Oct. 28, 1947. F. WRIGHT 2,429,863

ENGINE STARTER

Filed Aug. 11, 1943 3 Sheets-Sheet 1

Fig. 1.

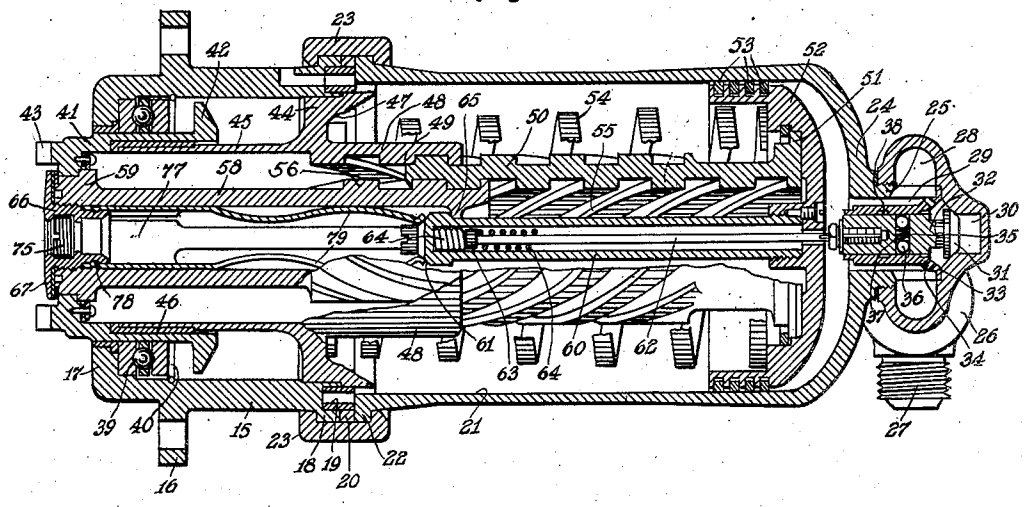


Fig. 2.

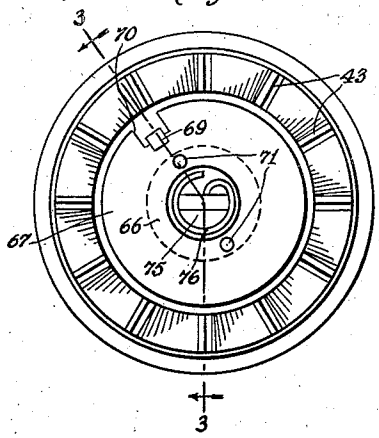
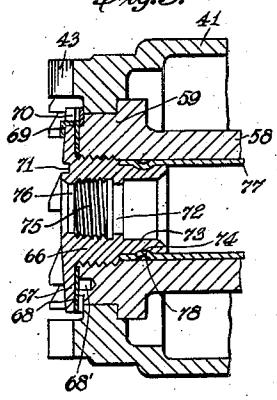


Fig. 3.



INVENTOR.
FRANK WRIGHT

BY
Cousino & Cousino
ATTORNEYS.

Oct. 28, 1947. F. WRIGHT 2,429,863

ENGINE STARTER

Filed Aug. 11, 1943 3 Sheets-Sheet 2

Fig. 4.

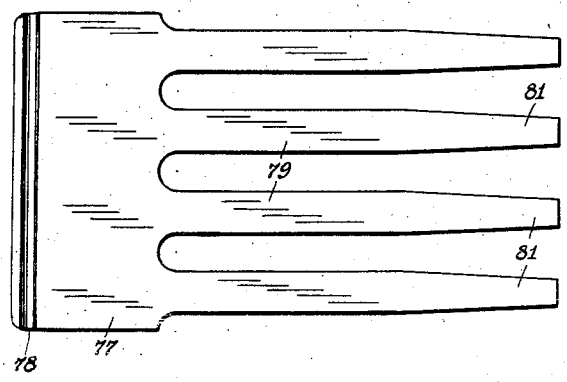


Fig. 5.

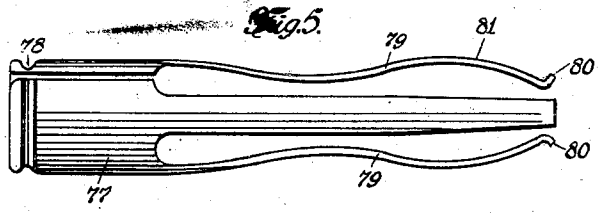


Fig. 6.

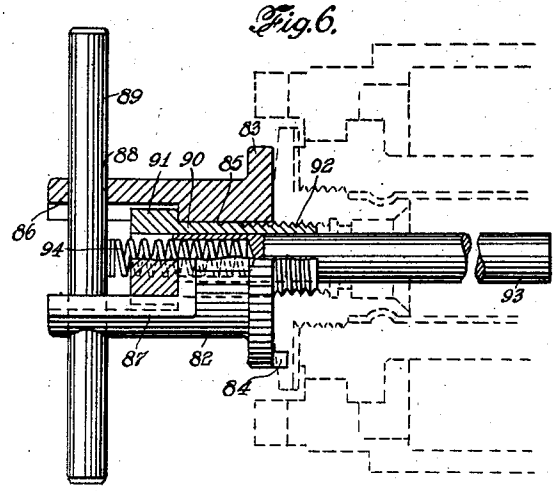
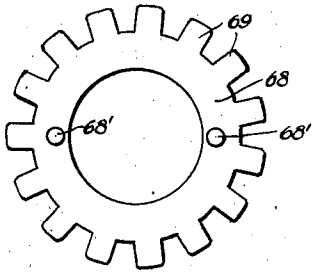


Fig. 7.



INVENTOR.
FRANK WRIGHT

BY Cousins & Cousins

ATTORNEYS.

Oct. 28, 1947. F. WRIGHT 2,429,863

ENGINE STARTER

Filed Aug. 11, 1943 3 Sheets-Sheet 3

Fig. 8.

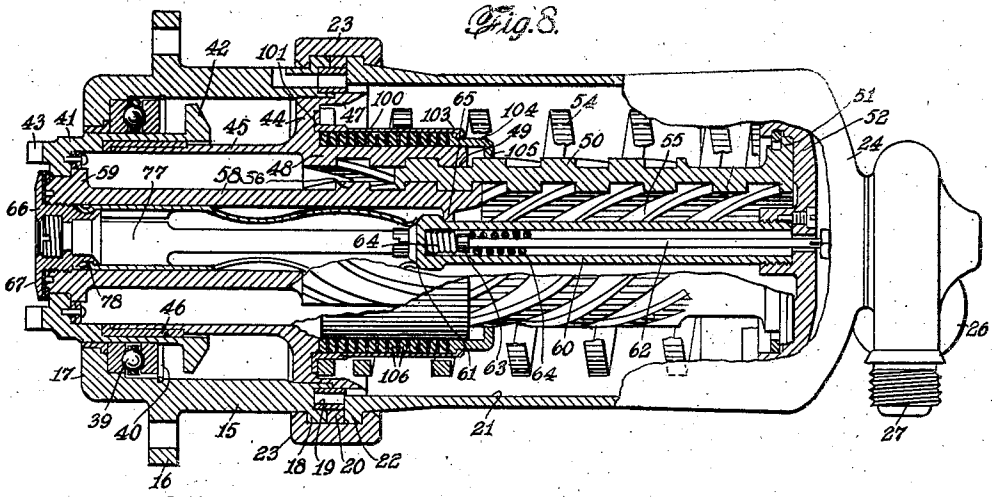


Fig. 9.

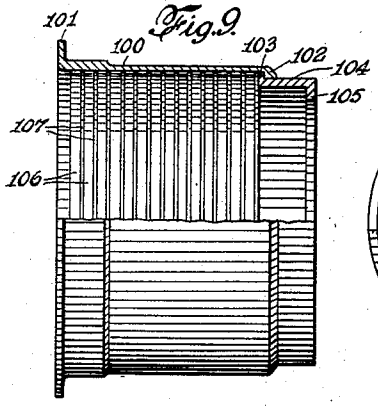


Fig. 10.

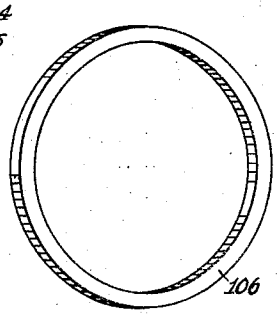


Fig. 11.

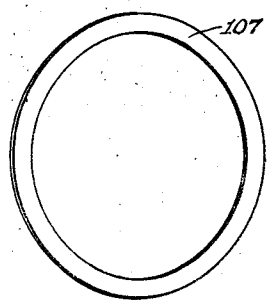


Fig. 12.

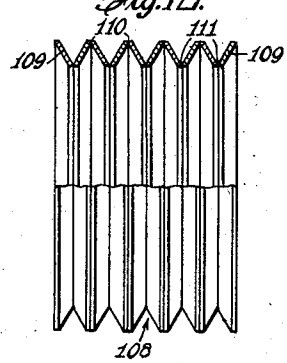
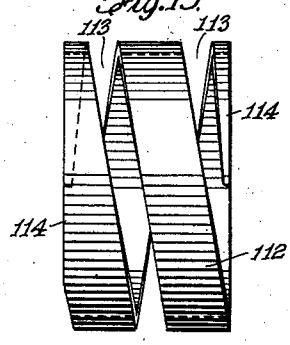


Fig. 13.



INVENTOR.
FRANK WRIGHT

BY Cousins & Cousins

ATTORNEYS

Patented Oct. 28, 1947

2,429,863

UNITED STATES PATENT OFFICE

2,429,863

ENGINE STARTER

Frank Wright, East Orange, N. J., assignor to Breeze Corporations, Inc., Newark, N. J., a corporation of New Jersey

Application August 11, 1943, Serial No. 498,441

6 Claims. (Cl. 123—179)

1

This invention relates to improvements in starters for internal combustion engines, and more particularly to starters using expansive gases of explosives. Such devices are exemplified in the patents to Coffman, Nos. 2,005,913 and 2,283,185, and several others of earlier date, all of which are considered as capable of extensive improvement.

One of the objects of the present invention is to materially simplify the construction, by reducing the number of parts, and so arranging the parts as to be more readily accessible and convenient in assembling and dismembering.

A further feature is in the provision of a spring sleeve and associated parts, held in a manner to avoid weakening the structure and easily removable without dismantling the remaining mechanism.

Another purpose is to produce a starter adapted for partial assemblage, permitting piston reciprocation over a period of time, by any convenient means, whereby the moving parts are harmonized and their surfaces rendered even and uniform to operate smoothly, before the spring sleeve is entered.

A still further object is in the provision of a cushioning device to receive the impact of the main moving part, preventing upsetting and consequent malformation of parts to the extent of impeding, even actually obstructing action.

These objects are attained by the novel construction, combination and association of parts hereinafter described and illustrated in the accompanying drawings, constituting a graphical component of this disclosure, and in which:

Figure 1 is a longitudinal sectional view, taken on the center line of an embodiment of the invention.

Figure 2 is a front elevational view of the driving end, drawn to an enlarged scale.

Figure 3 is a transverse sectional view taken approximately on line 3—3 of Figure 2.

Figure 4 is a plan view of the spring sleeve blank.

Figure 5 is a side view of the completed spring sleeve.

Figure 6 is a side elevational view of the spring assembling tool, partially in section.

Figure 7 is a plan view of the hollow screw lock washer.

Figure 8 is a side view, similar to Figure 1, but broken away to show a cushioning means to absorb the impact of the drive member.

Figure 9 is a partial side, partial sectional view of the shock absorbing means drawn to an enlarged scale.

2

Figure 10 is a perspective detail view of one of the absorbing elements.

Figure 11 is a similar view of one of the separators disposed intermediate the cushioning elements.

Figure 12 is a partial side, partial sectional view of a form of spring which may be substituted for the elements shown in Figures 10 and 11.

Figure 13 is a side elevational view of an alternative type of cushioning spring.

Referring in greater detail to the drawings, the numeral 15 designates a cylindrical base bracket, having an annular flange 16, provided with bolt receiving openings by which it may be held securely upon a support, arranged with respect to the drive shaft of the engine to be started.

At the outer, forward end of the bracket is an inturned flange 17, while at its rear end is an outturned flange 18 in which are set a plurality of tubular dowels 19 which pass through the flange 20 of an abutment ring, later described.

A cylinder 21 has a flange 22 seated against the flange 20 and a split clamp band 23, having inturned lateral edges, maintains the three flanges in juxtaposition, thereby uniting the cylinder to the base bracket.

The outer, rear end 24 of the cylinder is closed and provided with a screw threaded axial boss 25, by which is attached one or more housings 26 provided with an inlet 27 leading to a circuitous passage 28, and thence by ducts 29 to communicate with the interior of the cylinder.

Exhaust takes place through an opening 30, controlled by a valve 31, its stem 32 being slidable in a sleeve 33 having vents 34 open to the passage 28. The opening 30 communicates with the outside atmosphere to effect the exhaust action.

The valve stem 32 contains a cross bore 35 in which two loose spherical elements 36 are oppositely stressed by an intervening helical spring 37, whereby they are caused to engage in an annular groove 38 in the sleeve 33, in the manner of spring detents, when the valve is in an extreme open position.

In the front of the bracket 15, against the inner side of the flange 17, is set the fixed outer member of an anti-frictional thrust bearing 39, the inner member being retained in place by a spring ring 40 set in a groove in the bracket.

A cylindrical barrel 41 is slidably and rotatably mounted in the bearing 39 and provided with an outstanding annular flange 42 on its inner, rear end adapted to contact the bearing 39 when in its extreme forward position.

The outer, projecting end of the barrel is provided with an annular row of teeth 43 to clutchingly engage mating teeth on the end of the engine drive shaft (not shown).

An abutment ring 44 is fixed in the base bracket 15, having its flange 20 seated against the inner end of the bracket and is formed with a cylindrical extension 45, entering the bore of the barrel 41, but out of contact, due to the interposition of a sleeve 46.

The opposite end of the ring 44 contains a recess 47, and a cylindrical projection 48 provided with coarse pitched square screw threads 49 which act as guides for similar threads formed on the outer side of a driving member 50.

This member 50 has an enlarged circular head 51 set in the under side of a piston 52, movable in the cylinder 21 which is provided with the usual ring packings 53; the piston is normally retained outwardly, adjacent the closed end of the cylinder, by a strong coiled compression spring 54, seated within the piston at one end and at the other in the recess 47.

The driving member 50 is provided on its inner surface with helical threads or splines 55 co-operative with mating threads or splines 56, on a driven member 58 whereby the latter is moved longitudinally and also rotatively.

The driving member 50 engages, at its forward end, an extension of the driven member 58, which terminates at its outer end in a head 59, fitting an opening in the barrel 41 to transmit motion to it.

Also carried by the piston is an axial sleeve 60 having a closed conical inner end or head 61. A valve rod 62 is fixed in the valve stem 32 and provided with an enlarged head 63, cushioned in its action by coiled compression springs 64 at either range of its motion within the sleeve 60.

A shoulder 65, reaching inwardly from the wall of the extension 58, acts as an abutment for the head 61 of the sleeve, when the valve 31 engages its seat, limiting the movement of the sleeve 60, and also the piston, in an outward direction.

Screw-threaded into the bore of the driven member 58 is a hollow screw 66 having a flanged head 67 which makes contact with a lock washer 68, having a plurality of radial teeth 69 in its periphery and provided with rigid dowel pins 68' to fit openings in the end of the driven member head 59, the teeth being selectively adapted to be upturned through a notch 70 in the head 67 to prevent loosening of the screw, the head of which is provided with openings 71 for a spanner or similar wrench.

The screw 66 has a bore 72 and a hollow extension 73 in which is an annular peripheral recess 74. A screw plug 75 is fitted to engage in the outer portion of the screw 66 and is held from jarring loose by a keeper spring ring 76 set in an annular groove in the screw. A spring sleeve 77 is entered over the screw extension 73 and is formed with a bead 78 to engage the recess 74.

The sleeve 77 is formed from sheet spring material to present a plurality of fingers or prongs 79, shaped as shown in Figure 5, these fingers having outturned terminals 80, and outbowed elements 81 adapted to contact the inner wall of the drive member extension 58.

The function of the springs 79 is to engage the conical head 61 in a manner so that the movement of the piston 52 will cause a longitudinal movement of the driven member 58, to the extent required, that is, to cause the clutch teeth 43 to engage the driving member of the engine, at

which time the barrel flange 42 makes contact with the thrust bearing 39; after this the springs will yield to permit passage of the head 61 and its sleeve 60.

It is to be understood that in the initial forward movement of the piston 52, the driven member 58 is not caused to rotate with respect to the driving member 50, which turns only after the resistance of the springs 79 has been overcome.

Such springs have been usually secured within the driven member 58, by riveting, which has a tendency to weaken the parts and, in case breakage occurs, access can be had only by removal of most of the main elements of the structure through its rear.

It is to be noted that the present structure avoids such contingencies and further permits assembly and actual "working in" of the parts before insertion of the springs. Such insertion and removal are greatly facilitated by the use of a special hand tool (see Figure 6) which comprises a frame 82 having a flanged base 83 from which projects a lug 84 suited to engage the openings 71 in the screw head 67.

The frame 82 contains an axial bore 85, a counterbore 86 in its outer end portion, and is flattened on two opposite sides 87 and provided with central, diametrically drilled openings 88, in which is set a handle bar 89.

Freely movable in the bore 85 is a sleeve 90 having an enlarged head 91 adapted to be seated on the shoulder of the counterbore 86, while the lower extending end is provided with screw threads 92 suited to fit the internal threads of the hollow screw 66.

Slidable through the sleeve 90 is a rod 93 acting as a guide for the tool and springs 79, the rod being slidable through the bore 72 of the hollow screw 66, and normally pressed outwardly by a spring 94, its upper end being seated against the bar 89.

In operation, after the structure has been fully assembled, except the spring elements 77—79, the plug 75 is removed and the centering rod 93 inserted through the bore 72 of the hollow screw 66, whereupon the lug 84 is engaged in the opening 70 of the hollow screw, and upon actuating the handle bar 89 of the tool, the screw may be withdrawn.

Thereafter the spring sleeve is passed over the rod, its head entered into the groove 74 of the hollow screw 66, the lug 84 set in the opening 70 of the screw flange, and the screw 66 seated in position to be locked by one of the lock washer elements 69; then the tool is withdrawn and the plug 75 inserted.

It will be understood that removal of the springs 79 is easily and quickly done by reversal of the foregoing operations.

Although a stiff spring 54 is provided to oppose the power stroke of the piston 52, and return it to its initial position at the end of the stroke, it is not possible to prevent occasional striking of the reciprocating parts against stationary parts. For instance, the flange 51 on the drive shaft 50 at times will strike the end of the stationary nut-like hub element 48, deforming the outer splines or threads 49, causing them to bind on the splines or threads of the drive shaft, and such repeated hammer-like blows may eventually prevent rotation and reciprocation of the drive shaft.

The inner end of the drive shaft 50, striking against the end 59 of the driven shaft 58, also becomes deformed or upset, creating further

binding, to the extent of preventing proper action of the engine starter.

These harmful conditions are overcome by the device shown in Figure 8 and those following, in which a thin walled cylindrical casing **100** is fastened by its outstanding base flange **101** to the inner face of the abutment ring **44**, the casing having an inturned annular bead **102** at its opposite end.

Fitted to move freely within the casing **100** is the flange **103**, of a plunger ring **104** movable over the peripheral surface of the internally threaded element **48**, and is provided with an inreaching annular flange **105**, which clears the drive shaft **50**.

Mounted to move freely within the casing **100**, circumjacent the bracket element **48**, are a plurality of flat, highly elastic rings **106**, such as synthetic rubber, having interposed between their side faces rigid washers **107**, slightly larger in diameter and of lesser thickness, constituting a stack of cushion elements, seated at one end against the flange **44** and at its opposite end in contact with the slidable flange **103**, which moves inwardly of the casing, under impact of the drive member, preventing its deformation by absorbing its energy at the end of its stroke.

From this it will be seen that the hammer-like blows of the drive shaft, including its head **51**, are very materially cushioned, preventing damage to the splines and likewise to the stationary parts engaged by it.

In the modification shown in Figure 12 a series of inclined flat springs **108** are substituted for the elastic cushion, these elements being contained within the casing **100**.

Each spring **109** is shaped as the frustum of a cone, their outer edges being in contact, as at **110**, while the inner edges abut one another, as at **111**.

Figure 13 shows another spring device, consisting of a strip **112** of material of such thickness as to be contained in the casing **100** and of considerable width, the strip being helically wound, each convolution spaced as at **113** from the next adjacent, and its ends **114** finished square across.

While the foregoing is descriptive of the best known embodiments of the invention, it is not to be held as restrictive, but rather suggestive, within the scope of the annexed claims.

Having thus fully described the invention, what is claimed as new and sought to be secured by Letters Patent of the United States is:

1. An engine starter comprising in combination with a gas expansion motor, including a cylinder, a piston operable therein, a drive member actuated by the piston, a driven member engaged therewith, and a toothed clutch associated with said driven member to impart rotary motion to the engine to be started; a screw threaded into said driven member, a sleeve having a plurality of spring fingers rotatably connected with said screw to extend inwardly of said driven member, and a conically headed member fixed to said piston, said conical head frictionally abutting the free ends of said fingers whereby said driven member is initially caused to advance longitudinally and after passage of said conical head through said spring fingers to rotate without further advancement.

2. An engine starter comprising in combination with a gas expansion motor, including a fixed cylinder, a piston therein, a drive member actuated indirectly by said piston, said drive member having a limited lineal movement and an unlimited rotative movement, a driven member engaged therewith, a toothed clutch fixed on said driven member to impart rotary motion to the engine to be started; a hollow screw threaded axially into said driven member, releasable means to retain said screw when entered therein, a series of integrally connected spring fingers engaged on said screw to extend into said driven member, and a tubular member carried by the piston having an enlarged conical head in contact with the inner ends of said spring fingers during the lineal movement of said driven member, said fingers yielding to permit passage of the head therebetween at the beginning of rotative movement of the driven member.

3. An engine starter comprising in combination with a gas expansion motor, including a fixed cylinder, and a piston therein; a reciprocative drive member, a driven member engaged therewith having a clutch engageable with the engine to be started, a hollow screw removably engaged in said driven member, said screw having a flanged head, a fixed washer interposed between said head and driven member, means on said washer to lockingly engage said head to retain the screw in adjustment, a series of inreaching spring fingers supported by said screw, and a conical headed sleeve fixed on said piston initially in contact with said spring fingers, said fingers yielding at the end of the lineal movement of the driven member to permit passage of said head therebetween as the piston moves forwardly.

4. In an engine starter of the type described, including a reciprocative drive member, a driven member engaged therewith and a clutch combined therewith; a hollow screw set in said driven member, said screw having a front part containing an annular recess and a rear part internally threaded, a sleeve having a bead fitting said recess, a plurality of spring fingers integral with said sleeve to extend into said driven member, a starter member carried by the drive member having a conical head in frictional contact initially with said fingers and capable of eventually passing therebetween, at the end of the lineal movement of the driven member, and means to lock said screw when set.

5. In combination with an engine starter having a clutch member mounted for lineal and rotative movement and means to initiate such linear movement and thereafter a rotative movement; a hollow screw threaded axially into a driven member attached to said clutch member, a flanged head on said screw provided with a peripheral notch, and at least one wrench receiving opening, a washer fixedly interposed between said head and clutch member, said washer having a plurality of peripheral teeth selectively engageable in the flange notch, said screw having a cylindrical inner portion provided with an annular recess and an internally threaded outer end, a sleeve having means to engage in the recess of the screw, a plurality of spring fingers integral with said sleeve to extend inwardly therefrom, a starter member having a conical head in frictional contact initially with said fingers and capable of eventually passing therebetween at the end of the lineal movement of the driven member, and a plug fitting the internally threaded portion of said hollow screw.

6. An engine starter comprising in combination, a piston adapted to be driven by an expanding gas charge, a reciprocable and rotatable driven member having one end arranged to en-

gage a rotatable member of the engine, a supporting member connected to said one end of the driven member and readily detachable therefrom, a set of spring fingers mounted on said supporting member and extending within said driven member, and an elongated member connected to the piston and having a tapered head portion disposed initially in contact with said spring fingers and adapted to press against said fingers until the end of the lineal travel of the driven member and then spread them apart and pass between them in response to forward motion of the piston.

FRANK WRIGHT.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,283,185	Coffman	May 19, 1942
2,300,002	Nardone	Oct. 27, 1942
1,951,030	Nardone	Mar. 13, 1934
2,197,155	Nardone	Apr. 16, 1940
2,005,913	Coffman	June 25, 1935