June 2, 1931. W. L. McGRATH 1,808,115

STARTER DRIVE

Filed Sept. 10, 1929 2 Sheets-Sheet 1

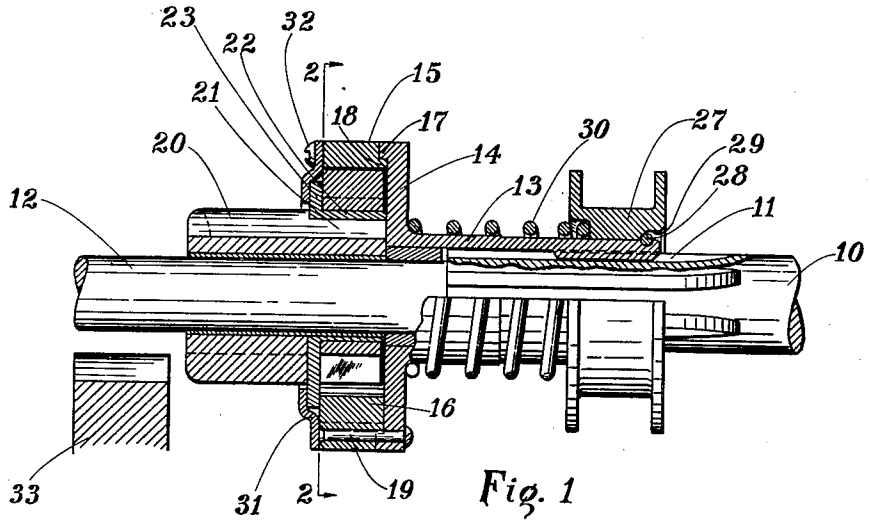

Fig. 1

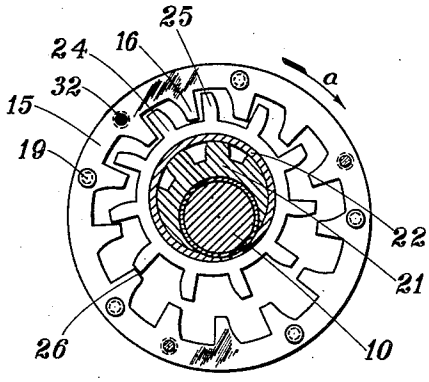

Fig. 2

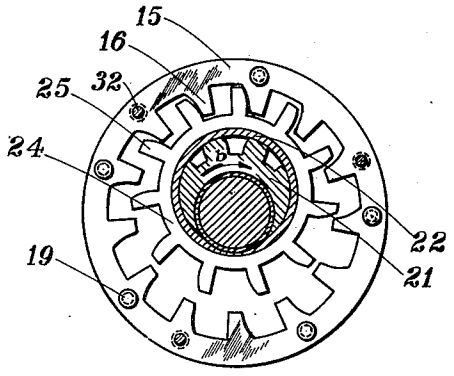

Fig. 3

INVENTOR
William L. McGrath
BY Clinton L. Janes.
ATTORNEY

June 2, 1931. W. L. McGRATH 1,808,115

STARTER DRIVE

Filed Sept. 10, 1929 2 Sheets-Sheet 2

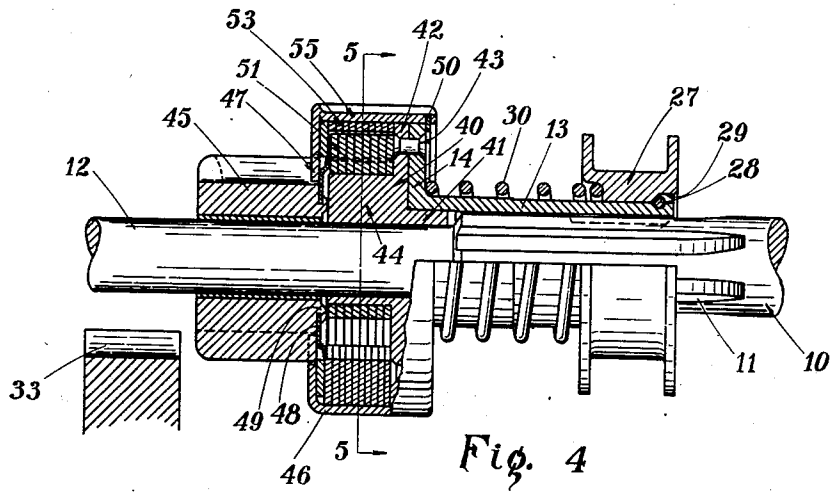

Fig. 4

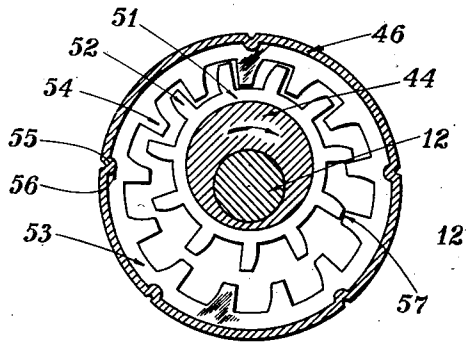

Fig. 5

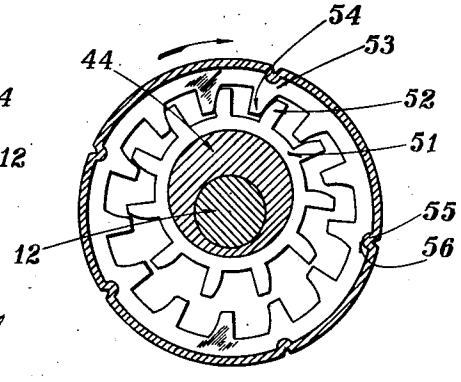

Fig. 6

INVENTOR
William L. McGrath
BY Clinton L. Jones
ATTORNEY

Patented June 2, 1931

1,808,115

UNITED STATES PATENT OFFICE

WILLIAM L. McGRATH, OF ELMIRA, NEW YORK, ASSIGNOR TO ECLIPSE MACHINE COMPANY, OF ELMIRA, NEW YORK, A CORPORATION OF NEW YORK

STARTER DRIVE

Application filed September 10, 1929. Serial No. 391,641.

This invention relates to starter drives for internal combustion engines, and more particularly to a starter drive including a manual shift for a starter pinion.

One object of the present invention is the provision of a novel starter drive which is positive and efficient in operation and economical to manufacture.

Another object of the invention is the provision of a novel positive one-way driving means for a starter pinion which is adapted to release and allow the pinion to over-run freely without jamming.

A further object is to provide a starter drive, the parts of which may be formed by economical machining methods, and do not require a high order of acuracy in the formation thereof.

Other objects and advantages will be apparent to those skilled in this art from the following description taken in connection with the accompanying drawings in which:

Fig. 1 is a side elevation of one embodiment of the invention;

Fig. 2 is a vertical section taken substantially on the line 2—2 of Fig. 1, with parts shown in driving relation;

Fig. 3 is a vertical section similar to Fig. 2 showing the parts in over-running relation;

Fig. 4 is a view similar to Fig. 1 of another embodment of the invention;

Fig. 5 is a vertical section taken substantially on the line 5—5 of Fig. 4 with the parts in driving relation; and

Fig. 6 is a vertical section similar to Fig. 5, showing the parts in over-running relation.

Referring first to Fig. 1 of the drawings, a power member in the form of a driving shaft 10 which may be the armature shaft of a starter motor, or any other suitable power shaft is shown having a portion thereof provided with straight splines 11, and being provided beyond the splined portion with a reduced smooth portion 12. An internally splined shifter sleeve 13 is mounted to slide freely upon the splined portion 11 of the driving shaft 10 and has a radial flange 14 formed at the end thereof adjacent to the smooth portion 12 of shaft 10. An annular driving clutch member 15 provided with internal teeth 16 is adapted to be fixed against the periphery of flange 14 in any suitable manner as by means of inter-fitting shoulders 17 and 18 formed respectively on the flange 14 and ring 15, and rivets 19 passing through the flange and ring.

A starting pinion 20 is rotatably and slidably journaled on the smooth portion 12 of shaft 10, and is provided with a cylindrical eccentric portion 21 adapted to be positioned within the annular member 15. A thimble 22 which may preferably be formed of a bearing alloy is fixed on the eccentric portion 21 of pinion 20 as by being pressed thereon, and is provided with a radial flange 23 which is concentric with the driving shaft.

An intermediate clutch or transmission member 24 in the form of a pinion is journaled freely upon the thimble 22 and is provided with teeth 25 adapted to cooperate with the teeth 16 of the annular clutch member 15, the relative sizes of the transmission member and annular member being so arranged that if the cooperating teeth 25 and 16 were formed as ordinary symmetrical gear teeth, these two elements would cooperate as planetary eccentric gears and rotate freely in either direction. It will be noted however, with special reference to the showing in Fig. 2, that whereas the teeth of the two clutch members are each formed on one side thereof with appropriate tooth contours for free running together, that on the opposite sides thereof the teeth are cut away in an approximately radial direction so that sufficient back-lash is introduced to allow the ends of the teeth to come into abutting relation as shown at 26 in Fig. 2 when the annular clutch member 15 is rotated with respect to the clutch member 24 in the direction of the arrow (a) there illustrated. It will be seen that this abutment of the ends of the driving and driven teeth 16 and 25 respectively, forms a positive driving connection between the two clutch members, and by reason of the eccentric mounting of the clutch member 24 on the pinion

20 the latter is also positively connected to the clutch member 15 for rotation therewith in one direction.

A shift collar 27 of any suitable form is loosely mounted on the exterior of the shifter sleeve 13, being retained thereon by suitable means such as a split ring 28 mounted in the shifter sleeve and adapted to seat in a recess 29 in said shift collar. The shift collar is normally maintained in contact with the ring 28 by suitable yielding means such as a spring member 30 bearing at one end on the shift collar 27 and at the other end against the radial flange 14 of the shifter sleeve. A suitable closure member such as a stepped ring member 31 is adapted to be secured against the face of the annular clutch member 15 as by means of screws 32, and is arranged to bear against the outer side of the flange 23 of thimble 22, thus retaining the clutch and pinion in assembled relation and connecting the pinion at all times for longitudinal movement with the shifter sleeve 13.

In operation, when it is desired to start the engine the shift collar 27 is moved to the left in Fig. 1 by any suitable manual shifting means not shown, thereby causing the pinion 20 to move longitudinally into mesh with the flywheel gear of the engine indicated at 33. The switch of the starting motor is thereupon closed, causing the motor to rotate shaft 10 in the direction of the arrow (*a*) in Fig. 2. Rotation of shaft 10 is transmitted through the splines 11 to the shifter sleeve 13 and clutch member 15, which thereupon engages the clutch member 24 as indicated at 26 in Fig. 2, thus rotating clutch member 24 and pinion 20 to crank the engine. When the engine starts under its own power, the pinion 20 is driven by the flywheel 33 at high speed, but the clutch member 15 is not compelled to rotate with the pinion 20 since the transmission member 24 planetates idly within the clutch member 15 allowing the pinion 20 to overrun freely, as indicated by the arrow (*b*) in Fig. 3. This condition is maintained until the pinion 20 is withdrawn from engagement with the flywheel 33 by the operator restoring the shifter parts to normal position.

It will be readily appreciated from a consideration of the structure and operation of this device that the cooperating clutch elements are not dependent for their successful operation on any high degree of accuracy in the formation thereof.

It will further be noted that by reason of the driving engagement of the clutch members being a substantially normal engagement of flat surfaces on the ends of the teeth, there is no tendency to wedge and jam the clutch members. Over-running of the pinion is, therefore, allowed to take place freely without transmitting any substantial accelerating force to the armature shaft of the starting motor.

In the embodiment of the invention illustrated in Figs. 4, 5 and 6, a motor shaft 10 is provided with splines 11 and a reduced smooth portion 12. A shifter sleeve 13 is splined on the shaft, and is provided with a shift collar 27 loosely mounted thereon and retained by suitable means such as a split ring 28 seated in a groove in sleeve 13 and adapted to be received in an annular recess 29 in the shift collar. The shift collar is yieldably held against the retaining ring 28 by suitable means such as a spring 30 bearing at one end against the collar and at the other against a radial flange 14 on the end of sleeve 13.

An eccentric member 40 is loosely mounted on the smooth portion 12 of shaft 10. This member comprises an extension 41 concentric with shaft 10, forming a seat for the end of shifter sleeve 13, a radial flange 42 also concentric with the shaft, adapted to be suitably fixed to the flange 14 of sleeve 13 as by means of rivets 43, and a cylindrical eccentric portion 44.

A pinion 45 is slidably mounted on the shaft 10 adjacent the eccentric member 40, and a casing 46 is adapted to be mounted on the end of the pinion, being splined thereto by inwardly extending teeth 47 on the casing formed to interfit with the teeth of the pinion 45, and being retained on the pinion by suitable means such as a ring member 48 fixed to the end of the pinion as indicated at 49. The casing 46 is adapted to extend over the eccentric member 40, loosely surrounding the peripheries of the flanges 42 and 14, which are suitably retained therein as by means of a split ring 50 seated in the end of the casing.

An intermediate transmission or clutch member 51 in the form of a plurality of laminations having asymmetrical peripheral teeth 52 as above described in connection with the first embodiment of the invention is freely journaled on the eccentric portion 44 of member 40. A driven clutch member 53 in the form of a plurality of laminations having conjugate asymmetrical internal teeth is mounted within the casing 46 and non-rotatably connected thereto as by means of the interfitting ribs 55 and depressions 56 formed in said casing and laminations respectively.

The operation of this embodiment of the invention is substantially similar to that previously described. When the operator moves the shifting collar 27 to the left in Fig. 4 by the usual pedal mechanism, not shown, the pinion 45 is meshed with flywheel 33 and thereafter the motor is energized to rotate shaft 10. Rotation of shaft 10 is transmitted through sleeve 13 and rivets 43 to eccentric member 40, which,

turning in the direction of the arrow in Fig. 5, moves the driving clutch member 51 into driving engagement with the driven clutch member 53 as shown at 57. Rotation of the driven clutch member is transmitted through casing 46 to pinion 45 to crank the engine.

When the engine starts, the pinion 45 is driven by the flywheel 33, causing the driven clutch member 53 to overrun the driving clutch member 51 in the direction of the arrow as shown in Fig. 6. Since this overrunning constitutes in effect simply the meshing of a pair of unloaded internal and external spur gears, and since the only torque transmitted back through the clutch to rotate the motor shaft is the result of the slight bearing friction of the clutch member 51 on the eccentric member 40, it is obvious that the overrunning is quiet without any substantial rotative effect on the motor shaft.

It will be noted that since the clutch parts may be made from stampings and punchings and involve no expensive machining operations nor close fitting, the device is exceptionally cheap to manufacture and easy to assemble.

It is to be understood that various other embodiments of the invention are possible and various changes may be made in the construction and arrangement of the parts without departing from the spirit of the invention. Reference is therefore to be had to the claims appended hereto for a definition of the limits of the invention.

What is claimed is:

1. A starter drive for internal combustion engines including a member adapted to engage and rotate an element of the engine to be started, a power member and unidirectional driving means connecting the power member to the engine engaging member including an annular element connected to one of said members, an eccentric fixed to the other member and an intermediate transmission member mounted on said eccentric and having means adapted to interlock with the annular element in one direction of rotation.

2. A starter drive for internal combustion engines including a member adapted to engage and rotate an element of the engine to be started, a power member, and unidirectional driving means connecting the power member to the engine engaging member including an internally toothed annular element connected to one of said members, an eccentric fixed to the other member and an intermediate transmission member journaled on said eccentric and having teeth adapted to interlock with the teeth of the annular element in one direction of rotation.

3. A starter drive for internal combustion engines including a member adapted to engage and rotate an element of the engine to be started, a power member, and unidirectional driving means connecting the power member to the engine engaging member including an internally toothed annular element connected to one of said members, an eccentric fixed to the other member and an intermediate transmission member journaled on said eccentric and having teeth adapted to positively interlock with the teeth of the annular element and drive the engine engaging member, but being formed to mesh freely therewith to allow the engine engaging member to overrun the power member.

4. A starter drive for internal combustion engines including a member adapted to engage and rotate an element of the engine to be started, a power member, and unidirectional driving means connecting the power member to the engine engaging member including an internally toothed annular element connected to one of said members, an eccentric fixed to the other member and an intermediate transmission member journaled on said eccentric and having teeth provided with contours on one side adapted to cooperate and cause meshing of the teeth as gear teeth in one direction of relative rotation of the parts, but being cut away to allow the ends of the teeth to abut and prevent relative rotation in the other direction.

5. An overrunning clutch including driving and driven members, a clutch element connected to rotate with one of said members, a cooperating clutch element mounted on an eccentric axis fixed with respect to the other member, said elements having cooperating means formed and arranged to lock and cause the assembly to rotate as a unit in one direction of drive while being formed to run together freely in the other direction of drive.

6. An overrunning clutch including driving and driven members, a toothed clutch element connected to rotate with one of said members, a cooperating toothed clutch element mounted on an eccentric axis fixed with respect to the other member, the teeth on said elements having such contours that said teeth lock and cause the assembly to rotate as a unit in the normal direction of drive, and formed to run together freely when the driven member overruns the driving member.

7. An overrunning clutch including driving and driven members, a toothed clutch element mounted to rotate with one of said members, a cooperating rotary toothed clutch element journaled on an eccentric axis fixed to rotate with the other member, the teeth on said elements having substantially flat tops and being provided with such asymmetrical contours that the ends of the teeth will abut and lock the assembly for

rotation as a unit in the normal direction of drive, but the teeth will mesh and run together freely when the driven member overruns the driving member.

8. An overrunning clutch including a driving member, a driven member substantially aligned therewith, a toothed clutch element mounted coaxially on one of said members and adapted to rotate therewith, a journal bearing mounted eccentric to the other member and fixed to rotate therewith, and a toothed clutch element mounted on said bearing and adapted to cooperate with the first clutch element, the teeth on said elements being formed to lock and cause the assembly to rotate as a unit in one direction of drive, but to run together freely in the other direction of drive.

9. An overrunning clutch including an internally toothed annular member, a member having an eccentric portion located therewithin and an intermediate transmission member rotatably mounted on said eccentric portion and having teeth adapted to interlock with the teeth of the annular member in one direction of rotation.

10. An overrunning clutch including an internally toothed annular member, a member having an eccentric portion located therewithin and an intermediate transmission member in the form of a pinion rotatably mounted on said eccentric portion and having teeth adapted to mesh with the teeth of the annular member, said teeth being formed to lock against relative rotation in one direction, but to allow free relative rotation in the other direction.

11. An overrunning clutch including an internally toothed annular member, a member having an eccentric portion located therewithin and an intermediate transmission member rotatably mounted on said eccentric portion and having teeth adapted to mesh with the teeth of the annular member, said teeth having suitable contours on one side for meshing as gear teeth in one direction of relative rotation, but being cut away on the other sides whereby the ends of cooperating teeth abut and positively prevent relative rotation in the other direction.

12. A starter drive for internal combustion engines including a drive shaft, a shifter sleeve mounted to rotate therewith but free to move longitudinally thereon, a member slidably journaled on the shaft and adapted to engage and rotate a member of the engine to be started, means connecting the sleeve and engine engaging member for longitudinal movement in unison, means under the control of the operator for shifting the sleeve to move the engine engaging member into and out of driving engagement, and a one way driving connection between the sleeve member and engine engaging member including an eccentric fixed on one of said members, an internally toothed clutch element fixed to the other member and an intermediate transmission member journaled on said eccentric and having teeth formed and arranged to lock with the clutch teeth in one direction of relative rotation but to freely mesh therewith on the other direction of relative rotation.

13. A starter drive for internal combustion engines including a drive shaft, a shifter sleeve splined thereon, a pinion slidably journaled on the shaft and adapted to engage and rotate a member of the engine to be started, interengaging flanges fixed to the sleeve and pinion and connecting the same for longitudinal movement in unison, means under the control of the operator for shifting the sleeve to move the pinion into and out of driving engagement, and a one way driving connecting between the sleeve and pinion including an eccentric fixed on one of said members, an internally toothed clutch ring fixed to the other member and an intermediate transmission member journaled on said eccentric and having an annular series of teeth formed and arranged to lock with the ring teeth in one direction of relative rotation but to freely mesh therewith in the other direction of relative rotation.

In testimony whereof I have signed this specification.

WILLIAM L. McGRATH.