Oct. 13, 1936. F. LINDER 2,057,386

ENGINE STARTING MECHANISM

Filed June 18, 1931 2 Sheets-Sheet 1

Fig. 1.

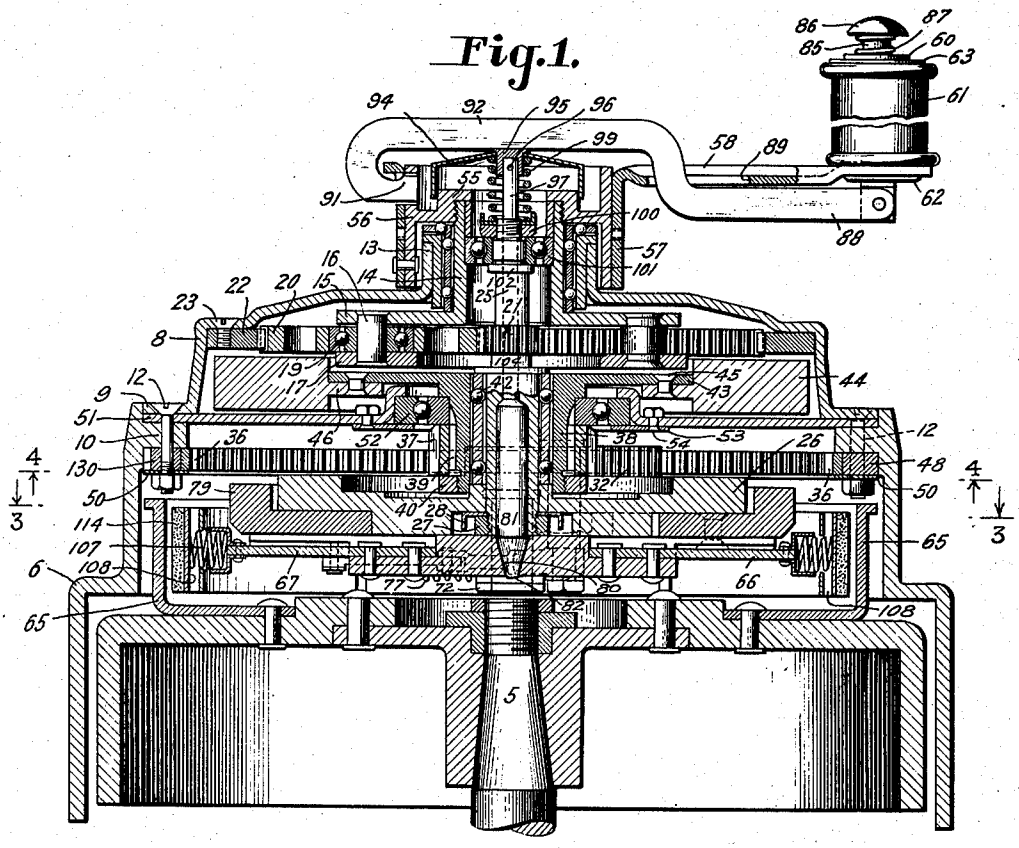

Fig. 2.

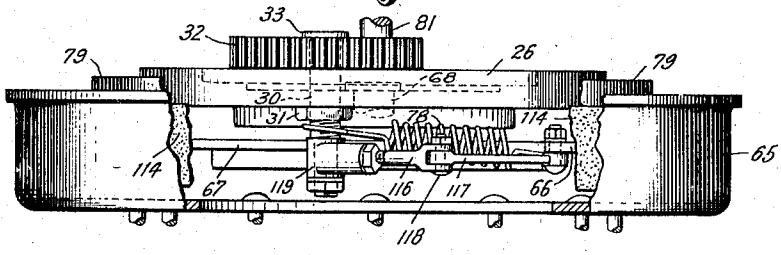

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Fig. 3.

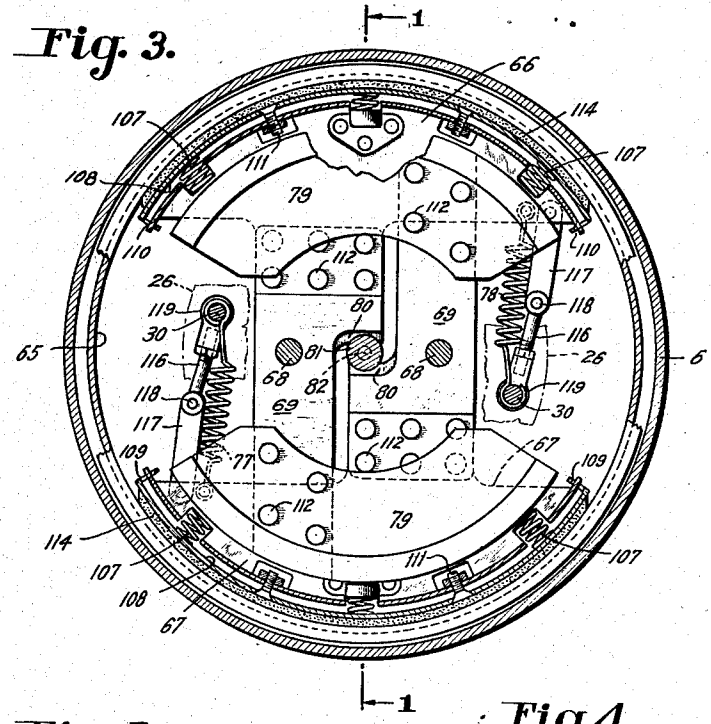


Fig. 5.

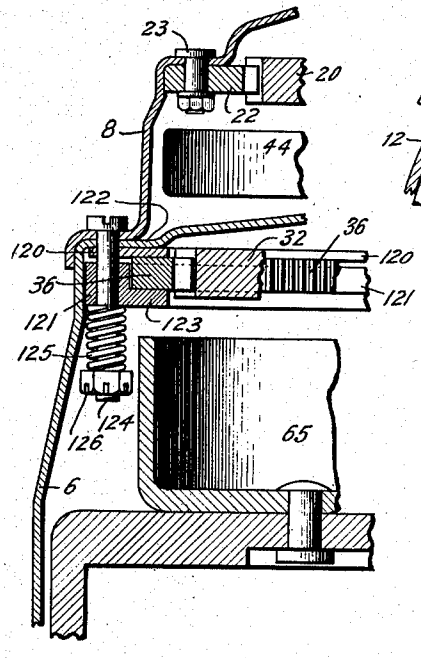


Fig. 4.

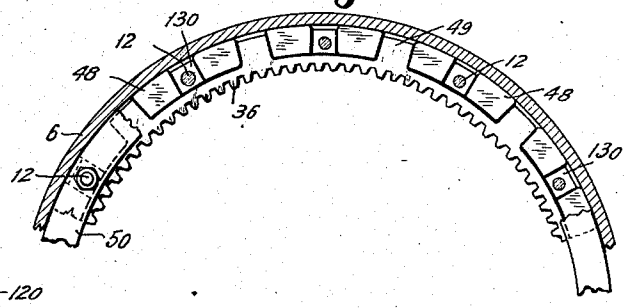


Fig. 6

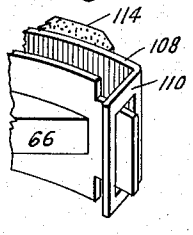
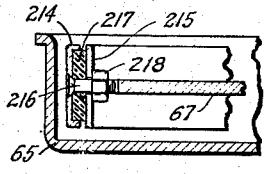


Fig. 7.



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UNITED STATES PATENT OFFICE

2,057,386

ENGINE STARTING MECHANISM

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Application June 18, 1931, Serial No. 545,316

10 Claims. (Cl. 192—76)

This invention relates to engine starting mechanism, and more particularly to a starter of the inertia type.

An object of the invention is to provide a novel engine starter of the type embodying an engine-engaging member which is radially movable into driving engagement with a member of the engine to be started, and which is drivably connected to a small high speed flywheel through reduction means which convert the high speed of the flywheel into a high torque applicable to rotate the engine member.

Another object of the invention is to provide an engine starter of the inertia type embodying novel means for transmitting a limited driving torque to a member of the engine to be started.

A further object of the invention is to provide a novel engine starter embodying radially movable members adapted to transmit a limited driving torque to a member of the engine to be started.

A further object of the invention is to provide a novel engine starter of the type adapted to transmit a driving torque in one direction only, said means including mechanism for releasing the driving connection between the starter and the engine on starting of the latter under its own power.

Another object of the invention is to provide in an inertia starter having a driven member movable into engagement with a member of the engine to be started, to transmit thereto a torque previously developed in the inertia member of the starter, novel means for limiting the torque capable of being transmitted from said inertia member to said driven member.

Another object of the invention is to provide novel torque transmitting means interposed between the inertia member and the engine-engaging member of a starter of the foregoing type, said torque transmitting means including gearing acting not only as a torque transmitting connection but also as a load limiting clutch adapted to yield to render such driving connection ineffective whenever the load exceeds a predetermined amount.

A further object of the invention is to provide a novel resilient driving connection between an engine starter and a member engageable by the driving member of the starter.

Another object of the invention is to provide resilient driving connections of the foregoing type in combination with novel means for controlling the resiliency of such driving connection.

A further object of the invention is to provide novel shock-absorbing and torque limiting means interposed between the gearing and the housing of an inertia starter.

These and other objects and advantages to be derived from the use of the invention will become apparent from inspection of the following specification when read with reference to the accompanying drawings, wherein is illustrated the preferred embodiment of the invention. It is to be expressly understood, however, that the drawings are for the purpose of illustration only, and are not designed as a definition of the limits of the invention, reference being had for this purpose to the accompanying drawings.

In the drawings,

Fig. 1 is a longitudinal section of a device embodying the invention, a portion of which is taken along the line 1—1 of Fig. 3 (but with the driving elements shown in non-engaging position);

Fig. 2 is a view in elevation including only a portion of the complete assembly shown in Fig. 1, the outer members of such portion being broken away to clarify the illustration;

Fig. 3 is a transverse sectional view along the line 3—3 of Fig. 1;

Fig. 4 is a fragmentary sectional view along the line 4—4 of Fig. 1;

Fig. 5 is a fragmentary view in longitudinal section showing a modification;

Fig. 6 is a detail of a portion of the driving elements; and,

Fig. 7 is a detail view of a modification of the structure shown in Fig. 6.

Referring to the drawings, and more particularly to Fig. 1, it will be seen that the engine to be started is provided with a rotatable member 5 which, if desired, may be integral with or secured to the crankshaft of the engine, or a member drivably associated therewith.

The invention is shown embodied in novel starting or cranking means associated with the rotatable member 5 for developing and transmitting the starting torque to said member whereby the engine may be cranked. As shown, such means includes a housing having a section 6 extending upwardly from around the engine member 5, said housing having an upper section 8 with an outwardly turned marginal flange 9 registering with section 6 and adapted to be supported on an inwardly turned flange 10 on the section 6, suitable means such as screws 12 being provided to rigidly secure the flange 9 of section 8 to the flange 10 of section 6. The upper portion of section 8 is preferably provided with a centrally disposed hub 13 having a central open-

ing through which extends the cylindrical hub 14 of a yoke or spider member 15 provided for a purpose presently to be described.

Suitable means are employed for storing up energy to be subsequently used at the will of the operator for rotating the engine member 5 and thereby starting the engine. As shown, such means is preferably constituted by an inertia member adapted to be rotated at high speed through suitable gearing drivably connected to a cranking member, the gearing being preferably divided into two or more stages. For this purpose, the spider 15 above referred to is provided with a plurality of supporting posts 16 extending downwardly to retain in place an annular member or ring 17 on which is rotatably supported, with the aid of ball bearings 19, a corresponding number of driving gears 20 adapted to mesh with a sun gear or pinion 21 and also with the teeth of an internal or annulus gear 22 which is secured to the housing section 8 by suitable means as indicated at 23. As shown, the gears 20, 21 and 22 constitute a planetary system of gears operating in response to rotation of member 14 to impart rotation at a multiplied speed to the inertia means to be described; the gear 21 being preferably integral with a centrally disposed shaft 25.

Appropriate means are provided for drivably connecting the shaft 25 with the second stage of the gearing which leads to the inertia member. As shown, such means preferably involves the provision at the lower end of shaft 25 of a recessed apertured plate or spider 26 rotatable in response to rotation of the sun gear 21 by the means above described. The spider 26 is referred to as a "driving member" in certain of the subjoined claims. The supporting means for spider 26 may be of any suitable form, but as shown, consists in the provision of a threaded reduced portion at the lower end of shaft 25 to which is secured a nut 27 adapted to hold in place, with the aid of locking washer 28, the aforesaid spider 26. Near the outer periphery of spider 26 are located a plurality of supporting posts or bolts 30 (see Figs. 2 and 3), having threaded lower ends for attachment of nuts 31, said bolts being adapted to rotatably receive a corresponding number of gears 32, the bolts being preferably enlarged, as indicated at 33, to form heads preferably resting on bearings (not shown), the latter being provided to facilitate rotation of said gears. The rotation of these gears about the posts 30 is preferably brought about by providing an internal gear 36 with which is associated shock absorbing means constituting one of the important features of the invention to be further described hereinafter.

The preferred means for imparting rotation to the inertia member at a greatly multiplied speed, in response to the rotation of the member 14, further includes a second sun gear or pinion 37 having teeth meshing with the teeth of the gears 32 and hence adapted to be rotated thereby; the gear 37 being rigidly secured to a member 38 by suitable means, which as illustrated, takes the form of splines 39, a retaining nut 40 being threaded to the lower end of member 38. Member 38 is, in turn, rotatable relatively to the driving shaft 25, the relative rotation between the two being facilitated by the provision of suitable bearing means as indicated at 42. The member 38 is also provided at its upper end with an outwardly turned flange 43 adapted to be secured to an inertia member 44 by suitable means which, in the form shown, comprises a plurality of studs or rivets 45 rigidly connecting the flange 43 with an inwardly extending annular flange 46 provided on the inertia member, or flywheel 44.

Novel means are provided for permitting limited angular movement of the internally toothed gear 36 relatively to the housing 6 so as to absorb shocks, particularly the shock incident to the initial driving engagement between the starter and engine, and otherwise steady the operation of the planetary gears 32 and the other parts involved in the cranking operation. As illustrated in Fig. 4, such means preferably comprises the provision of a plurality of cushioning members 48 composed of suitable elastic material and mounted in recesses formed between radial projections 49 on the gear 36 and blocks 130, secured to the housing by any suitable means which, if desired, may be bolts 12 above referred to.

The bolts 12 also serve to hold in place an annular disc 50, supporting gear 36, together with a transversely disposed plate or partition 51 which is adapted to support a ball bearing 52 representing any suitable means upon which the flywheel 44 and flanged member 38 may be rotatably mounted, the ball bearing member 52 being preferably adapted to rest at its outer edge on the supporting plate 53 rigidly fastened to the partition 51 by suitable means, as indicated at 54.

In place of the shock absorbing means just described, the invention contemplates the use of novel torque limiting means which incidentally possess the qualities above ascribed to the resilient members 48. Referring to Fig. 5, the novel torque limiting means is shown therein as interposed between the gear 36 and the housing and comprising a pair of annular discs 120 and 121, the former being interposed between the gear and the plate 122 in which the section of the housing terminates; the latter being spaced therefrom and having an inwardly directed rim 123 engageable with the under surface of the gear 36; the disc being adapted to exert a predetermined pressure on the gear by the provision of suitable means including, as illustrated, a plurality of angularly spaced bolts 124, each having associated therewith a coil compression spring 125, the stress of which is regulable by the adjustment shown at 126. With this construction it is apparent that on sudden excessive loads, as for example in the event of backfire of the engine being started or in the initial transmission of torque, the springs 125 will allow the gear 36 to slip on the discs 120 and 121, thereby protecting the gearing and other parts from severe strain and allowing the excess load to be dissipated in friction on the discs, which are of suitable material for the purpose. Normally, however, the pressure of the springs on the discs is such as to hold the gear 36 relatively stationary, thereby allowing transmission of starting torque to the engine through the connections hereafter described.

Any suitable means may be provided for rotating the hub 14 to store energy in the inertia member 44 through the speed multiplying mechanism above described. As illustrated in Fig. 1, such means preferably comprises the provision of a threaded upper portion on member 14 for engagement with an internally threaded member 55 having a transversely extending section which, at its outer edge, turns in both the upward and downward directions to form a sleeve 56, the downwardly extending portion having secured thereto a cylindrical encasing member 57 at the

upper edge of which, on one side thereof, there extends outwardly in a substantially horizontal direction, an arm 58 provided with an aperture through which passes a post 60 which, together with the surrounding sleeve 61, constitutes a handle by means of which rotation is imparted to the member 56 and the hub 14 threadedly secured thereto.

The post 60 may be secured to the outer end of crank-arm 58 by any suitable means as, for example, by being peened over at its lower end, as indicated at 62 in Fig. 1, and the sleeve 61 may likewise be secured in place by suitable means such as collar 63 fitting in a circumferential groove provided near the upper end of post 60.

Appropriate means are provided for operatively connecting the flywheel 44, after the desired amount of energy has been stored therein, to the engine member 5. Such novel means preferably comprises a cylindrical member or drum, such as that indicated at 65, rigidly secured to the flywheel 5, in combination with a plurality of elements such as those indicated at 66 and 67 (Figs. 1 and 3) having convex arcuate surfaces with which are associated friction bands 108 adapted to be moved radially into engagement with the drum 65 by operation of the engaging means to be described.

These radially movable elements 66 and 67 are adapted to rotate with the recessed plate or spider 26, which said elements are pivotally secured by suitable means as, for example, the transversely extending arms 69, provided with apertures for reception of bolts 68, the bolts being held in place by suitable means as, for example, the nuts 72 (Fig. 1) engaging the lower threaded ends thereof, the bolts 68 being preferably so located as to render the elements 66 and 67 self-energizing, that is, cause them to wrap themselves snugly against the inner surfaces of drum 65 upon radial movement from their normal positions shown in Fig. 1, assuming rotation in a clockwise direction as viewed in Fig. 3.

Suitable means are provided for maintaining the members 66 and 67 in non-engaging position with respect to the drum 65, notwithstanding the tendency of such elements to move outward radially in response to the centrifugal force resulting from rotation of these elements during the cranking operation. As shown, such means comprises first a plurality of resilient means so positioned as to oppose the centrifugal action and, secondly, the provision of suitable counter-balancing means also tending to oppose the centrifugal action. The resilient means preferably comprises a pair of springs 77 and 78 (Fig. 3), the former being fastened at one end of the element 67 and at its other end to the lower end of post 30, while the latter is fastened to the element 66 at one end and at the other end to the oppositely disposed post 30, the points of attachment being so located with respect to the pivots 68 on which the friction elements are suspended, and with respect to the axis of rotation of these elements, that they exert a resilient force in opposition to the centrifugal force resulting from rotation of the parts.

The novel counterbalancing means which acts in conjunction with the above described resilient means to oppose the centrifugal force created by rotation of the members 66 and 67, and maintain such elements in non-driving position during cranking operation, comprises preferably a pair of weighted arcuate members 79 rigidly secured, as by rivets 112, to the outer ends of the cross-arms 69. These counterweights are preferably positioned diametrically opposite to the arcuate driving elements 66 and 67 so as to have maximum counterbalancing effect, the elements 66 and 67 being preferably unsymmetrically located with respect to the cross-arms 69 (as shown in Fig. 3). This unsymmetrical mounting of the friction elements and counterweights 79 also has the advantage of permitting the arrangement of the cross-arms 69 in parallelism as indicated in Fig. 3. It will also be noted that the counterbalancing weights 79 are attached to the cross-arms 69 in such a manner as to permit superimposing the friction elements 66 and 67 thereupon, as indicated best in Fig. 3.

Novel means are provided to move elements 66 and 67 outwardly in a radial direction into frictional driving contact with the surface of drum 65, such novel means also permitting the continuance of the manual cranking action through the handcrank, if so desired. For this purpose the cross-arms are preferably provided with sloping shoulders, as indicated at 80, spaced apart sufficiently to permit their being engaged by the centrally and vertically disposed rod 81, the lower end 82 of which is of conical shape, the degree of taper being such as to correspond to the angle of slope of members 69 whereby, upon downward movement of the rod 81, a wedging action is produced which moves the cross-arms 69 away from each other, thereby moving the friction elements 66 and 67 into engagement with the drum 65.

Downward movement is imparted to the rod 81 by operation of novel engaging means associated with the handcrank 58 and preferably comprising a pin 85 having a knob or button 86 secured to its upper end, the pin and knob being normally held in the position indicated in Fig. 1 by suitable means such as spring 87 located in a recess formed in post 60. To the lower end of pin 85 is pivotally secured an arm 88 extending beneath the crank-arm 58 for a suitable distance and then turning upwardly through aperture 89 to pass over the upper portion of the starter casing and then turn downwardly and inwardly forming a hooked end 91 extending loosely into casing 57 and also into the upwardly extending portion of sleeve 56, as shown clearly in Fig. 1.

Cooperating with the central portion 92 of arm 88 is a cap 94 having a knob or other suitable striker member 95 centrally disposed thereon, the said knob 95 being preferably secured, as indicated at 96, to the upper end 97 of the rod 81, the rod and knob being normally urged upwardly by suitable means such as the spring 99 which thereby holds the rod normally in the position indicated in Fig. 1. The spring is provided with a seat 100 rotatable with shaft 25, the latter being supported on a bearing member 101 within which the shaft 25 revolves, the said bearing member being in turn supported on collar 102 formed on the upper end of shaft 25, the said shaft being provided with a second collar 104 resting on bearing 42 previously referred to.

The novel means for effecting a gradual resilient driving connection between the arcuate elements on the one hand, and the drum 65 on the other, whereby the driving connection may slip under excessive load, comprises a plurality of coiled springs 107 disposed at equal intervals about the arcuate surface of the driving shoes 66 and 67, suitable recesses being provided therein for the purpose. These springs operate to maintain a clearance between the outer rim of the members 66, 67 and the arcuate bands 108 which are hooked

to the rims of the former by suitable means, as indicated at 109 and 110, and held in spaced relation from said rims by the screw and nut connection indicated at 111, the degree of clearance being governed by the setting of these latter connections. The arcuate bands 108 are preferably provided with linings 114 of suitable friction material adapted to firmly engage the inner circumferential surface of the drum 65.

In conjunction with the above described resilient driving connections, the invention contemplates the provision of novel means for limiting and controlling the resilient action thereof. As shown, such controlling means comprises a plurality of (as shown two) toggle mechanisms, each of which comprises a pair of links 116 and 117 pivotally secured as indicated at 118, each link 117 being pivoted at its opposite end to one of the driving shoes, while the associated link 116 is threadedly secured in a thimble or eye-piece 119 rotatably mounted on the lower end of the post 30. Springs 77 and 78, above mentioned, are provided in proper position to buckle the toggle links from their positions indicated in Fig. 3, from which position the toggle links are operable in response to inward radial movement of the driving shoes.

Fig. 7 shows a modified construction which may be used in place of that shown in Fig. 6. In this modification, the friction bands 114 are replaced by metallic bands 214 secured to the rims 215 of the driving shoes 66 and 67 by suitable means such as bolts 216, buffer member 217 of elastic compressible material such as rubber being interposed between the engaging surfaces 214 and the shoes, the amount of resiliency of the assembly being adjustable by virtue of the provision of adjusting nuts 218.

In operation, when it is desired to start the engine, the crank 58 is rotated by means of handle 61, which preferably remains in place at all times, such rotation operating to store energy in the flywheel 44 through the speed multiplying means above described; the path of transmission being from the member 57 to the member 56, thence to the member 14, spider 15, and planetary gears 20 to the sun gear 21, thence through shaft 25 to the spider 26, and thence to the planetary gears 32, sun gear 37, and hub 43 to the flywheel 44.

When the flywheel has by the foregoing means been brought up to a sufficient speed to store the desired amount of energy for use in cranking the engine, the operator may press downwardly on button 86, thereby producing a downward pressure on knob 95 to compress spring 99 and move rod 81 downwardly to cause arms 69 to be swung about their pivots 68 and thereby produce a corresponding radial movement of the members 66 and 67, these elements moving radially against the resisting pressure of springs 107 and also against the tension of toggle springs 77 and 78, the ends of the shoes adjacent said springs being subjected to a somewhat greater radial movement than their opposite ends due to the swinging about the pivots 68 as above explained. Since the shoes 66 and 67 have a limited outward movement, the springs 107 are compressed only to a certain extent, and therefore only a limited pressure, or torque, is transferable to the drum 65 to rotate the latter and thus bring the engine up to a sufficient speed to produce starting thereof under its own power, the springs 107 being effective to ease the shock due to initial application of torque to the engine.

On the occurrence of such self-operation of the engine, the resulting suddenly increased speed imparted to the drum 65 by virtue of its connection with the engine flywheel 5, together with the withdrawal of the wedge 82 (which follows automatically upon release of the knob 86) allows springs 107 to return the shoes 66 and 67 to the non-operative positions, such action being assisted by toggle springs 77 and 78, which are at the same time effective to buckle the links 116 and 117 into a non-aligned position.

The operative connection between the starter elements and the drum 65 being thus released, the former come to rest, allowing the drum to rotate with the engine and without restraint from the starter elements.

There is thus provided a novel engine starter of the inertia type which is simple and rugged in structure, inexpensive to manufacture, and efficient in operation. It is especially adapted for use with small engines because of its compactness and light weight, but since it is a self-contained unit, it may be easily attached to any engine and requires no external supporting means, the whole unit in the embodiment shown being mounted within an extension of the engine housing and part of the mechanism being carried by a rotating member of the engine.

It is to be understood that various other changes may be made in the form, details of construction, arrangement of parts, and the uses to which they are applied, without departing from the spirit of the invention or the scope of the appended claims.

What is claimed is:

1. In an engine starting mechanism of the type employing an engine member and radially movable engine engaging friction elements, means for adjusting the frictional pressure of said elements on said engine member comprising a driving shoe associated with each of said friction elements and supporting the associated friction element in spaced relation therefrom, and means for varying the position of each friction element relatively to its supporting shoe, said means comprising a series of radially spaced members projecting inwardly from the convex arcuate surface of said friction elements, and means mounted on said driving shoes for threadedly engaging said inwardly projecting members.

2. In an engine starting mechanism of the type employing an engine member and radially movable engine engaging friction elements, means for adjusting the frictional pressure of said elements on said engine member comprising a driving shoe associated with each of said friction elements and supporting the associated friction element in spaced relation therefrom, means for varying the position of each friction element relatively to its supporting shoe, and resilient means interposed between said friction elements and driving shoes and yieldably maintaining the spaced relation therebetween, said resilient means comprising a plurality of coil springs disposed in radially spaced recesses in said driving shoe and engageable at their outer ends with the concave surface of said friction elements.

3. In a device of the class described, a driving member, a driven member, a plurality of radially movable friction elements interposed between said driving and driven members and movable radially into and out of engagement with said driven member, and toggle means for limiting the radial movement of said friction elements, said means comprising a pair of toggle links pivoted at one end to said friction elements, and means pivotally connecting the opposite ends

of said links to said driving member, said last named means comprising a pair of pivot members spaced apart from and disposed substantially midway between said friction elements.

4. In a device of the class described, a driving member, a driven member, a plurality of radially movable friction elements interposed between said driving and driven members and movable radially into and out of engagement with said driven member, and toggle means for limiting the radial movement of said friction elements, said means comprising a pair of toggle links pivoted at one end to said driving member and at the other end to said friction elements, and resilient means disposed substantially in parallelism with such toggle links for connection with said friction elements.

5. In a device of the class described, a driving member, a driven member, a plurality of radially movable friction elements interposed between said driving and driven members and movable radially into and out of engagement with said driven member, and toggle means for limiting the radial movement of said friction elements, said means comprising a pair of toggle links pivoted at one end to said driving member and at the other end to said friction elements, and resilient means for connection with said friction elements.

6. In a device of the class described, a driving member, a driven member, a plurality of radially movable friction elements interposed between said driving and driven members and movable radially into and out of engagement with said driven member, and toggle means for limiting the radial movement of said friction elements, said means comprising a pair of toggle links pivoted at one end to said driving member and at the other end to said friction elements, and resilient means for connection with said friction elements.

7. In a device of the class described, a driving member, a driven member, a plurality of radially movable friction elements interposed between said driving and driven members and movable radially into and out of engagement with said driven member, and toggle means for limiting the radial movement of said friction elements, said means comprising a pair of toggle links pivoted at one end to said driving member and at the other end to said friction elements, and resilient means disposed in parallelism with said links for connection with said friction elements.

8. In a device of the class described, a driving member, a driven member, a plurality of radially movable friction elements interposed between said driving and driven members and movable radially into and out of engagement with said driven member, and toggle means for limiting the radial movement of said friction elements, said means comprising a pair of toggle links pivoted at one end to said driving member and at the other end to said friction elements, and resilient means disposed in parallelism with said links for connection with said friction elements.

9. In an engine starting mechanism of the type employing radially movable driving members each having an inner section and an outer section, and each constituting a cranking member, the combination with said cranking members of means for maintaining said members in cranking position, and resilient means interposed between said inner and outer sections to oppose the action of said maintaining means.

10. In an engine starting mechanism of the type employing an engine member and radially movable engine engaging members, each having non-engaging and engaging sections, means for rotating said members, means for moving said engine engaging members into engine engaging position following operation of said rotating means, resilient means interposed between said engaging and non-engaging sections to act in a direction tending to release said members from the engine engaging position.

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