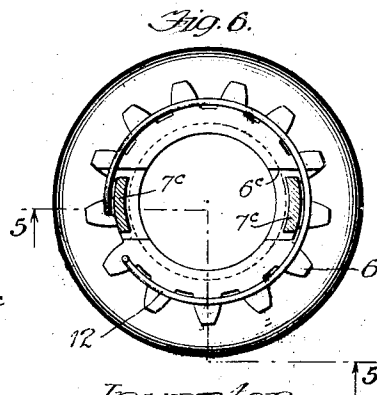
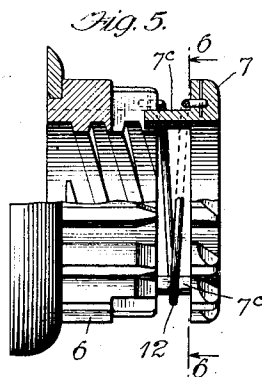
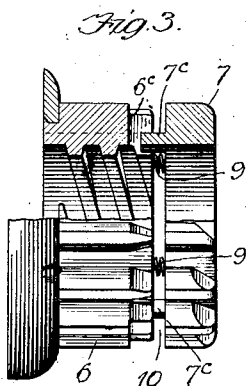
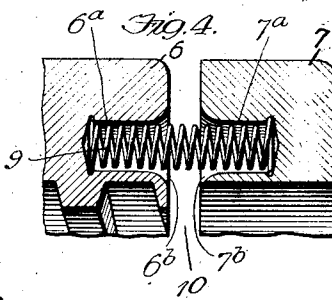
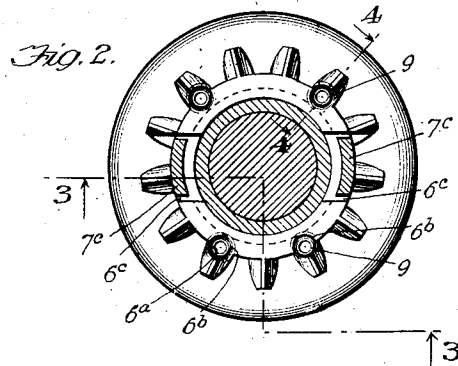
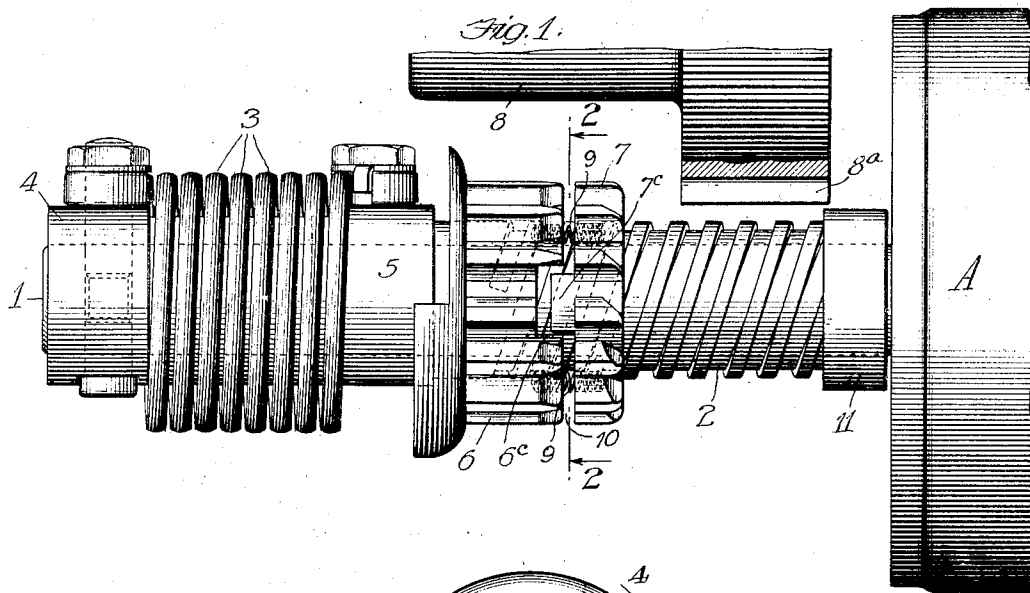


W. L. McGRATH.
ENGINE STARTER.
APPLICATION FILED MAR. 31, 1919.

1,348,288.

Patented Aug. 3, 1920.

2 SHEETS—SHEET 1.



Witnesses
Martin H. Olsen.
Robert Dobberman

Inventor
William L. McGrath
By Rector, Hibben Davis & Macauley
His Atty

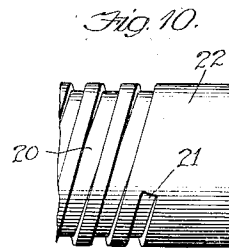
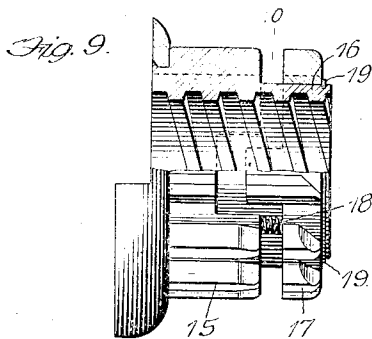
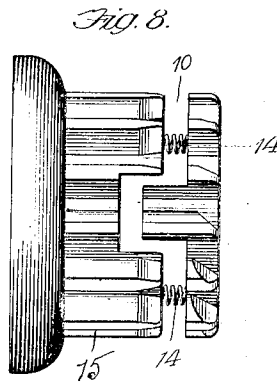
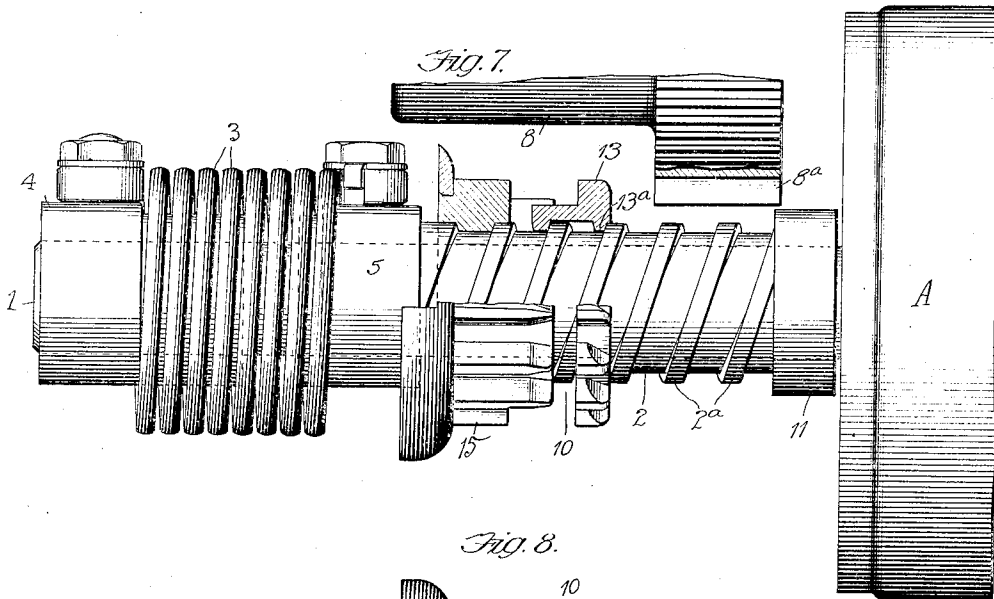
W. L. McGRATH.
ENGINE STARTER.

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2 SHEETS—SHEET 2.



Witnesses
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UNITED STATES PATENT OFFICE.

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ENGINE-STARTER.

1,348,288.

Specification of Letters Patent.

Patented Aug. 3, 1920.

Application filed March 31, 1919. Serial No. 286,322.

To all whom it may concern:

Be it known that I, WILLIAM L. McGRATH, a citizen of the United States, residing at Elmira, in the county of Chemung and State of New York, have invented certain new and useful Improvements in Engine-Starters, of which the following is a specification.

My invention relates to a starter for an engine such as an internal combustion engine, and pertains more particularly to the drive or transmission thereof for automatically connecting the starting motor or other source of power to a member or part of the engine to be started and for thereafter transmitting the power thereto for the starting of such engine.

My invention is embodied in the present instance in a structure of the type known as the Eclipse-Bendix type of drive such as exemplified by patents heretofore issued to Vincent Bendix, for example Patent No. 1,125,935, dated January 26, 1915, but my invention is not limited to any specific type of starter as I contemplate using the same wherever applicable. However, for a clear and definite description of my invention I have chosen to describe it in connection with said type of drive which is characterized by the employment of a rotatable member, such as a screw shaft, and a driving member, such as a pinion mounted thereon for longitudinal movement thereof and rotary movement therewith and adapted to be connected either directly or indirectly with the engine member. In the present instance the driving member is the pinion itself and the same is adapted to be connected directly with the engine member. My invention relates more particularly to the construction of this pinion whether the same is directly mounted upon said screw shaft or operated directly or indirectly thereby, and the object thereof is to provide simple and efficient means for facilitating the meshing of the pinion with the engine member such as the fly wheel. Speaking in general terms I accomplish this object by providing such pinion with a pilot member having teeth similar to the pinion itself and capable of movement with respect thereto and adapted not

only to facilitate the meshing with the fly wheel or other engine member but also to take the shock or impact of impingement in case the teeth of the pinion and fly wheel should not be in perfect register. It is the object of this pilot member to first itself come into mesh with the fly wheel and as a result to shift the position of the pinion accordingly for proper meshing with the fly wheel. The various features of advantage and utility in my construction and new mode of operation will be apparent from the description hereinafter given.

In the drawings Figure 1 is an elevation of a starter embodying my invention; Fig. 2 a section on the line 2—2 of Fig. 1; Fig. 3 an elevation of the pinion partly in section on the line 3—3 of Fig. 2; Fig. 4 a section taken on the line 4—4 of Fig. 2 but on a larger scale; Fig. 5 a sectional elevation of a modified form of pinion on line 5—5 of Fig. 6; Fig. 6 a sectional elevation on the line 6—6 of Fig. 5; Fig. 7 a sectional elevation of a modified construction; Fig. 8 an elevation of the pinion of Fig. 7 detached; Fig. 9 a sectional elevation of a pinion and pilot member illustrating a modified form of construction; and Fig. 10 a detail view of a modified form of screw shaft which may be used.

Referring to the herein illustrated embodiment of my invention the same is in general the Eclipse-Bendix type of drive, but my invention is not to be limited thereto. Moreover this drive is shown as direct driven by a starting motor, but it will be understood that it may be indirect driven in the well-known way and may also be hand driven if desired.

Referring to the construction illustrated in Figs. 1 to 4, the starting motor indicated at A has an extended armature shaft 1 on which is mounted the screw shaft 2, here in the form of a sleeve. This screw shaft is operatively connected with and driven by the shaft 1 through the driving spring 3 connected at its ends respectively with the driving collar 4 on the shaft 1 and the driving head 5 here forming a part of the screw shaft 2.

My invention relates to the pinion struc-

ture and the same is not the ordinary plain pinion but a special form of construction consisting of a pinion proper 6 and a pilot member 7. The pinion proper is screw-threaded upon the screw shaft and adapted to be automatically advanced longitudinally thereof by the screw shaft into engagement with the teeth 8^a of the fly wheel 8 of the engine, and also to be automatically demeshed and returned to normal position in automatic manner after the engine has started on its own power. The pilot member has teeth similar to the pinion teeth and normally in axial alinement therewith, but such member is not screw-threaded upon the screw shaft but is merely mounted upon the top faces of the threads of the screw shaft, the bore of such pilot member being slightly greater in diameter than the full diameter of the screw-threaded portion of the screw shaft including the screw threads.

The pilot member is carried by the pinion proper and is held projected therefrom slightly in advance of its right-hand face in a yielding manner, and the same also has an interlocking connection therewith. A plurality of coiled springs 9, here four in number, are anchored at their opposite ends in the bottom of sockets 6^a and 7^a respectively in the pinion proper and pilot member, as shown in detail in Fig. 4. These springs are of such length, that the pilot member will be held projected a certain distance in front of the pinion proper, as indicated by the clearance space 10 in Fig. 4, and said sockets have beveled mouths 6^b and 7^b respectively in order to accommodate the spring when the pilot member is moved rotarily with respect to the pinion as hereinafter explained.

In addition the pinion and pilot member have an interlocking connection which, as shown, is in the form of a tongue-and-groove connection, the grooves 6^c being here in the pinion and the tongues 7^c in the pilot member. The grooves are of greater width than the tongues which normally occupy a central position in the grooves as shown in Fig. 1 so that the pilot member may have a slight yielding movement rotarily before coming into contact with or disturbing the position of the pinion. The pilot member has the forward or engaging end of its teeth properly chamfered in order to assist in the operation of meshing with the fly wheel teeth. As shown in Fig. 1 for instance these teeth have a single chamfer, but owing to the fact that the pilot member is capable of oscillating in either direction, a double chamfer, that is a chamfer on both sides of the teeth may be employed. Moreover, the engaging end of the pinion teeth may be suitably chamfered (preferably double chamfered) which is of advantage in the event that the speed of the advancing pinion

should prevent its being swung by its pilot member into proper register with the pilot member.

Describing the mode of operation and starting with the parts in their normal position shown in Fig. 1, when the motor is operated and the screw shaft 2 thereby operated through the drive spring 3 the pinion will be automatically advanced longitudinally to the right and toward the fly wheel. The pilot member will be first presented to the fly wheel teeth and in case of perfect register between the teeth thereof (and consequently of the pinion teeth) and the teeth of the fly wheel, the pinion and its pilot member will be continued to be advanced without any interruption or change in their relative positions until the pilot member contacts the stop nut 11 whereupon the pinion will advance until it comes into contact with its pilot member and will thereupon partake of the rotary movement of the screw shaft and rotate the fly wheel. When the engine starts on its own power the pinion will be automatically demeshed and returned to normal position, in which operation the pilot member will be carried along by the pinion owing to the connection between them by virtue of the coiled springs.

In the event that the teeth of the pinion and fly wheel are not in perfect register, and the teeth of the pilot member should abut the fly wheel teeth end to end, such pilot member, which is very light in weight, will therefore cause practically no shock, and will tend to move slightly rotarily in one direction or the other until it comes into full register with the fly wheel teeth. In this slight rotarial movement the pilot member will correspondingly move the pinion in a yielding manner through the medium of the springs 9, or by direct contact through the interlocking connection if the movement should amount to that much. By the provision of the clearance space 10 sufficient time is given to the pilot member to adjust itself to perfect register with the fly wheel teeth before the pinion has advanced longitudinally into contact with such pilot member. In this manner and by this means the pinion itself is relieved of any shock of impingement with the fly wheel teeth, and the same is taken entirely by the pilot member which, being very light in weight, causes practically no shock or jar. Whatever shock there might be is also taken up by the springs 9. It will be understood that the pilot member is not a driving member as no load is transmitted therethrough, but that its function is to position the pinion for perfect meshing with the fly wheel.

In Figs. 5 and 6 I have shown a modified form of construction in which the pinion and pilot member are not connected by a

plurality of coiled springs but by a spring 12 having a single coil with its ends anchored in the pinion and pilot member respectively. In other respects the construction is the same and the mode of operation is also the same as the structure above described.

In Figs. 7 and 8 I have shown another modified form of construction according to which the pilot member 13 instead of being loosely mounted on the screw shaft is screw-threaded thereon, but provision is made for a yielding longitudinal movement on the screw shaft and toward the pinion and against the tension of the springs 14. As shown the pilot member has screw-threads 13^a which are much less in width than the distance between the screw-threads 2^a of the screw shaft, with the result that the pilot member is capable of said longitudinal movement toward and away from the pinion and against the tension of the springs 14 which normally hold the pilot-threads 13^a against the screw shaft threads 2^a. The mode of operation is substantially the same as above described except that in the driving operation the teeth of the pilot member take some of the load, depending upon the amount of space between the threads of the screw shaft and those of the pilot member relative to the space between the pinion and the pilot member.

In Fig. 9 I have shown a modified form of construction in which the pinion 15 has a forward sleeve extension 16 on which the pilot member 17 is mounted to slide longitudinally and also rotarily. This member is held projected from the pinion by springs 18 but retained thereon in suitable manner as by the split ring 19 engaging in a peripheral groove in such sleeve extension. Besides this different mounting of the pinion member, this construction embodies the feature of a pinion stop independent of the pilot member, in as much as the sleeve extension of the pinion will come into contact with the stop nut 11, it being understood that this pinion is mounted on a screw shaft such as shaft 2. In this way the pilot member is relieved of all load.

In addition, Fig. 9 illustrates double chamfering of the engaging ends of the teeth of both the pinion and pilot member, which chamfering may be adopted.

In Fig. 10 I have illustrated another means for stopping the pinion independently of the pilot member, according to which the screw shaft 20 has its threads stopping short of the outer end and terminating in abrupt stops 21, there being two thereof because by preference the shaft is double threaded, although only one of such stops is shown. When a pinion structure such as shown in Fig. 1 is in driving position the pinion

proper is stopped by said stops and the pilot member is positioned at the smooth end portion 22 of the shaft and carries no load.

I claim:

1. In an engine starter drive, means for facilitating the automatic meshing of a driving pinion with a gear of the engine to be started, including, in combination with such pinion, a pilot member located in advance thereof and having a rotarial movement independent thereof.

2. In an engine starter drive, means for facilitating the automatic meshing of a driving pinion with a gear of the engine to be started, including, in combination with such pinion, a pilot member located in advance thereof and having a yielding rotarial movement independent thereof.

3. In an engine starter drive, means for facilitating the automatic meshing of a driving pinion with a gear of the engine to be started, including, in combination with such pinion, a pilot member located in advance thereof and having a yielding rotarial movement with relation thereto.

4. In an engine starter drive, means for facilitating the automatic meshing of a driving pinion with a gear of the engine to be started, including, in combination with such pinion, a pilot member located in advance thereof and having a yielding endwise movement with relation thereto.

5. In an engine starter drive, means for facilitating the automatic meshing of a driving pinion with a gear of the engine to be started, including, in combination with such pinion, a pilot member extending in front of said pinion and having interlocking connection therewith.

6. In an engine starter drive, means for facilitating the automatic meshing of a driving pinion with a gear of the engine to be started, including, in combination with such pinion, a pilot member extending in front of said pinion and having a loose interlocking connection therewith permitting a rotarial movement of such member with respect to the pinion.

7. In an engine starter drive, means for facilitating the automatic meshing of a driving pinion with a gear of the engine to be started, including, in combination with such pinion, a pilot member projecting in front of said pinion and having a tongue and groove connection therewith permitting both rotarial and longitudinal movement of such member with respect to the pinion.

8. In an engine starter drive, means for facilitating the automatic meshing of a driving pinion with a gear of the engine to be started, including, in combination with such pinion, a pilot member, and a spring which is carried by the pinion and to which such

member is attached and on which it is held projected in front of said pinion.

9. In an engine starter drive, means for facilitating the automatic meshing of a driving pinion with a gear of the engine to be started, including, in combination with such pinion, a pilot member, said pinion and member having corresponding sockets, and a plurality of coiled springs secured in said sockets and thereby yieldingly connecting said member and pinion.

10. In an engine starter drive, means for facilitating the automatic meshing of a driving pinion with a gear of the engine to be started, including, in combination with such pinion, a pilot member, said pinion and member having corresponding sockets with flared mouths, and a plurality of coiled springs anchored at their ends in the bottoms of the sockets, thereby yieldingly connecting said member and pinion.

11. In an engine starter drive, means for facilitating the automatic meshing of a driving pinion with a gear of the engine to be started, including, in combination with such pinion, a pilot member in axial alinement with the pinion and normally positioned in advance of the same with a predetermined clearance space between them, and yielding means connecting said pinion and member.

12. In an engine starter drive, means for facilitating the automatic meshing of a driving pinion with a gear of the engine to be started, including, in combination with such pinion, a pilot member in axial alinement with the pinion and normally positioned in advance of the same with a predetermined clearance space between them, and a spring connecting the pinion and member and adapted to yield upon longitudinal movement of the member.

13. In an engine starter drive, means for facilitating the automatic meshing of a driving pinion with a gear of the engine to be started, including, in combination with such pinion, a pilot member mounted on the pinion to move rotarily thereof and having teeth normally in register with the pinion teeth.

14. In an engine starter drive, means for facilitating the automatic meshing of a driving pinion with a gear of the engine to be started, including, in combination with such pinion, a pilot member having teeth normally in register with the pinion teeth, and springs connecting the member and pinion and permitting rotarial movement thereof with respect to the pinion.

15. In an engine starter drive, means for facilitating the automatic meshing of a driving pinion with a gear of the engine to be started, including, in combination with such pinion, a pilot member having teeth normally in register with the pinion teeth, and

65 springs connecting the member and pinion and holding the member projected in front of the pinion and normally a predetermined distance in advance thereof.

16. In an engine starter drive, means for facilitating the automatic meshing of a driving pinion with a gear of the engine to be started, including, in combination with such pinion, a pilot member normally projecting in front of said pinion and having a tongue and groove connection therewith, and a spring connecting the pinion and member and normally holding the latter so projected.

17. In an engine starter drive, means for facilitating the automatic meshing of a driving pinion with a gear of the engine to be started, including, in combination with such pinion, a pilot member normally projecting in front of said pinion and having a loose tongue and groove connection therewith permitting both rotarial and longitudinal movements of said members with respect to the pinion, and a spring connecting between the pinion and members and normally holding the latter so projected and also tending to resist said rotarial movement thereof.

18. In an engine starter drive, means for facilitating the automatic meshing of a driving pinion with a gear of the engine to be started, including in combination with such a pinion having a longitudinal movement, a pilot member arranged in advance thereof, and means for stopping the pinion in its longitudinal movement independent of the pilot member.

19. In an engine starter drive, means for facilitating the automatic meshing of a driving pinion with a gear of the engine to be started, including in combination with such a pinion having a longitudinal movement, a pilot member mounted on and carried by the pinion in advance thereof.

20. In an engine starter drive, means for facilitating the automatic meshing of a driving pinion with a gear of the engine to be started, including in combination with such a pinion having a longitudinal movement, a pilot member arranged in advance of such pinion, the latter having an extension on which the pilot member is mounted.

21. In an engine starter drive, means for facilitating the automatic meshing of a driving pinion with a gear of the engine to be started, including in combination with such a pinion having a longitudinal movement, a pilot member mounted on the pinion in advance thereof, and having longitudinal and rotarial movements with respect thereto.

22. In an engine starter drive, means for facilitating the automatic meshing of a driving pinion with a gear of the engine to be started, including in combination with such a pinion having a longitudinal movement, a

pilot member in the form of a pinion arranged in advance thereof and cooperating therewith, the engaging teeth of the pinion and pilot member being chamfered.

- 5 23. In an engine starter drive, means for facilitating the automatic meshing of a driving pinion with a gear of the engine to be started, including in combination with such a pinion having longitudinal movement, a
10 pilot member in the form of a pinion arranged in advance thereof and cooperating therewith, the engaging teeth of the pinion and pilot member being chamfered, the pinion teeth being double chamfered.
- 15 24. In an engine starter drive, means for facilitating the automatic meshing of a driving pinion with a gear of the engine to be started, including in combination with such a pinion having a longitudinal movement, a
20 pilot member in the form of a pinion arranged in advance thereof and cooperating therewith, the engaging teeth of the pinion and pilot member being chamfered, the pin-

ion teeth having a double chamfer and the pilot member teeth having a single chamfer. 25

25. In an engine starter drive, means for facilitating the automatic meshing of a driving pinion with a gear of the engine to be started, including in combination with such a pinion having a longitudinal movement, a
30 pilot member in the form of a pinion arranged in advance thereof and cooperating therewith, the engaging teeth of the pilot member being chamfered.

26. In an engine starter drive, means for
35 facilitating the automatic meshing of a driving pinion with a gear of the engine to be started, including in combination with such a pinion having a longitudinal movement, a
40 pilot member in the form of a pinion arranged in advance thereof and cooperating therewith, the engaging teeth of the pilot member being provided with a single chamfer.

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