

March 8, 1927.

S. JENCICK

1,620,102

STARTING DEVICE FOR INTERNAL COMBUSTION ENGINES

Filed June 11, 1920

2 Sheets-Sheet 1

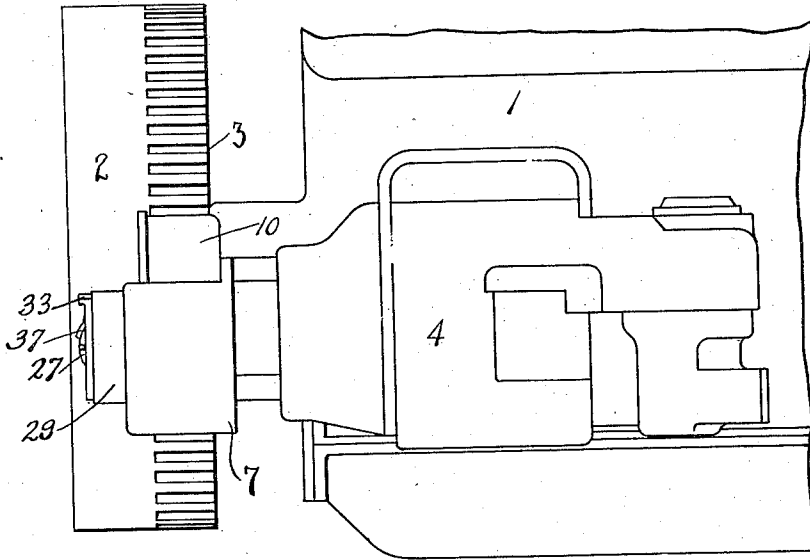


Fig. 1

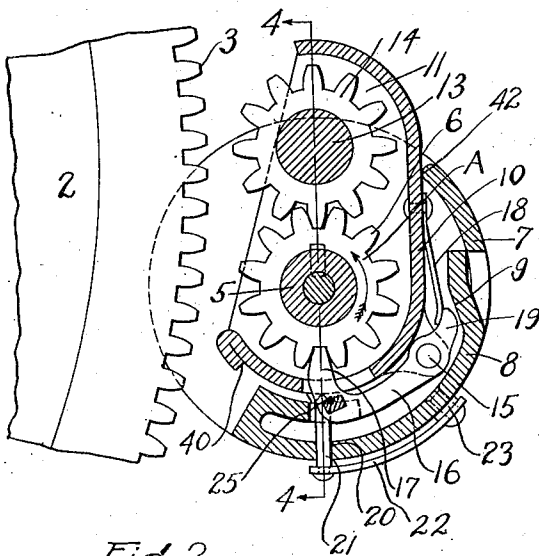


Fig. 2

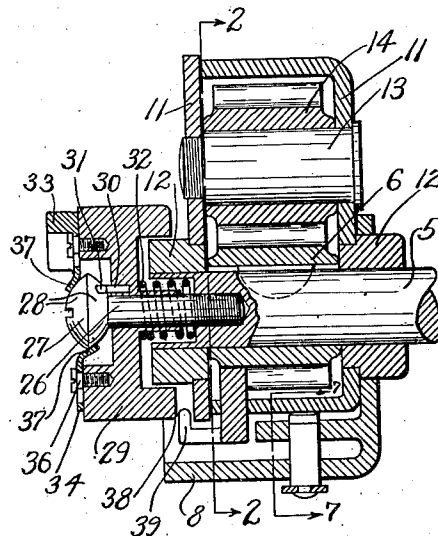


Fig. 4

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2 Sheets-Sheet 2

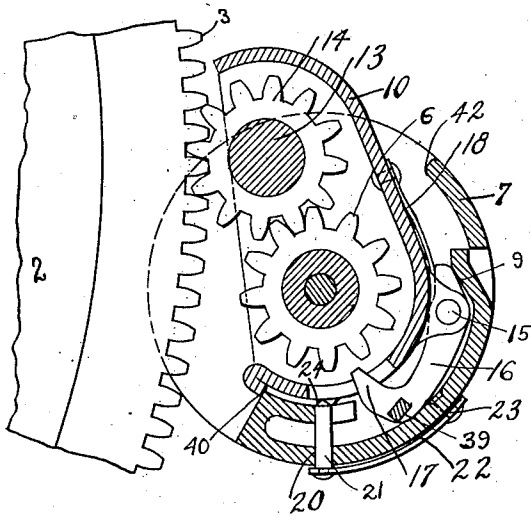


Fig. 3

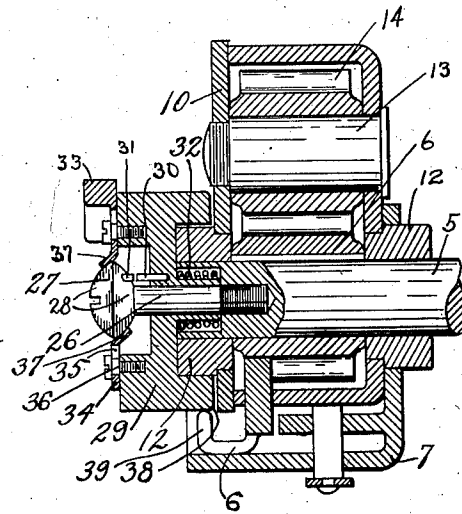


Fig. 6

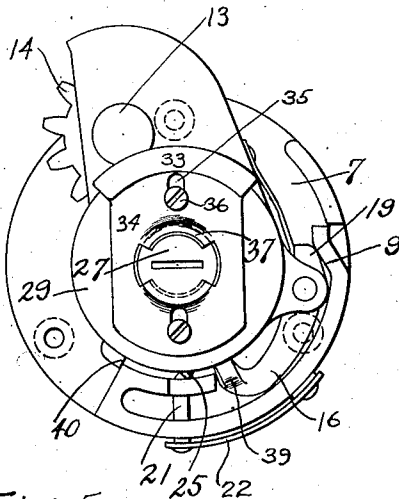


Fig. 5

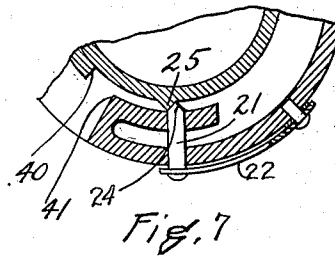


Fig. 7

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STARTING DEVICE FOR INTERNAL-COMBUSTION ENGINES.

Application filed June 11, 1920. Serial No. 388,195.

This invention relates to starting devices for internal combustion engines. The invention is an improvement upon the constructions shown, described and claimed in my prior applications Serial Nos. 275,983 and 275,984, filed Feb. 10, 1919.

The invention relates to that class of starting devices including a large gear driven by the internal combustion engine, a driving pinion operated by a starting motor or other source of power, and an intermediate pinion having planetary motion around the starting pinion into and out of mesh with the engine gear and the planetary motion of which is produced by the torque or rotating effect of the starting shaft.

The object of the invention is to provide improved mechanism for regulating or controlling the frictional or retarding effect upon the intermediate pinion and cause it to move positively into mesh with the engine gear for the starting operation, to reduce or stop the retarding effect when full meshing relation is reached, and then produce the same after a delay beyond the time when the gears have become disengaged so that the parts will be ready for another operation.

A further object of the invention is to provide means for yieldingly holding the intermediate pinion in either of its two positions, to wit, in or out of mesh with the engine gear, thereby to insure more positive effects and certainty in operation.

A further object of the invention is to provide a simple form of mechanism for this purpose which can be made and sold at low cost, which can be applied between any forms of starting motor and internal combustion engine, and which is not liable to get out of order in service.

Further objects of the invention are in part obvious and in part will appear more in detail hereinafter.

In the drawings, Fig. 1 represents a side elevation illustrating the invention applied to an internal combustion engine; Fig. 2 is a sectional elevation, on a larger scale, on the line 2—2, Fig. 4, showing the parts in disengaged or ineffective position; Fig. 3 is a similar view showing the parts in driving position; Fig. 4 is a sectional elevation on the line 4—4, Fig. 2, looking in the direction of the arrows; Fig. 5 is an end view from the left in Fig. 4; Fig. 6 is a sectional view corresponding to Fig. 4, but showing the parts

in engaged or driving relation; and Fig. 7 is a section on the line 7—7, Fig. 4.

In the drawings, 1 represents the internal combustion engine, which may be of any suitable form and the crank shaft of which, not shown, is connected to drive the usual fly wheel 2 provided with gear teeth 3 forming a relatively large gear to which power may be applied for starting the internal combustion engine.

The starting effect may be produced by any suitable power source, the drawings showing for this purpose an electric motor 4. the shaft 5 of which carries a pinion 6 which may be termed the starting pinion as it is the pinion from which power is derived for the starting operation.

Suitably mounted upon a stationary part, such as upon a portion of the motor frame, is a stationary frame 7 of hollow form having its outer wall 8 shaped to provide a cam surface 9. This casing surrounds and incloses the starting pinion 6. Within said casing is mounted a rocking or swinging supplemental casing or frame 10, the side walls 11 of which are provided with openings to receive the bearing portions 12 mounted to turn upon the shaft 5 so that said frame has oscillating motion about the axis of the starting motor shaft. In said supplemental frame is supported a short shaft 13 on which rotates the intermediate pinion 14 meshing directly with the teeth of the pinion 6. The oscillating motion of the intermediate frame produces planetary or rolling motion of the intermediate pinion 14 around the starting pinion 6, this motion being utilized to move said intermediate pinion into and out of mesh with the engine gear 3.

On a boss or suitable portion of the intermediate frame is pivoted at 15 a trigger, locking or retarding device 16 having a tooth or toe 17 adapted to enter the space between two of the teeth of pinion 6. In normal or ineffective position of the parts, as shown in Fig. 2, this locking tooth is moved to and held in the locking position shown by a suitable yielding device, such as the leaf spring 18 secured to the outside of the wall of the intermediate frame. With the parts in this position the intermediate frame and also the intermediate pinion are, in effect, locked to the starting pinion 6. Consequently when the starting motor is operated by connecting it to a source of

current, its torque or rotating effect, which is exerted in the direction of arrow A, Fig. 2, tends to turn the pinion 6 which carries with it the frame 10 and pinion 14 toward the engine gear 3 until the intermediate pinion is fully meshed with the engine gear and in driving relation therewith. During this swinging motion the tail 19 of the locking trigger rides over the cam surface 9 with the result of retracting its tooth 17 out of engagement with the teeth of pinion 6. When full driving relation is established the retarding effect of the trigger, which normally prevents rotation of pinion 14 on its own axis, is relieved and the driving effect of the engine motor becomes fully effective upon the starting gear and hence upon the internal combustion engine. The torque of the starting motor is effective upon the intermediate pinion, not only to the extent of driving the internal combustion engine, but of also maintaining the intermediate pinion in its meshing relation between the starting pinion and the engine gear. The final result is, of course, to start the internal combustion engine under its own power, whereupon the speed of rotation of the gear 3 is increased beyond its speed due to the effect of the starting motor, and the increased speed of rotation immediately kicks or throws the intermediate pinion out of mesh with the engine gear and returns the frame 10 to its original position.

According to the present invention suitable means is provided for yieldingly holding the frame 10 in either of its two positions, and for locking the trigger 16 in its unlocked position when it has been moved thereto and holding it in said unlocked position for a short period of time after the intermediate pinion and engine gear have been disengaged to avoid the usual tendency in mechanisms of this kind of the intermediate pinion moving back to driving relation. The re-application of the retarding effect upon the pinion 14 is governed according to the present invention by centrifugal effect and particularly by a centrifugal effect produced by the starting motor shaft, as the result of which the driving member itself controls the retarding effect.

As illustrated the stationary casing or frame 8 is provided near its bottom with an opening 20 through which extends a pin 21 carried by a leaf spring 22 fastened at 23 to the casing. The inner end of the pin 21 is flattened off angularly on two sides into V form, as illustrated at 24. The bevel surfaces on the end of this pin co-operate with bevel surfaces upon a projection 25 carried by the rocking frame 10. Fig. 2 shows the normal or ineffective position of the parts. The pressure of the spring 22 is exerted upon one of the faces of projection 25 and tends to hold the rocking frame

in normal position, but the torque of the starting motor will turn said rocking frame and move the projection 25 past the yielding pin 21 so that the pressure of said pin is exerted upon the other inclined face of projection 25, thereby tending to releasably hold the rocking frame in its operative position. The abutting engagement of shoulder 40 on frame 10 with the end 41 of frame 7 limits the movement of frame 10 toward the gear 3 allowing proper engagement of pinion 14 with the gear. As the frame 10 rocks back away from the gear, its movement in this direction will be limited by contact with the part 42 of the stationary frame 7.

On the outer end of shaft 5 is an extension 26 formed by a bolt threaded into the shaft and provided with a head 27 having rounded or curved inner and outer cam surfaces 28. Upon said extension bolt is rotatably mounted a small disc or fly wheel 29 provided with clutch connections to the shaft 5. For example, wheel 29 has a clutch pin 30 adapted to co-operate with the clutch pin 31 on the head of the bolt 27. The fly wheel is yieldingly urged outwardly or toward the end of the shaft extension by a compression spring 32. It is provided on its end face with a centrifugal governor including a weight 33 attached to a slide 34 having elongated slots 35 through which securing bolts 36 are passed into the fly wheel. The slide 34 is provided with cam portions 37 engaging the inner and outer curved surfaces of the bolt head, and the inner edge of the fly wheel is rounded off, as at 38, to form a cam surface for co-operation with the head of a curved or bent latching arm 39 attached to the tooth member 16.

The operation is as follows:

In the normal or ineffective position of the parts, to wit, when the starting motor is idle, the parts occupy the position shown in Fig. 2, and the fly wheel 29 is yieldingly pressed outwardly by the spring 32. Said fly wheel lies outwardly beyond the end of arm 39 and the trigger 16 is in locked engagement with a tooth of the pinion 6. The outward pressure of spring 32 moves the cam members 37 along the curved faces of the bolt head so that the weight 33 is moved inwardly toward the center or axis of the device. As soon as the starting motor begins to turn as the result of current supplied thereto, shaft 5 rotates and through the clutch members 31, 30 turns with it the fly wheel 29. These clutch members, however, are not absolutely essential because even without them the fly wheel 29 would rotate as the result of the friction between the fly wheel and shaft, or between the cam members 37 and the bolt head. The fly wheel, however, is rotatable relative to the shaft, as will be readily understood.

As stated before, the effect is to rock the

frame 10 and mesh the gears, moving the trigger 16 to unlocked position. At the same time the centrifugal effect of the weight 33 throws said weight outwardly and causes the cams 37 to ride along the curved bolt head, moving the fly wheel 29 axially along the shaft to the position shown in Fig. 6. In this position the free end of the arm 39 abuts the outer cylindrical surface of the fly wheel so that said fly wheel serves as a lock to prevent the trigger 16 from returning to engagement with pinion 6.

Finally the internal combustion engine starts under its own power and kicks out the intermediate pinion, thereby overcoming the tendency of the spring pressed pin 21 to hold the parts in meshing relation. Frame 10 returns to its initial position but so long as the shaft 5 rotates or until the power has been cut off from the motor and its spinning effect has ceased, the fly wheel 29 remains in the position shown in Fig. 4. When said shaft ceases or nearly ceases to rotate, the effect of the spring 32 upon the fly wheel again moves it endwise and returns the weight 33 to its initial position. The fly wheel 29 thus moves away from the arm 39 so that the spring 18 can again move the trigger to locking engagement with the pinion 6. Locking engagement, however, is produced only when the pinion 6 has come to rest so that there will be renewed tendency of said pinion to again produce meshing relation and subsequent clashing of the gears.

What I claim is:

1. Starting mechanism for operative connection with a gear that is adapted to be driven by an internal combustion motor, comprising a starting shaft carrying a primary driving pinion, an intermediate pinion adapted to be driven thereby and adapted to move in an orbital path about the said shaft into and out of mesh with the motor gear, a frame rotatably mounted upon said starting shaft, said intermediate pinion being mounted in said frame, means upon said frame for preventing rotation of said primary pinion, means for controlling the same, whereby the rotation of said intermediate pinion about its own axis will be retarded to cause orbital movement thereof into meshing relation with the motor gear, and means for locking said frame in different positions with respect to the said starting shaft.

2. Starting mechanism for operative connection with a gear that is adapted to be driven by an internal combustion motor, comprising a starting shaft carrying a primary driving pinion, an intermediate pinion adapted to be driven thereby and adapted to move in an orbital path about the said shaft into and out of mesh with the motor gear, a frame rotatably mounted upon said starting shaft, said intermediate pinion being mount-

ed in said frame, means upon said frame for preventing rotation of said primary pinion, whereby the rotation of said intermediate pinion about its own axis will be retarded to cause orbital movement thereof into meshing relation with the motor gear, means in the path of said last named means for releasing said primary pinion so as to cause transmission of power through said pinions, and means for maintaining said primary pinion in released condition.

3. Starting mechanism for operative connection with a gear that is adapted to be driven by an internal combustion motor, comprising a starting shaft carrying a primary driving pinion, an intermediate pinion adapted to be driven thereby and adapted to move in an orbital path about the said shaft into and out of mesh with the motor gear, a frame rotatably mounted upon said starting shaft, said intermediate pinion being mounted in said frame, means upon said frame for preventing rotation of said primary pinion, whereby the rotation of said intermediate pinion about its own axis will be retarded to cause orbital movement thereof into meshing relation with the motor gear, means in the path of said last named means for releasing said primary pinion so as to cause transmission of power through said pinions, and means controlled by operation of said starting shaft for maintaining said primary pinion in released condition.

4. Starting mechanism for operative connection with a gear that is adapted to be driven by an internal combustion motor, comprising a starting shaft carrying a primary driving pinion, an intermediate pinion adapted to be driven thereby and adapted to move in an orbital path about the said shaft into and out of mesh with the motor gear, means for retarding rotation of said intermediate pinion about its own axis to cause orbital movement thereof into meshing relation with the gear, a member mounted for longitudinal movement along the axis of said starting shaft, means for releasing said retarding means and means controlled by operation of said starting shaft for causing said member to move along its axis and maintain said retarding means in released position.

5. Starting mechanism for operative connection with a gear that is adapted to be driven by an internal combustion motor, comprising a starting shaft carrying a primary driving pinion, an intermediate pinion adapted to be driven thereby and adapted to move in an orbital path about the said shaft into and out of mesh with the motor gear, means for retarding rotation of said intermediate pinion about its own axis to cause orbital movement thereof into meshing relation with the gear, a member mounted for longitudinal movement along

the axis of said starting shaft, means for releasing said retarding means, and centrifugal means for causing said member to move along its axis and maintain said retarding means in released position.

6. Starting mechanism for operative connection with a gear that is adapted to be driven by an internal combustion motor, comprising a starting shaft carrying a primary driving pinion, an intermediate pinion adapted to be driven thereby and adapted to move in an orbital path about the said shaft into and out of mesh with the motor gear, means for retarding rotation of said intermediate pinion about its own axis to cause orbital movement thereof into meshing relation with the gear, a member mounted for rotary and longitudinal movement about and along the axis of said starting shaft, means for releasing said retarding means, and centrifugal means upon said member for causing said member to move along its axis and maintain said retarding means in released position.

7. Starting mechanism for operative connection with a gear that is adapted to be driven by an internal combustion motor, comprising a starting shaft carrying a primary driving pinion, an intermediate pinion adapted to be driven thereby and adapted to move in an orbital path about the said shaft into and out of mesh with the motor gear, means for retarding rotation of said intermediate pinion about its own axis to cause orbital movement thereof into meshing relation with the gear, a member mounted upon said starting shaft for longitudinal movement along said shaft, means for normally holding said member in engagement with said shaft for rotary movement therewith, means for releasing said retarding means, and means controlled by the operation of said shaft for moving said member along said shaft out of rotating engagement therewith and into engagement with said retarding means to hold said retarding means in released position.

8. Starting mechanism for operative connection with a gear that is adapted to be driven by an internal combustion motor, comprising a starting shaft carrying a primary driving pinion, an intermediate pinion adapted to be driven thereby and adapted to move in an orbital path about the said shaft into and out of mesh with the motor gear, means for retarding rotation of said intermediate pinion about its own axis to cause orbital movement thereof into meshing relation with the gear, a member mounted upon said starting shaft for rotary and longitudinal movement about and along said shaft, means for normally holding said member in engagement with said shaft for rotary movement therewith, means for releasing said retarding means, and means

carried by said member and controlled by the operation of said starting shaft for moving said member out of rotating engagement therewith and into engagement with said retarding means to hold said retarding means in released position.

9. Starting mechanism for operative connection with a gear that is adapted to be driven by an internal combustion motor, comprising a starting shaft carrying a primary driving pinion, an intermediate pinion adapted to be driven thereby and adapted to move in an orbital path about the said shaft into and out of mesh with the motor gear, means for retarding rotation of said intermediate pinion about its own axis to cause orbital movement thereof into meshing relation with the gear, means for releasing said retarding means, a member mounted upon said starting shaft for rotary and longitudinal movement about and along said shaft, cam means carried by said shaft, centrifugal means having co-operative relation with said member, and cam means for moving said member along said shaft into engagement with said releasing means so as to maintain the same in released position.

10. Starting mechanism for operative connection with a gear that is adapted to be driven by an internal combustion motor, comprising a starting shaft carrying a primary driving pinion, an intermediate pinion adapted to be driven thereby and adapted to move in an orbital path about the said shaft into and out of mesh with the motor gear, means for retarding rotation of said intermediate pinion about its own axis to cause orbital movement thereof into meshing relation with the gear, means for releasing said retarding means, a member loosely mounted upon said starting shaft for longitudinal movement along said shaft, a clutch connection between said member and said shaft, means for normally holding said clutch in operative engagement, cam means carried by said shaft, centrifugally controlled means for co-operation with said cam to effect disengagement of said clutch and to move said member into engagement with said releasing means to hold the same in released position.

11. Starting mechanism for operative connection with a gear that is adapted to be driven by an internal combustion motor, comprising a starting shaft member carrying a primary driving pinion, an intermediate pinion adapted to be driven thereby and adapted to move in an orbital path about said shaft member into and out of mesh with the motor gear, means for retarding rotation of said intermediate pinion about its own axis to cause orbital movement thereof into meshing relation with the gear, means for releasing said retarding means, a member loosely mounted upon said

starting shaft member for longitudinal movement along said shaft member, a clutch connection between said members, means for normally holding said clutch in operative engagement, cam means carried by one of said members, centrifugally controlled means carried by said other member for co- operation with said cam means to effect disengagement of said clutch and to move said longitudinally movable member into en- 10 gagement with said releasing means to hold the same in released position.

In testimony whereof I affix my signature.

STEPHEN JENCICK.