. Said brushes are in contact with the rings 23 and 24 which rotate with the shaft 2. The brush 26 is connected by conductors 29 and 30 with a double pole, double throw switch 31. The brush 27 is connected by a conductor 32 with an adjustable terminal 33 forming part of a variable resistance 35 connected with the switch 31, by conductors 37 and 38.

A battery 39 forms a source of electric energy and is connected with the switch 31, in the usual manner. When the switch 31 is in the position shown in Fig. 1 the field circuit is completed for energizing the coils 17 and 18 which form the field poles of a motor or dynamo.

Within the field poles 15 and 16 is located an armature 40 having a hub 41 and a relatively heavy rim 42. Said hub 41 is freely rotatable relatively to the shaft 2. The hub 41 is provided with commutator sections 43 and 44, with

which are associated brushes 46 and 47, arranged in the usual manner and supported upon brackets 48 carried by the flywheel 10.

Armature coils, or windings 50 and 51 are mounted upon the peripheral ring 42 of the armature 40 and are connected in a circuit including conductors 54, 55 and 56. Said conductors 54 and 56 are connected with the commutator sections 43 and 44 arranged with the brushes 46 and 47 in contact therewith in the usual manner. The brushes 46 and 47 are connected by conductors 57 and 58, which extend through the shaft 2, with rings 59 and 60 secured upon the shaft 2. Said rings 59 and 60 are in contact with brushes 61 and 62 which are connected by conductors 64 and 65 with a pole changer 66, which is connected by conductors 67, 68, 67a and 68a with the switch 31, through which the armature coils 50 and 51 may be energized by the battery 39 for rotating the armature 40, as a motor. By reversing the position of the pole changer 66 the motor may be rotated in the opposite direction.

The switch 31 is provided with terminals 69 and 70, adapted to be connected by a bar conductor 71 mounted upon a cross piece 71a of insulating material carried by the blades of the switch 31. When the switch 31 is in the position shown in Fig. 2 the field circuit, including conductors 30 and 38, will be disconnected from the battery circuit and the field circuit will be short circuited by the bar conductor 71.

The switch 31 also has a pair of terminals 80 and 81 and a pair of terminals 82 and 83, all of which are included in the armature circuit. The battery circuit is included in the armature circuit when the switch 31 is in the position shown in Fig. 1, with the terminals 80 and 81 engaged, and also when the switch is in the position shown in Fig. 2, with the terminals 82 and 83 engaged, thus energizing the armature circuit, by the battery circuit, when the switch is in the positions shown either in Figs. 1 or 2.

When the armature is rotating, the switch 31 is moved from the position shown in Fig. 1 to that shown in Fig. 2. With the armature rapidly rotating due to its inertia, a current will be generated by the rotation of the armature windings relatively to the field coils and when the field circuit is closed through the bar conductor 71 of the switch 31 the armature will be magnetically locked with the field coils and the inertia of the rapidly rotating armature will cause the flywheel to rotate and start the engine, or other mechanism with which the shaft 2 is connected.

Mechanical means in the form of a sliding bolt 72 is provided for mechanically locking the armature 40 relatively to the casing for holding the armature stationary, thus forming a generator, or dynamo electric machine, when the field coils 17 and 18 are revolving with the flywheel from the power of the engine after the latter has been started.

The bolt 72 is slidably mounted in the cover 6 of the casing, and its outer end is pivotally connected with a lever 74, which in turn is pivotally mounted in a bearing 75 formed upon the cover 6. The bolt 72 is shown in Fig. 3 in a position within the notches 76 formed in the hub 41, thus engaging the armature 40 and locking the same in a fixed position, relatively to the casing.

The operation of my invention is as follows: When it is desired to operate the starter to

start the engine, or other mechanism, the switch 31 is positioned to include the battery circuit, as shown in Fig. 1. The adjustable member 33 of the resistance 35 is placed in the position indicated at A, thus eliminating the resistance 35.

The circuits as shown in Fig. 1, are now closed to form a motor, with the armature 40 rotating loosely relatively to the shaft 2. The adjustable terminal 33 of the resistance 35 is gradually moved from position A to position B for reducing the strength of the current in the field coils 17 and 18, thereby increasing the speed of the armature 40 to its maximum speed.

With the resistance 35 still included in the field circuit, and the armature rotating loosely relatively to the shaft 2, at a high rate of speed, the switch 31 is moved to the position shown in Fig. 2, to open the connection between the battery circuit and the conductors 30 and 38 of the field circuit, and make contact with the terminals 69 and 70, thus short circuiting the field circuit, by connecting the conductors 29 and 37 through the conductor 71 of the switch. The armature 40 is now magnetically associated with the field coils 17 and 18, thus tending to rotate the flywheel with the armature, due to the inertia stored in the latter. The armature circuit is energized by the battery, through the terminals 82 and 83 of the switch, when the latter is in the position shown in Fig. 2.

The terminal 33 of the resistance 35 is now moved from the position B to position A, for gradually increasing the current in the field coils, thus interlocking to a greater extent the armature with the field coils, whereby the inertia of the rotating armature will cause the flywheel to rotate with it and start the engine, or other mechanism with which the shaft 2 may be associated.

When the engine is running the switch 31 is moved to an intermediate position for opening the circuits thereby allowing the armature 40 coming to rest so that the bolt 72 may be inserted into the notches formed in the hub 41, thus locking the armature with the casing cover 6, so that the flywheel, which is being rotated by the engine, will form a generator, or dynamo, due to the field coils 17 and 18 rotating relatively to the armature windings 50 and 51. By placing the switch 31 in the position shown in Fig. 1 the current thus generated may be utilized for recharging the battery, or for other purposes. The strength of the current generated may be controlled by the resistance 35 included in the circuit.

When the armature 40 is locked relatively to the casing by the bolt 72, the armature 40 may be used as a brake for retarding, or stopping the engine, by shifting the switch 31 into the position shown in Fig. 2, in which the circuit including the field and coils is short circuited, thereby magnetically locking the engine with the armature which later is locked by the bolt 72 with the casing. This feature for braking the engine is utilized in marine engines for preventing the same from being rotated by the action of the water upon the propeller when the boat is moving through the water, and provides means for quickly stopping the engine so that it may be again started rotating in the reverse direction by changing the position of the pole changer 66, for changing the polarity of the armature coils.

The present invention may be carried out by

various other forms of motor and generator windings and other constructions, well known in the art. My starter may be utilized for starting other forms of mechanism, as well as engines, and various changes may be made in the construction and operation of the parts without departing from my invention.

I claim:

1. An inertia starter comprising a rotatably mounted part having a frictional load to which motion is to be imparted, a second part rotatably mounted relatively to the first mentioned part, electric motor units arranged upon said parts, a source of electric current, a circuit including said source of current and said units for energizing the latter for rotating said second part relatively to the first mentioned part, and means for magnetically interlocking said motor units for rotating the first mentioned part by the action of the inertia stored in said second part while it is rotating.

2. An inertia starter comprising an electric motor part having a frictional load, a bearing in which said part is rotatably mounted, a second electric motor part positioned in operative relation with said first mentioned part, a bearing upon which said second part is mounted and freely rotatable, a source of electric current, electric circuits, including said source of current and said motor parts arranged for rotating said second motor part relatively to the first mentioned part, and means arranged for magnetically coupling said motor parts for rotating the first mentioned motor part by the action of the inertia stored in said second motor part.

3. An inertia starter comprising an electric motor part arranged to be mounted upon a device having a frictional load to which rotary motion is to be imparted, a second motor part operatively associated with the first mentioned part, a bearing in which said second part is freely rotatable relatively to said first mentioned part, a source of electric current, an electric field circuit, an electric armature circuit, said circuits including said source of current and said motor parts arranged for energizing the motor parts for rotating said second part, means for opening said field circuit while said second part is rotating, and means for short circuiting said field circuit for magnetically interlocking said motor parts for imparting a rotary motion to the first mentioned motor part by the action of the inertia stored in said second motor part while still in motion.

4. An inertia starter comprising an electric motor part arranged to be mounted upon a device having a frictional load to which rotary motion is to be imparted, a second motor part operatively associated with the first mentioned part, a bearing in which said second part is freely rotatable relatively to said first mentioned part, a source of electric current, an electric field circuit, an armature circuit, said circuits including said source of current and said motor parts arranged for energizing the motor parts for rotating said second part, means for opening said field circuit while said second part is rotating, an adjustable resistance in said field circuit arranged for varying the speed of said second part when the field circuit is energized by the source of current, and means in said field circuit for short circuiting the field circuit while said second part is in motion for magnetically interlocking said parts for imparting rotary motion to the first mentioned part by

the action of the inertia stored in said second part.

5. An inertia starter comprising an electric motor part arranged to be mounted upon a device having a frictional load to which rotary motion is to be imparted, a second motor part operatively associated with the first mentioned part, a bearing in which said second part is freely rotatable relatively to said first mentioned part, a source of electric current, an electric field circuit, an armature circuit, said circuits including said source of current and said motor parts arranged for energizing the motor parts for rotating said second part, means for opening said field circuit while said second part is rotating, means in said circuit for short circuiting said field circuits for magnetically interlocking the motor parts, and an adjustable resistance in said field circuit arranged for varying the magnetic lines of force between said motor parts for gradually increasing the locking of said motor parts by reducing the resistance in the field circuit whereby the inertia stored in the freely rotating motor part will set up a rotary motion in the first mentioned motor part.

6. An inertia starter comprising an electric motor part arranged to be mounted upon a device having a frictional load to which rotary motion is to be imparted, a second motor part operatively associated with the first mentioned part, a bearing in which said second part is freely rotatable relatively to said first mentioned part, a source of electric current, an electric field circuit, an electric armature circuit, said circuits including said source of current and said motor parts arranged for energizing the motor parts for rotating said second part, means for opening said field circuit while said second part is rotating, means for magnetically locking said motor parts for imparting rotary motion to the first mentioned part by the action of the inertia stored in said second motor part while in motion, and means for mechanically locking said second motor part relatively to the bearing after the first mentioned part is set in motion forming a dynamo electric machine by the rotation of the first mentioned part relatively to said second part.

7. An inertia starter comprising an electric motor part arranged to be mounted upon a device having a frictional load to which rotary motion is to be imparted, a second motor part operatively associated with the first mentioned part, a bearing in which said second part is freely rotatable relatively to said first mentioned part, a source of electric field current, an electric circuit, an electric armature circuit, said circuits including said source of current and said motor parts arranged for energizing the motor parts for rotating said second part, means for opening said field circuit while said second part is rotating, means for magnetically locking said motor parts for imparting rotary movement to the first mentioned part by the action of the inertia stored in said second motor part while in motion, means for mechanically locking said second motor part relatively to the bearing for generating current by the rotation of the first mentioned part relatively to said second part, and means for short circuiting said field circuit to form a brake for stopping the rotation of the first mentioned motor part.

8. An inertia starter comprising a rotatably mounted part having a frictional load to which

motion is to be imparted, a second part rotatably mounted relatively to the first mentioned part, electric motor units arranged upon said parts, a source of electric current, a circuit including said source of current and said units for energizing the latter for rotating said second part relatively to the first mentioned part, means for magnetically interlocking said motor units for rotating the first mentioned part by the action of the inertia stored in said second part while it is rotating, and a pole changer in said circuit arranged for changing the polarity of the motor for reversing the direction of rotation of said motor parts.

9. An inertia starter for an engine, comprising a shaft operatively associated with the engine and rotatable therewith, an electric motor unit mounted upon the shaft, an armature forming an electric motor unit operatively associated with the first mentioned unit and freely rotatable relatively to the latter, a field circuit, an armature circuit, said circuit including a source of current for energizing said units as a motor for rotating the armature, means for opening the field circuit from the source of current, said motor units arranged to generate current by the rotation of the armature, and means for short circuiting the field circuit for magnetically interlocking the motor units for rotating the first mentioned unit by the action of the inertia stored in the rotating armature.

10. An inertia starter for an engine, comprising a shaft operatively associated with the engine and rotatable therewith, a flywheel secured upon said shaft, electric motor field units upon the flywheel, an armature freely rotatable relatively to the flywheel, electric motor armature units upon the armature operatively positioned relatively to said field units upon the flywheel to form a motor for freely rotating the armature relatively to the flywheel, and means for short circuiting said field motor units for magnetically locking the motor units together when

the armature is rotating for imparting rotary motion to the flywheel by the action of the inertia stored in the revolving armature.

11. An inertia starter for an engine, comprising a shaft operatively associated with the engine and rotatable therewith, field coils upon the flywheel forming magnetic poles, an armature freely rotatable relatively to the flywheel, an electric field circuit, an armature circuit, said circuits including a source of power for energizing the field coils and the armature for rotating the latter relatively to the flywheel, means for magnetically locking the field coils with the armature while the latter is rotating for imparting rotary motion to the flywheel due to the inertia of the armature, and a resistance included in said field circuit arranged for varying the speed of rotation of the armature and for graduating the application of the locking force between the armature and the flywheel.

12. An inertia starter for an engine, comprising a casing, a shaft rotatably mounted upon the casing and operatively associated with the engine, a flywheel secured upon the shaft, field coils upon the flywheel, an armature rotatably mounted upon the shaft, an electric field circuit, an electric armature circuit, said circuits including a source of power for energizing the field coils and the armature for rotating the latter relatively to the flywheel, means for magnetically locking the field coils with the armature for rotating the flywheel by the action of the inertia stored in the armature, a locking device upon the casing for locking the armature against rotation when the flywheel is in motion for generating current by the rotation of the field coils relatively to the armature, means for short circuiting the field circuit including the field coils when the armature is locked with the casing for retarding the rotation of the flywheel, and an adjustable resistance device included in said field circuit.

THOMAS DAVID BOWES.

45

120

50

125

55

130

60

135

65

140

70

145

75

150