Nov. 6, 1945. G. S. THOMPSON 2,388,450

ENGINE STARTER

Filed Oct. 19, 1942

Fig. 1.

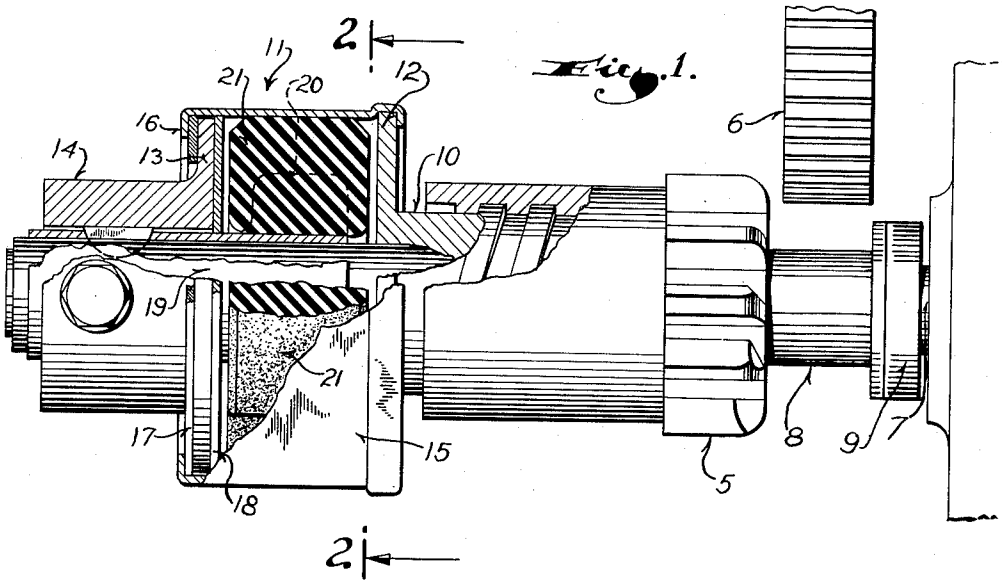


Fig. 2.

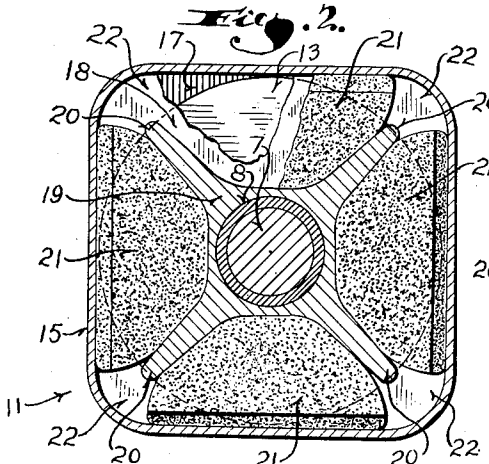


Fig. 3.

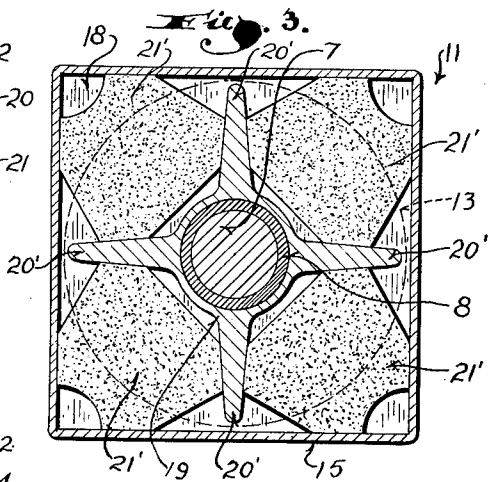
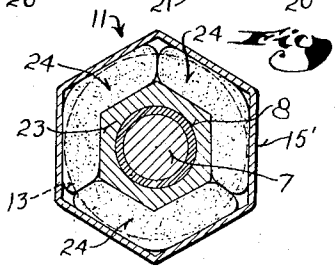


Fig. 4.



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ENGINE STARTER

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4 Claims. (Cl. 64—11)

This invention relates to engine starters, and refers particularly to the so-called automatic type of starter wherein the pinion is automatically propelled to and from its operative driving position during operation of the starter.

The invention also concerns itself primarily with starters of that type wherein the necessary resiliency is obtained through the use of rubber or other similar material having cubical elasticity.

One of the difficulties that has been encountered in starters of this type is that the rubber when repeatedly placed under compression takes a permanent set which interferes with the proper functioning of the starter by lessening the frictional grip between the rubber and the driving and driven members so that initial starting is not as positive as it should be.

The present invention seeks to overcome this difficulty and it is therefore an object of the invention to provide an improved manner of yieldingly or resiliently coupling the driving and driven elements of the starter in such a way that the ill effects of a permanent set of the rubber are entirely obviated.

More specifically, it is an object of this invention to provide an engine starter of the character described wherein the yielding connection between the driving and driven elements is so constructed that the rubber or other similar cushioning members are never placed under endwise compression, but in which all resiliency is obtained through a novel manner of utilizing torsional resiliency.

More specifically it is an object of this invention to provide an engine starter wherein the resilient driving connection is contained within a housing and wherein the shape of the housing constitutes one of the elements of the driving connection.

With the above and other objects in view which will appear as the description proceeds, this invention resides in the novel construction, combination and arrangement of parts substantially as hereinafter described and more particularly defined by the appended claims, it being understood that such changes in the precise embodiment of the hereindisclosed invention may be made as come within the scope of the claims.

The accompanying drawing illustrates several complete examples of the physical embodiment of the invention constructed according to the best modes so far devised for the practical application of the principles thereof, and in which:

Figure 1 is a view partially in side elevation and partially in longitudinal section through an engine starter embodying this invention;

Figure 2 is a cross sectional view taken through Figure 1 on the plane of the line 2—2;

Figure 3 is a cross sectional view similar to Figure 2 but illustrating a slightly modified adaptation of the invention; and

Figure 4 is also a cross sectional view similar to Figure 2 illustrating another form of the invention.

Referring now particularly to the accompanying drawing, in which like numerals indicate like parts, the numeral 5 designates the pinion of an engine starter embodying this invention and which, as is customary, is adapted to be propelled axially to and from a driving position meshing with an engine ring gear 6.

The entire starter is mounted on the shaft 7 of a starting motor, preferably by means of a main sleeve 8 one end of which has a pinion stop 9 fixed thereto.

Loosely mounted on the sleeve 8 is an actuating member 10 which has the usual threaded connection with the pinion so that relative rotation between these parts effects endwise motion of the pinion as required.

The actuating member 10 is driven from the motor shaft through a resilient or yieldable connection indicated generally by the numeral 11. This driving connection comprises two axially spaced abutments or flanges 12 and 13, the former being part of or secured to the actuating member 10, and the latter being part of a collar 14 which is fixed to the sleeve 8 and the drive shaft 7. The abutment 13 thus constitutes the driving abutment and the abutment 12 the driven abutment.

To the extent so far described the driving connection is similar to those previously employed, but it is to be observed that the abutment or flange 12 is not round as is the abutment 13, but substantially square and that the manner in which the abutments are yieldingly connected is quite different from that heretofore employed.

Fastened to the square driven abutment 12 is a shell 15 which, like the abutment or flange 12, is substantially square or polygonal in cross section on a plane normal to the axis of the starter. The shell extends across the space between the abutments and over the flange 13 where it has an inturned marginal flange 16 limiting separation of the abutments.

Confined between the flange 16 and the back face of the abutment or flange 13 is an antifriction washer 17, and overlying the inner face of

the abutment or flange 13 is a washer or disc 18 shaped to fit the inside of the shell 15 so as to be secured against rotation with respect thereto.

Inside the space between the abutments, which is enclosed by the shell, is a driving part 19 consisting of a hub and radial vanes or blades 20. The hub of this driving part is extended and is received in the bore of the collar to be secured to the drive shaft 7 by the same means which secures the collar 14.

The driving part 19 is thus fixed with respect to the shaft, and upon relative rotation between it and the actuator 10 with the shell 15 fixed thereto, the radial vanes move toward the flat faces of the shell on the other side. Such relative motion between the driving part and the shell is yieldingly opposed by cushioning members 21 in the form of blocks of rubber or other material having cubical elasticity seated in the space between the radial arms or vanes of the driving part and contacting the flat side walls of the shell 15.

It is to be observed that the axial dimension of these blocks is less than the space between the inner face of the abutment 12 and the inner face of the disc 18, and while this relationship is shown with actual clearance between the faces of the blocks and the adjacent faces of the abutment and disc, an actual space is not required as long as the engagement does not place the blocks under endwise compression.

It is also to be observed that inasmuch as both surfaces between which the blocks are positioned are secured against relative rotation, there is no tendency to twist the blocks and no relative motion between the faces of the blocks and these surfaces which may be contacted by the blocks during operation of the starter, as when the teeth abut end to end.

The torque load is carried entirely through the lateral compression applied to the blocks by the radial vanes or arms of the driving member 19 moving toward the flat sides of the shell 15.

To allow for the deformation of the blocks which occurs during use, the blocks are of such size that they do not fill the entire cross section of the housing or shell, but leave spaces 22, preferably at the corners of the shell, as clearly shown in Figure 2.

The specific relationship between the driving part and the shell is, of course, subject to modification, and in Figure 3 another application of the design shown in Figures 1 and 2 is illustrated. In the structure shown in Figure 3 the radial arms or vanes 20' of the driving part project toward the flat faces of the shell rather than toward the corners, and the rubber blocks 21' are shaped differently to fit into the corners of the shell and engage the adjacent faces of the radial arms or vanes, but as before, the rubber blocks are so shaped as to allow space for deformation.

Another application of the invention is illustrated in Figure 4 wherein the outer shell 15' is hexagonal in cross section and the driving part is in the form of a hexagon 23 suitably secured to the drive shaft with its faces parallel with those of the shell when the starter is in its free normal condition.

Interposed between the hexagonal driving part and the hexagonal shell are cushion members 24 of rubber or other similar material having cubical elasticity, each one of which preferably extends across two flat faces of the hexagonal driving part and the shell.

From the foregoing description, taken in connection with the accompanying drawing, it will be readily apparent to those skilled in the art that this invention provides an exceedingly simple but effective manner of resiliently transmitting torque from the motor shaft to the actuator of an engine starter and that this manner of utilizing rubber or similar material having cubical elasticity obviates the objectional possibility of having the permanent set, which such material takes, destroy the positiveness of the starter.

What I claim as my invention is:

1. In an engine starter having a pinion and a pinion actuating member screw-connected so that relative rotation therebetween propels the pinion axially to and from an operative driving position: means for yieldingly driving the actuating member from a power shaft comprising a driving abutment fixed with respect to the shaft; a driven abutment fixed with respect to the actuating member, said abutments being spaced axially; a shell fixed to one of the abutments and having angularly disposed side wall portions enclosing the space between the abutments, said angularly disposed side wall portions constituting a housing structure noncircular in cross section on a plane normal to the axis of the starter; noncircular means fixed with relation to the other abutment and disposed within the space between the abutments and inside the housing structure; cushion members confined between the housing structure and said noncircular means to provide a resilient torque transmitting connection therebetween, said cushion members being composed of material having cubical elasticity; and means for transmitting axial forces, due to reaction of the pinion propelling actuating member, into the fixed driving abutment including a washer interposed between said cushion members and the driving abutment.

2. In an engine starter having a pinion and an actuating member connected therewith and by which the pinion is propelled to and from its operative position, means for yieldingly transmitting driving torque to the actuating member comprising: a driving abutment adapted for connection to a drive shaft; a driven abutment fixed with respect to the actuating member, said abutments being coaxial and spaced apart; a shell fixed to one of the abutments and spanning the distance between the abutments to enclose the space therebetween, said shell being noncircular in cross section on a plane normal to the common axis of the abutments and being free to revolve with respect to the abutment to which it is not connected; a part noncircular in cross section on a plane normal to the common axis of the two abutments and secured against rotation with respect to said other abutment not connected to the shell, said part being disposed inside the space between the abutments; blocks of material having cubical elasticity confined between said part of noncircular cross section and the inner walls of the noncircular shell to establish a yielding torque transmitting connection therebetween, said blocks being entirely loose from said abutments so that no torque is transmitted by frictional contact between the blocks and the abutments; and spacing means between said blocks and said other abutment not connected to the shell, for precluding rubbing of the blocks against said other abutment upon angular yielding of the blocks.

3. In an engine starter having a pinion and an actuating member connected therewith and by

which the pinion is propelled to and from its operative position, means for yieldingly transmitting driving torque to the actuating member comprising: a driving abutment adapted for connection to a drive shaft; a driven abutment fixed with respect to the actuating member, said abutments being coaxial and spaced apart; a shell fixed to one of the abutments and spanning the distance between the abutments to enclose the space therebetween, said shell being noncircular in cross section on a plane normal to the common axis of the abutments and being free to revolve with respect to the abutment to which it is not connected; a part noncircular in cross section on a plane normal to the common axis of the two abutments and secured against rotation with respect to said other abutment not connected to the shell, said part being disposed inside the space between the abutments; blocks of material having cubical elasticity confined between said part of noncircular cross section and the inner walls of the noncircular shell to establish a yielding torque transmitting connection therebetween, said blocks being entirely loose from said abutments so that no torque is transmitted by frictional contact between the blocks and the abutments; a washer between the blocks and the abutment which is freely rotatable with respect to the shell; and means holding said washer against rotation with respect to the shell so that both surfaces with which the opposite sides of the blocks may come in contact during operation of the starter are tied together against relative rotation.

4. In an engine starter having a pinion and an actuating member connected therewith and by which the pinion is propelled to and from its operative position, means for yieldingly transmitting driving torque to the actuating member comprising: a driving abutment adapted for connection to a drive shaft; a driven abutment fixed with respect to the actuating member, said abutments being coaxial and spaced apart; a shell fixed to one of the abutments and spanning the distance between the abutments to enclose the space therebetween, said shell being noncircular in cross section on a plane normal to the common axis of the abutments and being free to revolve with respect to the abutment to which it is not connected; radial vanes fixed with respect to said last named abutment within the space between the abutments; cushion members in the spaces between the radial vanes and engaging the inner walls of the noncircular shell to provide a yielding torque transmitting connection between said last named abutment and the shell and the other abutment fixed thereto; and means rotatable with the shell cooperating with the shell and said abutment to which the shell is fixed to form an annular enclosure for the cushion members opening only to said radial vanes.

GLENN S. THOMPSON.