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FRICTION HOLDING AND SEALING MEANS FOR DIRECT CRANKING ENGINE STARTERS AND THE LIKE

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Fig. 1

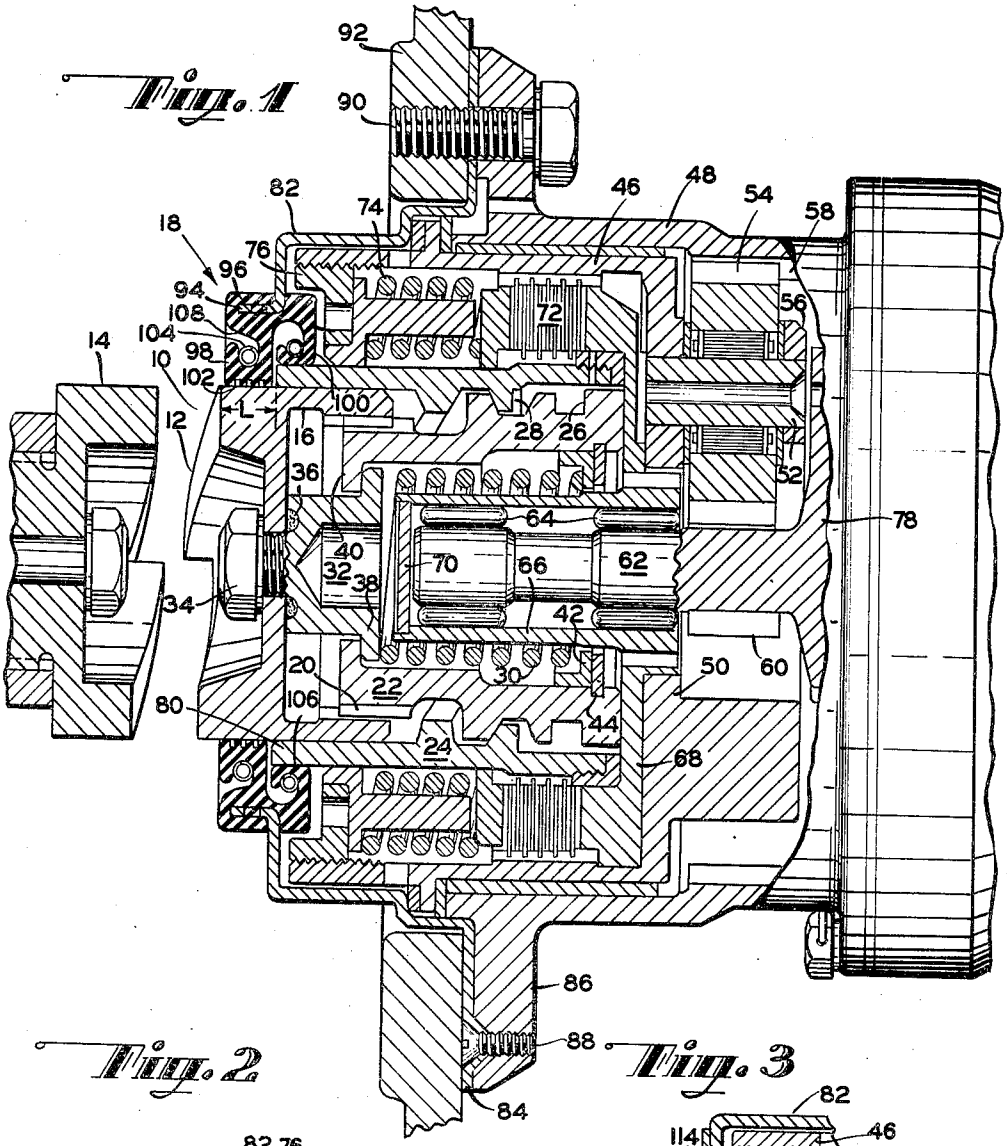



Fig. 2

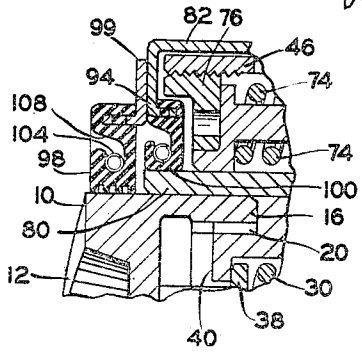
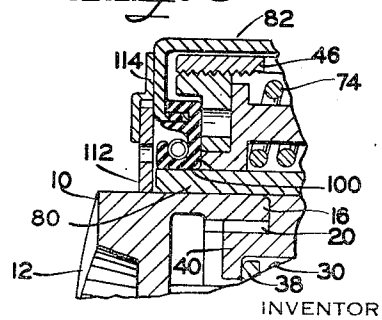



Fig. 3

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## FRICTION HOLDING AND SEALING MEANS FOR DIRECT CRANKING ENGINE STARTERS AND THE LIKE

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3 Claims. (Cl. 74—7)

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The invention hereof relates to friction holding and sealing means for direct cranking engine starters and the like, and particularly to means for frictionally holding the starter jaw for axial movement by a screw shaft and for sealing the starter about the jaw without axial rubbing on the seal.

In a starter of the general type indicated, as formerly constructed, especially in aircraft practice, it has been usual to insert a small portion of one end of the starter housing into the crank casing of the engine through an opening of the casing, and to have a clutch rotor or jaw member in an aperture of the starter housing adapted for axial movement between a position in which the jaw is mostly in the starter housing and spaced from an engine rotor or jaw element, and a position in which the starter jaw engages the engine jaw.

In such arrangement, the jaw end of the starter is naturally subject to a strong tendency of the crank casing oil to enter the starter housing about the starter jaw, and this tendency has long presented a difficult and perplexing problem, resulting in many suggestions for its solution.

It is extremely undesirable to have any appreciable amount of such oil enter the starter housing, or to have any oil at all between the discs of a torque-limiting friction disc pack or between friction elements of torque limiting means of any type.

In direct cranking starters, it has been exclusively the practice, irrespective of the many improvements heretofore suggested, so far as applicant is aware, to retain a ring seal between the starter housing and the jaw, which seal is subjected not only to rotative rubbing by the jaw, but to the axial sliding rubbing by the jaw as well.

A ring seal subject to rotative rubbing only, is considerably more effective in excluding oil or any other fluid or liquid mixture, such as gasoline and oil or water, than a similiar seal which is also subject to axial rubbing.

Another objection to the axially sliding rotative seal directly on a jaw, is that it is subject to greater adverse effects from radial vibration of the jaw resulting from the necessary radial or rotative clearances of the jaw added to the cumulative radial clearances of other elements in the starter leading to the jaw.

Accordingly, among the objects of the present invention are to avoid all of the former objections to a starter jaw or like member, in connection with which a seal is subject to both rotative and

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axial rubbing, and to effect such results by novel effective means.

Another object, for certain applications, is to entirely eliminate a sliding jaw seal, and to provide non-sealing friction holding means in combination with a seal which is subject to rotative rubbing only.

Another object, for certain other applications, is to utilize a combined sliding seal and friction means in combination with a seal which is subject to rotative rubbing only.

Another object, for certain further applications, is to provide a single ring having axially offset parts, one of which constitutes a combined friction means and sliding seal, and the other of which is subject to rotative rubbing only.

Another object is to provide means of the above indicated character which are simple and durable in construction, economical to manufacture, and effective in their operation.

These and other objects and features of the invention are pointed out in the following description in terms of the embodiment thereof which is shown in the accompanying drawing. It is to be understood, however, that the drawing is for the purpose of illustration only, and is not designed as a definition of the limits of the invention, reference being had to the appended claims for this purpose.

In the drawing:

Figure 1 is a side view, partially in section and partially in elevation, of a portion of a direct-cranking starter structure embodying the invention in one form;

Figure 2 is a view similar to a portion of Figure 1, of a modification of the invention; and

Figure 3 is a view similar to Figure 2 of a further modification of the invention.

In Figure 1, which shows only so much of a direct-cranking starter sufficient for an understanding of the invention, the device comprises a starter rotor member 10 having jaws 12 and adapted for axial movement, from its retracted position shown, to a position of engagement with an engine rotor jaw or load element 14. The member 10 is also adapted for rotative movement to rotate the element 14 to start the engine.

A hollow shank portion 16 of the member 10 is surrounded by a unit 18 of the invention, to be later more fully described, and has an inner spline connection 20 to a hollow screw shaft 22 having long-lead screw thread connection to a hollow axially stationary rotative nut 24.

Shoulders 26 and 28, on the shaft 22 and the nut 24, respectively, engage each other, after

rotation of the nut has caused movement of the shaft to the left, as viewed in the drawing, and the member 10 has been correspondingly moved by the shaft, through the intermediary of a spring 30, into engagement with the engine element 14, to rotate the elements 10 and 14 to start the engine.

A member 32, held by a nut 34 in an opening in a central wall portion of the member 10, has a sealing ring 36, compressed by the nut between the members 10 and 32, and is provided with a flange 38 behind a flange 40 of the screw shaft 22. The spring 30 extends between the flange 38 and a backing ring 42 held to the shaft 22, as by a lock ring 44 in a groove of the shaft.

A barrel 46, rotatively journaled in a housing portion 48, has a closed end wall 50, from which project trunnions 52 carrying planet gears 54 held in place, as by a ring 56, and engaging an orbital gear 58, fixed to the housing portion 48, and a sun gear 60 fixed to a shaft 62 journaled, as by needle bearings 64, in a tubular portion 66 of an annular plate-like member 68 positioned axially between the shaft 22 and the nut 24 at one side, and the wall 50, at the other side. The tubular portion 66 is closed at its left hand end, as by a wall 70.

A torque limiting disc pack 72, having discs splined to the nut 24 and the barrel 46, respectively, is pressed against the member 68 by springs 74, the degree of pressure of which is regulated by a ring nut 76 in the barrel 46.

The shaft 62 further carries a portion 78 on which planet gears are also carried for engagement with the orbital gear 58 and another sun gear, and connected to other elements completing a gear train for reducing the speed of a driving or motor shaft, to the right of the structure shown, to the speed desired of the barrel 46.

A feature of the invention resides in providing a cylindrical extension 80 of the nut 24 adapted to closely embrace the shank 16 of the member 10, and to extend axially to a position, short of the outer end of the shank in the retracted position of the member 10, leaving a length L of the shank between the jaws 12 and the adjacent end of the extension 80 constituting, in effect, a radially inward step from the radially outer surface of the extension 80 to the radially outer surface of the shank 16.

An end housing portion 82, having a radial flange 84 secured to a radial flange 86 of the housing portion 48, as by screws 88, is mounted with the portion 48, as by studs 90 extending through the flanges 84 and 86 and into a portion 92 of an engine crank casing.

The portion 82, constituting a portion of the unit 18, in this instance, has an axially extending annular flange 94 provided with radial apertures, around and about which flange, and through which apertures, a single ring body 96 of the unit 18 extends.

The body 96 is constructed, as of neoprene or the like, molded to have flexible radially inner axially offset portions 98 and 100 substantially corresponding in inner diameter to the outer diameters of the shank 16 and the nut 24, respectively. Each of the portions 98 and 100 is of substantially C-section forming annular grooves opening to the left, as shown, with at least the portion 98 provided, in this instance, with a labyrinth 102 of annular inner surface grooves facilitating wiping of oil from the shank in its movement to the right from its extended position to its retracted position shown.

The body 96 is locally vulcanized around and about the flange 94, and in the apertures of the flange, to strongly and rigidly anchor the body at these positions, and to leave the remainder of the body resilient, the body 96 thereby being positively interlocked with the housing portion 82 both axially and annularly and having effective yieldability for radially inward compression of the portions 98 and 100 against the shank 16 and the nut 24, respectively.

A garter spring 104, in the groove of the portion 98, has its radially inward pressing force chosen not only to provide an effective seal, but to effect sufficient friction on the member 10 for holding the latter for axial movement by the screw shaft 22 through the intermediary of the spring 30, as hereinabove mentioned.

A garter spring 106, in the groove of the portion 100 has its radially inward pressing force chosen to provide an effective seal against rotation of the nut 24 only.

Both of the portions 100 and 98, before assembly, with the nut extension 80 and the member 10, respectively, are formed with the radially inner surfaces thereof convergingly tapered from right to left, in which condition, with neither the extension 80 nor the member 10 in position, the grooves of the portions 100 and 98 are more open than they are as shown. Also, in this condition, the free edge tips of the grooves may be bent counterclockwise, as viewed at the top of the ring in Figure 1, relative to the more solid parts of the body 96, to further open the grooves for the reception of the springs 106 and 104.

When the body 96 is axially pressed onto the extension 80 and the member 10, the groove walls in the portion 100 close to a position as shown around the spring 106 from which the latter, or parts thereof, cannot escape from the unit 18. The body 96 has an annular surface 108 diverging to the left from a position near the spring 104, the shortest distance between which surface 108 and the free edge tip of the groove in the portion 98, is substantially less than the section diameter of the rim of the spring 104, in operative position as shown. Prior to assembly, the groove in the portion 98 is more open, for reasons above stated, and may be further opened to admit the spring 104 to the groove. When the portion 98 is pressed axially over the member 10, the free edge tip of the groove automatically closes around the spring 104 to prevent parts of the spring, in case of breakage, from falling into the engine casing 92.

In operation, the portion 100 is never subjected to any rubbing action except the rotative rubbing of the nut 24, during the first rotation of which nut the portion 98 is subjected to axial rubbing only. After the shoulder 26 engages the shoulder 28 both portions 98 and 100 are subjected to rotative rubbing, in which the rubbing on the portion 100 is slightly faster than that on the portion 98 by reason of the slightly large diameter of the nut 24 relative to the diameter of the member 10.

In Figures 2 and 3 corresponding parts are designated by corresponding reference characters, in Figure 2 of which the construction and operation are similar to those of the device of Figure 1, with the exceptions that the single body 96 is omitted and, in its place, are substituted the portions 98 and 100 as separate bodies. The portion or body 100 is vulcanized to the flange 94, extending axially oppositely to its direction of Figure 1, and the portion or body 98 is vulcanized

to a similar flange extending, in the direction of the flange 94 of Figure 1, from a separate annular member 99 secured to the end housing portion 82.

In Figure 3, the portion or body 100 is retained, and a split friction ring 112, as of Phosphor bronze, is substituted for the portion or body 98, and movably held, as by a ring 114 secured to the end housing portion 82, for spring action against the member 10.

Although only three embodiments of the invention have been illustrated and described, various changes in the form and relative arrangements of the parts, which will now appear to those skilled in the art, may be made without departing from the scope of the invention. Reference is, therefore, to be had to the appended claims for a definition of the limits of the invention.

What is claimed is:

1. In a direct-cranking engine starter compriing a housing, a screw shaft, a starter jaw member adapted for movement axially outwardly of the housing for engaging and rotative movement for rotating an engine jaw element and having a hollow shank portion providing for axial relative movement between the shaft and the jaw member, spring means axially compressible by and between said jaw member and said shaft, the combination of an axially stationary rotatably driven hollow nut having long-lead screw connection to said shaft thereabout and including a cylindrical extension adapted to closely axially and rotatively embrace said shank portion throughout the axial movement of the jaw member and in retracted position having its outer end short of the outer end of said shank portion leaving a length of the latter between the jaws of the jaw member and said outer nut extension end, a one-piece ring of rubber or the like around the axis of said shank having radially outer portions vulcanized to said housing and radially inner axially offset first and second portions of different internal diameters around and engaging said shank length and said nut adjacent to said outer nut extension end, respectively, said first and second portions being of substantially C-section forming channels opening toward the jaws of said member, a garter spring in said second channel exerting radially inward sealing pressure against said extension end, and a garter spring in said first channel exerting radially inward pressure against said shank sealing and frictionally holding said shank length in the retracted position of the jaw member and adapted to continue its friction seal pressure on the shank during axial movement of said jaw member between the retracted and the engine jaw element engaging positions of the starter jaw member.

2. In a direct-cranking engine starter comprising a housing, a screw shaft, a starter jaw member adapted for movement axially outwardly of the housing for engaging and rotative movement for rotating an engine jaw element and having a hollow shank portion providing for axial relative movement between the shaft and the jaw member, spring means axially compressible by and between said jaw member and said shaft, the combination of an axially stationary rotatably driven hollow nut having long-lead screw connection to said shaft thereabout and including a cylindrical extension adapted to closely axially and rotatively embrace said shank portion throughout the axial movement of the jaw member and in retracted position having its outer end short of the outer end of said shank portion leaving a length of the latter between the jaws of the jaw member and said outer nut extension end, a ring seal supported by said housing around said nut adjacent to said outer nut extension end, and a combined seal and friction ring supported by said housing and frictionally engaging and sealing said shank length in the retracted position of the jaw member and adapted to continue its friction seal engagement with the shank during axial movement of said jaw member between the retracted and the engine jaw element engaging positions of the starter jaw member.

3. In a direct-cranking engine starter comprising a housing, a screw shaft, a starter jaw member adapted for movement axially outwardly of the housing for engaging and rotative movement for rotating an engine jaw element and having a hollow shank portion providing for axial relative movement between the shaft and the jaw member, resilient means axially compressible by and between said jaw member and said shaft, an axially stationary rotatably driven hollow nut having long-lead screw connection to said shaft thereabout, driving means for the starter jaw member including a barrel surrounding the hollow nut and having a ring-receiving portion, torque-limiting friction disc means having interlayered discs axially-movably non-rotatively splined to the hollow nut and the barrel, respectively, means including spring means for pressing said discs together, and means for backing said spring means including a ring supported by said ring-receiving portion and locked to the barrel, the combination of a cylindrical extension of said nut adapted to closely axially and rotatively embrace said shank portion throughout the axial movement of the jaw member and in retracted position having its outer end short of the outer end of said sank portion leaving a length of the latter between the jaws of the jaw member and said outer nut extension end, a ring seal supported by said housing around said nut adjacent to said outer nut extension end, and means supported by said housing and frictionally engaging said shank length in the retracted position of the jaw member and adapted to continue its frictional engagement with the shank during axial movement of said jaw member between the retracted and the engine jaw element engaging positions of the starter jaw member.

CHARLES S. METSGER.




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