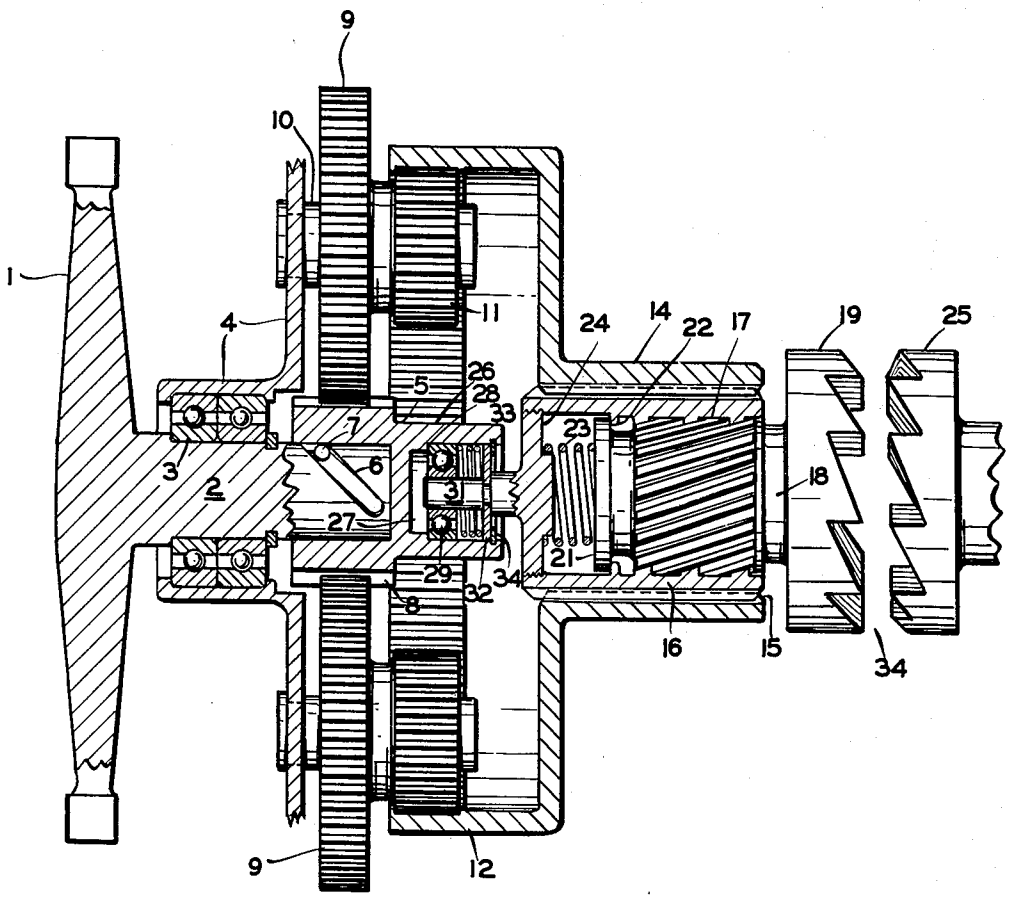
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ENGINE STARTER

Filed Sept. 30, 1954

FIG. 1



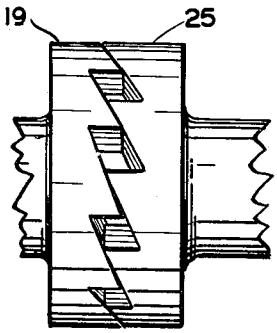




FIG. 2

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# ENGINE STARTER

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5 Claims. (Cl. 74—7)

The present invention relates to new and useful improvements in engine starters.

A general object of the invention is to provide an engine starter having high speed operation and relatively limited impact of the starter and engine jaws in engaging with one another.

A further object of the invention is to provide an engine starter wherein the jaws of the starter are caused to move axially into engagement with associated engine jaws before rotary motion of the starter driving power is transmitted to the jaw members.

A more particular object of the invention is to provide a high speed turbine driven engine starter of simple construction having relatively limited impact of its associated parts.

Because of the limited impact present in the operation of the device embodying the invention, the invention finds particular use in cases where large engine jaws and high speed are involved, for in such cases considerable impact of starting elements is apt to cause damage and wear to the coacting members. It does, for this reason, find particular use in combination with jet engines.

The invention further lies in the particular construction and arrangement of its various parts as well as in their cooperative association with one another.

The foregoing and other objects and advantages of the invention will appear more fully hereinafter from a consideration of the detailed description which follows, taken together with the accompanying drawings, wherein an embodiment of the invention is illustrated. It is to be expressly understood, however, that the drawings are for purposes of illustration and description, and are not to be construed as defining the limits of the invention.

In the drawings:

Fig. 1 represents a longitudinal cross section of a turbine driven engine starter embodying the invention; and

Fig. 2 is a view illustrating a situation where the jaws are not fully seated.

In describing the invention in further detail, reference is directed to the drawings wherein there is shown a pneumatically driven turbine 1, the drive shaft 2 of which is supported for rotation in suitable bearings 3 carried by a proper housing 4. The free end of shaft 2 is received in an axial bore of a short cup member 5 and is provided with an inclined slot or way 6. A stud 7 contained in the bore of member 5 is adapted to travel in the slot as the turbine is rotated, and in doing so causes the cup member 5 to move longitudinally to the right as the stud is drawn into the slot.

The cup member is provided with elongated peripheral splines 8 which engage with smaller splines or teeth of a plurality of surrounding gears 9. Gears 9 are of a relatively larger size than the cup member and each is supported by a stub shaft 10 for rotation in housing 4. Carried by a hub portion at the right of each gear 9 is a reduced gear 11. The latter gears are in mesh with a surrounding annulus gear 12.

The annulus gear is provided with an axially extending



reduced hollow hub portion 14. This hub is internally provided with horizontal or straight splines 15. Received in the hollow hub 14 is a correspondingly splined elongated cup member 16 which is adapted for axial slidable movement in the hub. The right internal portion of member 16 is provided with threads 17 inclined at a low angle. Engaged with thread 17 are the threads of a correspondingly threaded stub shaft 18. The latter carries at its outer end a large starting jaw member 19. Shaft 18 is threadable in or out of the cup for a short distance. It is normally threaded in the direction out of the cup, being limited in the extent thereof by a peripheral stop 21 carried thereon limiting against an internal abutment 22 of the cup member. When so threaded, the jaw end 19 of shaft 18 is positioned a short distance from the end walls of both the hub 14 and cup member 16. A coil spring 23 limiting between the end wall 24 of member 16 and stop 21 of shaft 18 biases the jaw member 19 in its outward direction and frictionally biases the engaging threads of cup and shaft against one another. By the foregoing structure, inward travel of shaft 18, that might otherwise occur upon an outward directional force being applied against the end wall of the cup member, is avoided.

The jaw member 19 in its normal position is located a short distance from a correspondingly toothed jaw member 25 of an associated engine. Upon further longitudinal movement, jaw member 19 is adapted to engage with jaw member 25. This further axial movement required to bring the jaws into mesh with one another is provided by axially sliding the cup member 16 in a direction out of hub 14. Movement of the cup member, it is clear, will, because of the frictional engagement of the threads of the cup and shaft, cause the jaw member 19 to move as a unit with it, until the latter engages with the associated engine jaw 25.

Sliding of cup member 16 as above is accomplished by transmitting the axial movement of the short cup member 5 to the elongated cup 16 through suitable means connecting the one to the other. To this end, cup 5 provides an axially extended reduced portion 26 having a recess 27 in its end in which is mounted against a shoulder 28 a bearing element 29. Extending axially from the left end wall of cup 16 is a stub shaft 31 which is carried for slidable as well as rotatable movement in bearing 29. Intermediately of bearing 29 and a washer 32 seated against a shoulder of shaft 31 is confined a coil spring 33. A snap ring 34, carried in a groove of the wall of recess 27, limits against the outer face of washer 32.

The construction and operation of the device is such, that rotation of the turbine draws the stud 7 down into slot 6 of the turbine shaft, and, as it does so, causes cup member 5 to slide between gears 9 in a longitudinal direction to the right. This movement is communicated through spring 33 to slide the elongated cup member 16 to the right, the latter carrying the jaw member with it and bringing the latter into engagement with the opposed engine jaw 25. Due to the inertia of the gear mass associated with cup member 5, longitudinal movement of the cup members 5 and 6 occurs before any appreciable movement develops in the associated gears 9 and 12. Upon engagement of the jaws taking place, the full torque of the turbine is then communicated through cup member 5 and the associated gearing to drive the jaw member 19 and the engine jaw engaged therewith.

It can be seen by this sliding engagement of the jaws with one another, that the slamming impact that would otherwise occur upon a direct rotary engagement is eliminated. This sliding engagement is also free of ramming due to the conversion of the torque motion of the turbine

to an axial motion and because of the cushion effects of the coil spring 33.

Now, it may occur, that in normal position the jaws of the engine member 25 have come to rest at a point midway between the opposed jaws of the starting member 19; in such cases, full axial movement of the starting member is blocked (Fig. 2) and some rotation thereof will be required to seat the one fully upon the other. Where such occurs, when the teeth of the starting jaws have been axially limited or arrested by the opposed walls of the engine jaws, the torque of the turbine will be transmitted through the gearing to rotate the starting jaw member into mesh with the engine jaw member. But, since there has been a small amount of torque already acting through the gears, this slight needed rotation of the starting jaw will take place before the full torque of the turbine is transmitted to the starting jaw member. Consequently, the force of impact of the engaging members will be relatively at a minimum, than would otherwise be the case if a full rotary meshing of the gears were to take place under a full torque communicated through the gears to the jaw member.

It is to be further noted that the axial distance 34 the starting jaw must travel to engage with the engine jaw is slightly less than the length of the slot 6 in the turbine shaft, so that the stud 7 never travels to the bottom of the slot and consequently is not in danger of being sheared off.

It is further obvious from the structure, arrangement and method of engaging the associated jaws that conventional slip clutches and the like normally incorporated in engine starter devices are not required here.

Disengagement takes place upon cutting off the turbine power, whereupon the jaw member 19 is thrust back by the associated engine jaw member. This action causes the shaft of the disengaged jaw to thread into the cup member 16 against the bias of spring 23. This increased tension of spring 23 together with the continuing outward directional force being exerted by spring 33 on cup member 16 tends to hold the shaft back within the cup until the turbine has fully decelerated. As the turbine comes to rest, stud 7 of cup member 5 is drawn out of the slot and cup member 5 axially restores. This action relaxes the tension of spring 33, whereupon the jaw member 19 under action of spring 23 threads out to normal position. It is further clear by the manner in which the mechanism restores that the device will be free of ratcheting and the damages usually following therefrom.

Although an embodiment of the invention has beeen illustrated and described in detail, it is to be expressly understood that the invention is not limited thereto. Various changes can be made in the design and arrangement of the parts without departing from the spirit of the invention as the same will now be understood by those skilled in the art.

What is claimed is:

1. A turbine engine starter adapted for cooperative engagement with the jaws of an engine, comprising a turbine driven shaft, a gear cup slidably carried on the shaft, slot means in the shaft cooperable with a stud in the gear cup to move the gear cup longitudinally upon rotation of the turbine shaft, a gear train mass operatively geared to the gear cup and including an annulus gear having an internally splined hub, an elongated cup member slidably splined within the hub for axial movement, a starting jaw member axially movable with the elongated cup member as a unit, and means for transmitting the axial movement of the gear cup to the elongated cup to cause the latter to carry the associated starting jaw axially into engagement with the opposed jaws of the engine, the inertia of the gear train mass acting on the gear cup to retard transmission of the torque of the gear cup to the starting jaw member until after the axial movement of the gear cup has been effectively transmitted to the jaw member.



2. In a turbine engine starter as in claim 1 wherein the means for transmitting the axial movement of the gear cup to the elongated cup is characterized by a coil spring confined between the two cup members.

3. In an engine starter of the character described, a rotary drive shaft member, a starter jaw, a short cup member axially slidable on the drive shaft, pin means in the cup member cooperable with slot means in the drive shaft to slide the short cup member axially along the shaft, splined means cooperable with spline means on the short cup member to retard rotation of the latter as it is slid axially along the shaft, an elongated cup slidable in a longitudinal direction and carrying the starter jaw, and spring means confined between the two cup members adapted to transmit the axial movement of the short cup member to the elongated cup member.

4. In an engine starter as in claim 3, wherein the sliding movement of the elongated cup member is limited by the jaw member engaging a complementary engine jaw member and the torque of the turbine communicated to the short cup member is thereupon effective to overcome the splined means retarding rotation of the short cup member, and gear means is provided to transmit the torque of short cup member to the starting jaw member and, as a consequence, to the engine jaw member engaged with the latter.

5. In an engine starter of the character described including a driving member, a jaw member threaded in an axially slidable cup member, the jaw member being normally threaded to a short distance out of the cup, spring means within the cup biasing the engaging threads of cup and starter jaw member frictionally against one another, means operatively connected to the driving member for first axially sliding the cup member and thereby moving the jaw member into engagement with an associated engine jaw and then rotating the cup member and engaged jaw members together, the starting jaw member adapted to be disengaged by the associated engine jaw member upon the driving member being decelerated and the starting jaw further adapted to be threaded back into the cup member against the bias of the spring means, the spring means serving to increase its tension on the complementary engaged threads of jaw member and cup to prevent the jaw member from threading out again to normal position.

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