April 7, 1925.

1,533,072

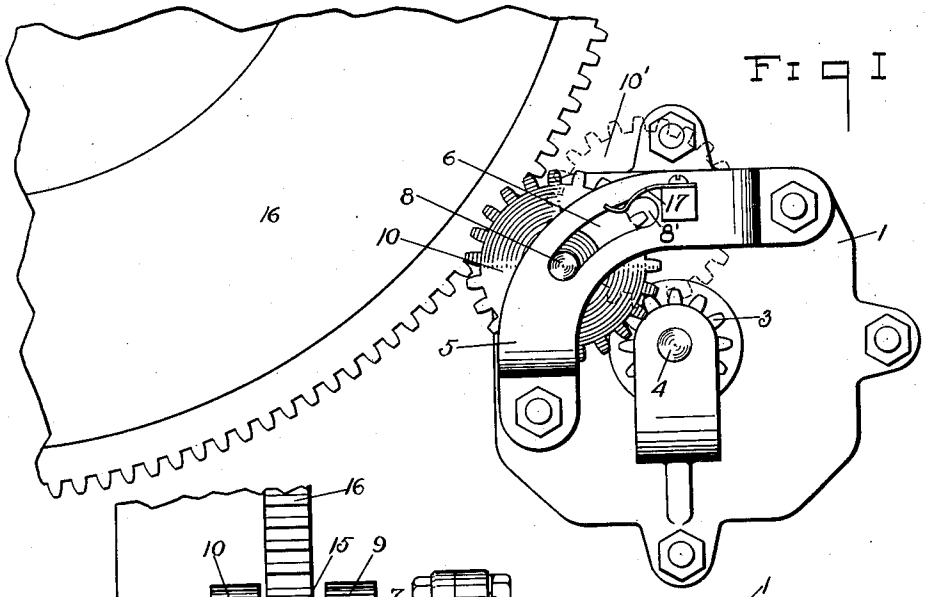
C. P. BROCKWAY

ELECTRIC STARTER

Filed Oct. 22, 1920

2 Sheets-Sheet 1

FIG I



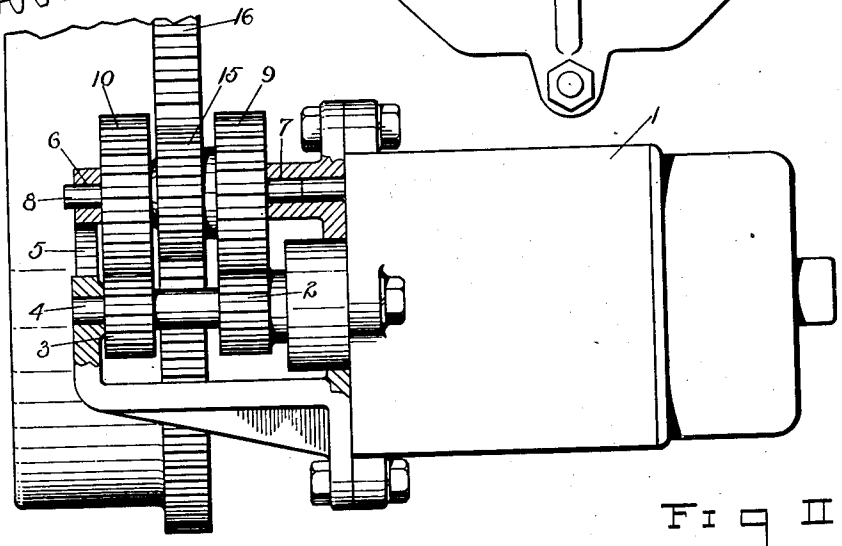


FIG II

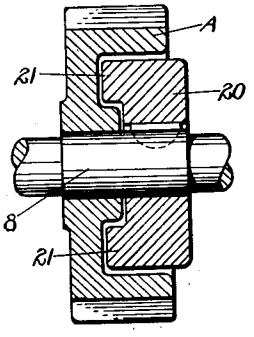


FIG IV

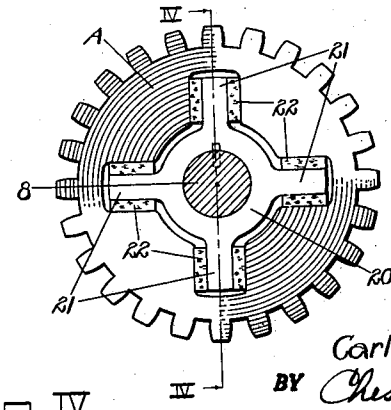


FIG III

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April 7, 1925. 1,533,072

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ELECTRIC STARTER

Filed Oct. 22, 1920 2 Sheets-Sheet 2

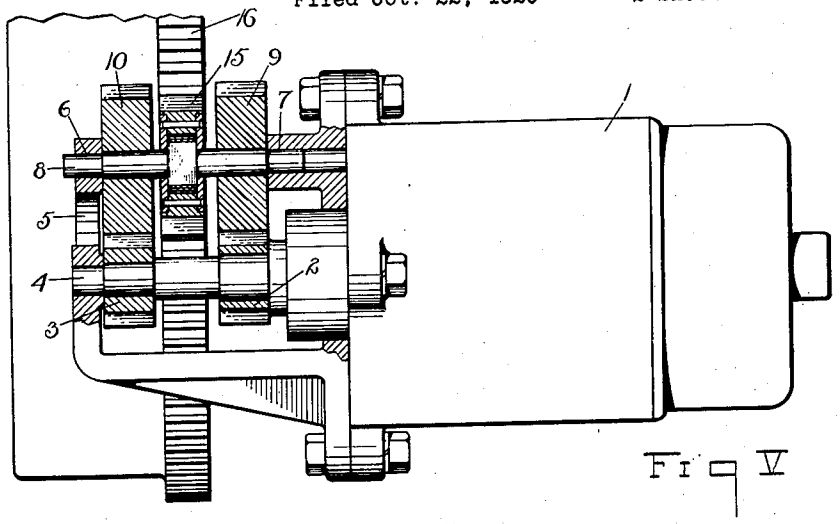

Fig V

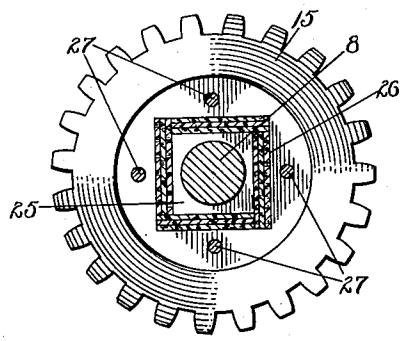

Fig VI

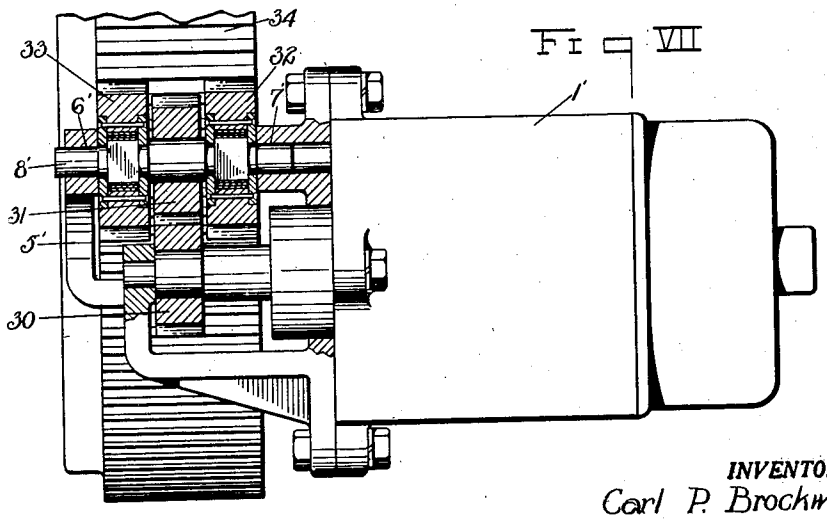

Fig VII

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Patented Apr. 7, 1925. 1,533,072

UNITED STATES PATENT OFFICE.

CARL P. BROCKWAY, OF TOLEDO, OHIO, ASSIGNOR TO INDUSTRIAL RESEARCH CORPORATION, OF TOLEDO, OHIO, A CORPORATION OF DELAWARE.

ELECTRIC STARTER.

Application filed October 22, 1920. Serial No. 418,805.

To all whom it may concern:

Be it known that I, CARL P. BROCKWAY, a citizen of the United States, residing at Toledo, in the county of Lucas and State of Ohio, have invented certain new and useful Improvements in Electric Starters, of which I declare the following to be a full, clear, and exact description.

This invention relates to improvements in the driving mechanism between a starting motor and the engine to be started and has for its main object the provision of an intermediate wheel between the motor and engine wheels which moves along an arcuate path into and out of engagement with its driven wheel but is not supported by the motor shaft, thereby avoiding a great amount of lateral thrust on the motor shaft.

Another object is to provide arcuate guides in a stationary support for said intermediate wheel to slide bodily along said guides.

Another object is to provide reduction gears between said intermediate wheel and the motor shaft.

Another object is to provide the motor pinion and its cooperating gears with teeth of smaller pitch than that of the said intermediate gear. This permits the motor pinion to be made as small as may be desired in order to get a high gear reduction between the motor and engine.

Another object is to provide a simple and effective flexible drive between the motor and the engine by making driving connection of one or more gears to its or their shaft by inserts of flexible material such as cork, rubber, etc.

Other objects and those relating to simplicity of construction and economies of manufacture will appear herein as I proceed with a detailed description of those particular embodiments of my invention which for the purposes of illustration I have shown in the appended drawings, in which,

Figure I is an end view of the motor showing its relation to a flywheel.

Figure II is a side view of the motor and flywheel.

Figure III is a detail of a flexible drive connection.

Figure IV is section on line 4—4 of Figure III.

Figure V is a view similar to Figure II but showing certain parts in section.

Figure VI shows a modified form of flexible drive connection between a pinion and its shaft.

Figure VII is a view similar to Figure V but shows a modification of the flexible drive arrangement.

Similar reference characters refer to similar parts throughout the several views.

In Figures II to V, 1 represents a starting motor which is rigidly supported relative to the engine casing and having small pinions 2 and 3 fixed to the motor shaft 4. The motor 1 has a bracket 5 rigidly mounted thereon, said bracket having two similar arcuate guide slots 6 and 7 having the motor shaft 4 as a center of curvature. Slidably and rotatably mounted in these guide slots 6 and 7 is a swinging shaft 8, which has mounted thereon two gears 9 and 10 which are aligned and at all times in mesh with pinions 2 and 3 respectively. Also mounted upon the shaft 8 and in between the two gears 9 and 10 is another gear 15 which is aligned with a gear wheel 16 and capable of being shifted into and out of mesh therewith when shaft 8 swings through the arcuate guides 6 and 7. Gear wheel 16 is arranged to drive the engine shaft and preferably is formed on the engine flywheel itself, but may be any other gear which can drive the engine shaft. Gear 15 preferably has a smaller pitch circle than the two gears 9 and 10. This enables the gear ratio between the motor and the engine to be greater thus allowing the motor to run at a higher speed. It is also preferable to have the teeth on gears 2, 3, 9, and 10 of smaller pitch than on gears 15 and 16, thus permitting a smaller diameter for the gears 2 and 3. The object of this is also to allow the motor to run at a higher speed. If desired there may be only one pinion on the motor shaft and one gear on the swinging shaft 8 which swings into and out of mesh with gear 16. Of course with this arrangement all the gear teeth must be of the same pitch and there can be no additional gear reduction, as we have in the arrangements shown in Figures I, II, V, and VII.

The operation of the invention will now be described. With the motor 1 at rest the shaft 8 will be held in the dotted position 8′ shown in Figure I, by a small spring 17 which snaps over the projecting end of the shaft 8. Of course any other spring or gravity means may be employed to hold the

shaft 8 away from the gear 16. Now when the motor 1 is started in the direction shown by the arrow the sudden impulse upon the gears 9 and 10 will jerk the shaft 8 from behind the detent spring 17 and swing it through the arcuate guides 6 and 7 until gear 15 comes into proper mesh with gear 16. The end of the guides 6 and 7 act as a stop to the swinging movement, or if desired any other suitable stop means may be provided, such as a yieldable spring which would prevent any shock. Upon the stoppage of the swinging movement of shaft 8, the gear 16 begins to turn. When the engine starts the gear 16 overruns the motor gears 2 and 3 and this causes the shaft 8 and its three gears to be swung upwardly through the guides 6 and 7 until gear 15 disengages gear 16. The inertia of this swinging movement and of the rotating gears is sufficient to cause the shaft 8 to snap behind the spring detent 17. The motor switch is now opened before the gears 9, 10, and 15 have lost their high speed of rotation and they now come to a stop and ready for the next starting operation.

It is desired that there be a flexible drive between the motor and engine and therefore several such arrangements are shown in the drawings. In Figures III and IV, the shaft 8 has a spider 20 keyed thereto. Rotatably mounted upon the shaft 8 is a pinion "A" which may be pinion 15 of Figures I or II or, if desired, the pinions 9 and 10. Pinion "A" is rotatably connected to the spider 20 by means of inserts 22 of some springy material such as cork, rubber, fiber, etc., which is placed between the lugs 21 and the corresponding recesses in the pinion "A". This flexible drive between the motor and engine allows the engine to speed up as it passes over compression without immediately overrunning the gear 15 and causing the taking up of the back lash in the gear teeth.

Figure V shows the middle gear 15 flexibly connected to the shaft 8 by means of the modified form of flexible connection shown in Figure VI. In Figure VI the shaft 8 is shown as having a square portion 25 which lies within a larger square hole 26 in the gear 15. The space between the square portion 25 and the pinion walls is filled with layers or sheets of compressible material preferably cork, rubber, or fiber. The compressible material may be held in place laterally by side plates which may be pinned to the gear 15 by means of pins 27 as shown.

Figure VII shows a modification in which there is only one pinion 30 on the motor shaft, which constantly meshes with the gear 31 which is keyed to the shaft 8'. The two gears 32 and 33 are flexibly connected to shaft 8' by means of the form of flexible connection shown in Figure VI, and both of these gears 32 and 33 engage the teeth of the gear wheel 34 which preferably is the flywheel of the engine. Of course in this modification the pitch of the gears 30 and 31 may be made smaller than the pitch of the gears 32, 33, and 34 for the same reasons as previously mentioned in reference to Figures I, II, and V. Also the gear 31 may have the flexible connection to the shaft 8' instead of the gears 32 and 33. Or all three gears 31, 32, and 33 may have flexible connection to shaft 8' if it is considered desirable. Likewise all three of the gears attached to shaft 8 in Figures I, II, and V may have flexible connection thereto if desired. The operation of all of the modifications described is substantially the same.

While I have illustrated and described in more or less detail certain embodiments of my invention I do not wish to be limited thereto as various other modifications will be obvious to those skilled in the art without departing from the scope of my invention as defined by the following claims.

What I claim is:

1. In a starter drive for an engine having a shaft and a gear connected therewith, and a starting motor having a stub shaft driven by the motor, a plurality of spaced gears on said shaft, a second auxiliary shaft associated with said starting motor having a plurality of similarly spaced gears thereon, an arc-shaped guide for said last mentioned shaft concentric with said first mentioned stub shaft, and a pinion carried by said second mentioned shaft intermediate said gears thereof and adapted to mesh with the gear connected with the engine, said spaced gears on said two shafts meshing, the mechanism arranged to cause said pinion to engage said gear on the engine upon the starting of the motor by bodily movement of said second mentioned shaft in said arc-shaped guide.

2. In a starter drive for an engine having a shaft and a gear connected therewith, and a starting motor having a stub shaft driven by the motor, a plurality of spaced gears on said shaft, a second auxiliary shaft associated with said starting motor having a plurality of similarly spaced gears thereon, an arc-shaped guide for said last mentioned shaft concentric with said first mentioned stub shaft, a pinion carried by said second mentioned shaft intermediate said gears thereof and adapted to mesh with the gear connected with the engine, said spaced gears on said two shafts meshing, the mechanism arranged to cause said pinion to engage said gear on the engine upon the starting of the motor by bodily movement of said second mentioned shaft in said arc-shaped guide and automatically disconnected therefrom, and means to temporarily retain said auxiliary shaft in disconnected position.

3. In a starter drive for an engine having

a shaft and a gear connected therewith, and a starting motor having a stub shaft driven by the motor, a plurality of spaced gears on said shaft, a second auxiliary shaft associated with said starting motor having a plurality of similarily spaced gears thereon, an arc-shaped guide for said last mentioned shaft concentric with said first mentioned stub, a third pinion carried by said second mentioned shaft intermediate said gears thereof and adapted to mesh with the gear connected with the engine, said spaced gears on said two shafts meshing, a yielding torque transmitting means in said gear train, the mechanism arranged to cause said pinion to engage said gear on the engine upon the starting of the motor by bodily movement of said second mentioned shaft in said arc-shaped guide and automatically disconnected therefrom, and means to temporarily retain said auxiliary shaft in disconnected position.

4. In a starter drive for an engine having a shaft and a gear connected therewith, and a starting motor having a stub shaft driven by the motor, end bearings for said shaft, a plurality of spaced gears on said shaft, a second auxiliary shaft associated with said starting motor having a plurality of similarly spaced gears thereon, a pair of arc-shaped guides to provide two end supports for the last mentioned shaft concentric with said first mentioned stub shaft, a pinion carried by said second mentioned shaft intermediate said gears thereof and adapted to mesh with the gear connected with the engine, said spaced gears on said two shafts meshing, a yielding torque transmitting means in said gear train, the mechanism arranged to cause said pinion to engage said gear on the engine upon the starting of the motor by bodily movement of said second mentioned shaft in said arc-shaped guide and automatically disconnected therefrom, and means to temporarily retain said auxiliary shaft in disconnected position.

In testimony whereof I affix my signature.

CARL P. BROCKWAY.