Sept. 19, 1933. R. M. NARDONE 1,927,714

ENGINE STARTER

Filed May 9, 1930 2 Sheets-Sheet 1

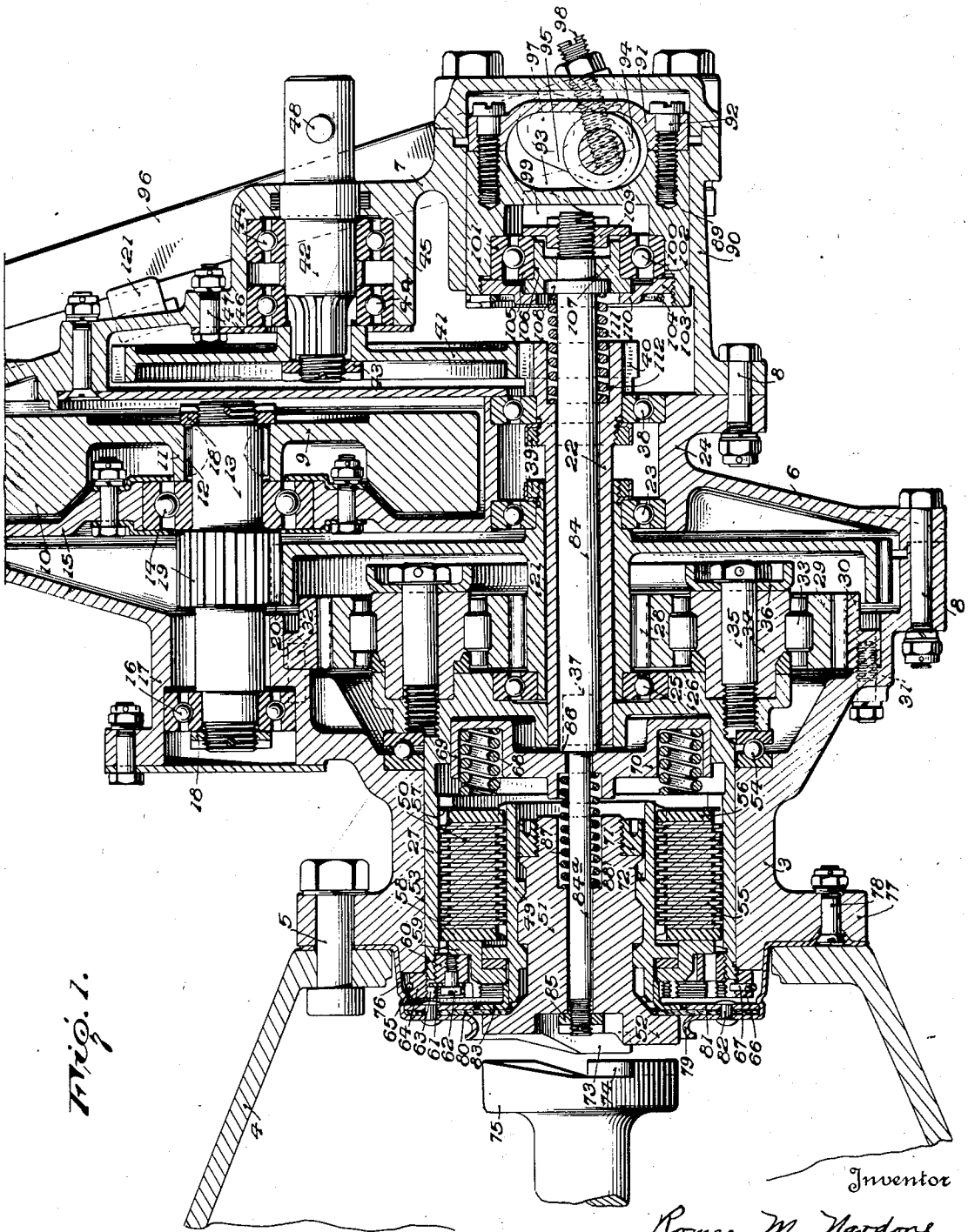


Fig. 1.

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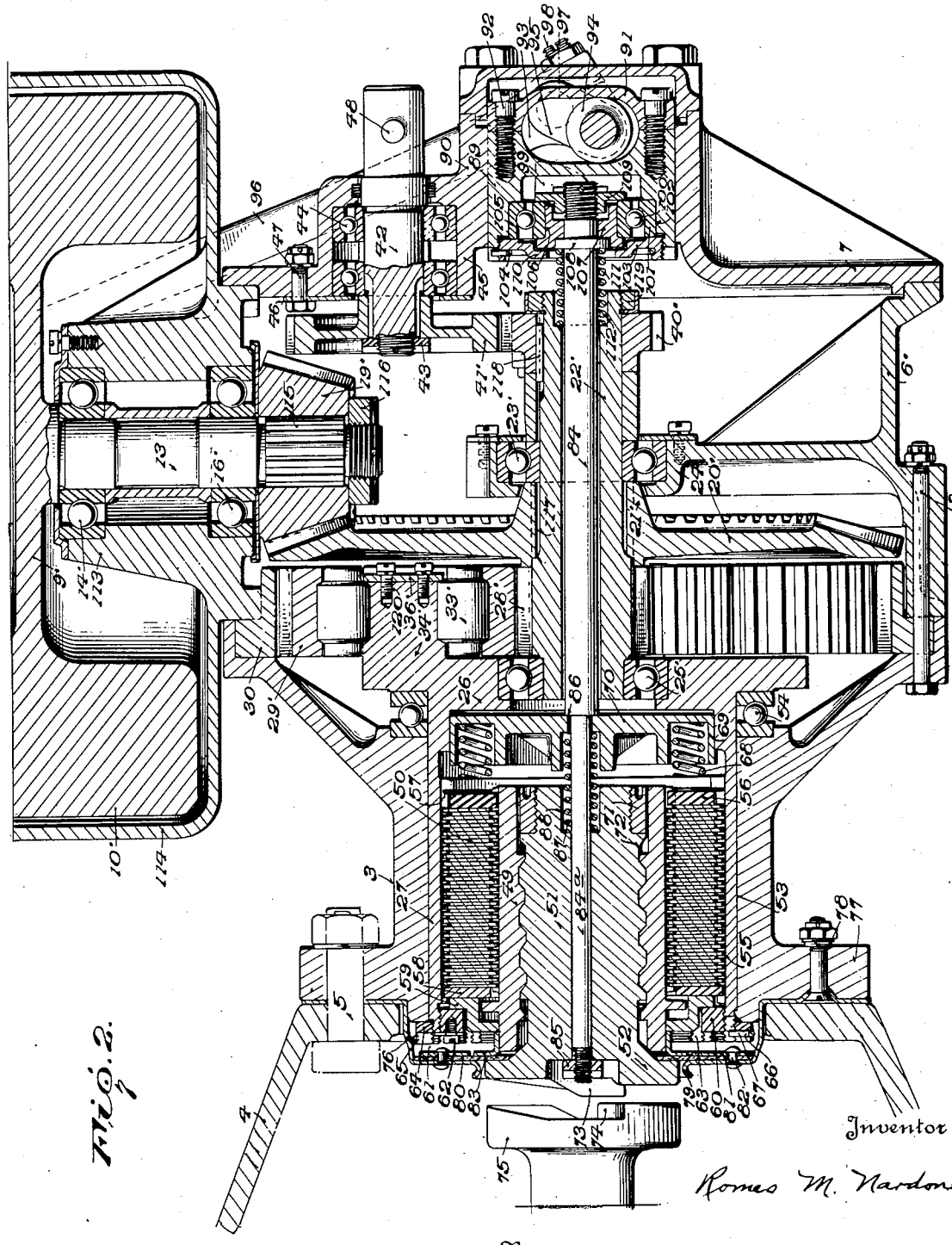


Fig. 2.

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1,927,714

ENGINE STARTER

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7 Claims. (Cl. 123—179)

This invention relates to engine starting apparatus and more particularly to starters for use with high compression and other large engines which present very heavy loads at the time of starting.

It has been previously proposed to employ mechanical starters of various types for starting internal combustion engines, and the results obtained therewith have been relatively satisfactory when used with engines operating on the Otto cycle, and employing comparatively low compression.

Such starters have commonly utilized a light inertia member, or flywheel, which is actuated by either manual or power means to a very high speed so as to store energy therein, the energy thus stored being then transmitted to a driving or engine-engaging member through a reduction gear train. The use of a yieldable driving connection, such as a friction clutch, between the flywheel and the driving member has also been suggested in order to protect the mechanism of the starter in case of overloads or backfiring of the engine being started.

In these starters the flywheel is usually very light in weight, and is rotated at very high speeds for example, 13,000 R. P. M., before the driving member is moved into cranking engagement with a rotatable member of the engine to be started. At this time, the driving member is rotating at a comparatively low speed, for example 100 R. P. M., depending upon the reduction ratio of the gear train, and full engagement with the engine member is easily effected, any reaction due to the suddenly added load being absorbed in the yieldable connection without injury to the teeth of the engaging members. The loads usually encountered, however, in starting internal combustion engines of the Otto cycle type are not excessive for this type of starter, and even large aircraft engines are readily started by these small starters without damage to the parts.

The starting of engines offering very heavy loads at the time of initial cranking, however, as for instance large Diesel engines or engines of the autocycle type, presents a different and more difficult problem. Not only is the load placed upon the starter much greater at the time of initial cranking engagement, but also more rapid cranking is usually required for starting than is the case in an engine of the Otto cycle type.

The maximum load which can be transmitted by the starter mechanism has a predetermined value, dependent upon the capacity of the clutch, and, even should the actual load exceed the predetermined maximum, the starter parts would suffer no injury provided the rapidly rotating driving member could be fully and completely meshed with the stationary engine member before transmission of the load begins. However, with a present clutch, it is practically impossible to obtain complete mesh before load transmission begins, and the result is that, if it is attempted to engage a rapidly rotating driving member with a rotatable member of a large engine to be started while the latter is at rest, only the ends of the teeth of the engaging members become meshed and there not being sufficient metal to take up the load, distortion or breaking of the teeth occurs.

It is therefore one of the objects of the present invention to provide a novel engine starter in which the driving member may be fully engaged with the rotatable member of the engine to be started without transmitting any load therebetween, and the full load may subsequently be gradually applied, the full faces of the engaged teeth taking the stress without distortion or breaking.

Another object is to provide an engine starter which is rugged and strong enough, and of sufficient capacity, to start a large, high compression engine in a dependable and efficient manner without requiring a structure of excessive size, weight, or cost of manufacture.

Another object is to provide an engine starter of the inertia type embodying a high speed flywheel of considerable mass, and novel means for transmitting the energy stored therein to an engine-engaging or driving member without subjecting the starter mechanism to excessive stresses.

Still another object is to provide an inertia starter embodying a novel form of clutch between the driving member and the inertia member whereby little or no torque is transmitted therebetween until after the driving member has been moved into cranking engagement with the engine to be started.

A further object is to provide a novel engine starter wherein the driving member may be moved into cranking engagement with the engine to be started at a time when the former is subject to little or no driving torque, the driving connection between said member and its source of energy being yieldingly effected after said movement has been completed, and by ac-

tuation of the same means as that causing the movement of the driving member.

These and other objects will appear more fully from a consideration of the detailed description of the invention which follows. Although only two embodiments of the present invention are described and illustrated in the accompanying drawings, it is to be expressly understood that these drawings are for the purpose of illustration only, and are not to be construed as a limitation of the scope of the invention, reference being had for this purpose to the appended claims.

In the drawings:

Fig. 1 is a longitudinal sectional view of one embodiment of the present invention; and

Fig. 2 is a similar view of another embodiment.

Referring now to the drawings, wherein like reference characters indicate like parts throughout the several views, there is disclosed therein an engine starter of the inertia type which is especially well adapted for use in starting high compression or other large engines, such as those of the Diesel or autocycle type, and which embodies novel means for transmitting the energy stored in a rapidly rotating flywheel to a driving or engine-engaging member which is adapted to be moved into cranking engagement with a rotatable member of the engine to be started.

In the preferred embodiment, illustrated in Fig. 1, the main or inner section 3 of the starter casing is removably secured to the crank casing or other suitable part 4 of the engine to be started in any desired manner as by bolts 5. The starter casing is made in sections in order to facilitate assembly and maintenance, and, in addition to the main or inner section 3 which houses and supports the major portion of the transmission and drive of the starter, comprises a middle section 6 wherein are formed the bearings for the inertia member and the central shaft of the transmission gear train, and an outer section 7 which supports the actuating means for the inertia member and the control end of the means for moving the driving member into cranking engagement. The various sections of the starter casing are detachably connected to one another by any suitable means such as bolts 8.

The source of driving energy in a starter of this type is a rotatable inertia member, or flywheel, which is adapted to be rotated at very high speeds, means being also provided to transmit the energy thus stored to the driving member. As shown, a flywheel 9 having a rim 10, wherein is concentrated a substantial amount of its mass, is provided with a hub 11 which is drivably secured in any suitable manner, as by keys 12, to a shaft 13 which is rotatably journaled in a ball bearing 14, supported by a transverse plate 15 formed integral with middle section 6 of the starter casing, and by a similar bearing 16 housed within a suitable inset boss 17 formed in inner section 3 of the starter casing. The entire assembly of flywheel 9, shaft 13, and ball bearings 14 and 16 is retained in proper operative position by a pair of slotted nuts 18, one of which is threaded onto each end of shaft 13.

Flywheel 9 may be actuated by any suitable means, either manually or power driven, but preferably utilizes a gear train which includes as a portion thereof the transmission gear train drivably connecting the flywheel with the driving member, and which is driven from a cranking shaft so disposed as to be readily accessible for manual or power cranking. As shown, flywheel shaft 13 is provided, intermediate its ends, with a plurality of gear teeth forming a pinion 19 which meshes with a large external gear 20 having an extended hub 21 freely surrounding a hollow shaft or sleeve 22 and rotatably supported at one extremity by a ball bearing 23 housed in a boss 24 formed in middle section 6 of the starter casing, and at the other end by a ball bearing 25 housed in an end plate 26 of the driving barrel 27 later to be described. Hub 21 is also provided, at its inner end adjacent bearing 25, with a set of gear teeth forming a pinion 28 constituting the sun gear for a plurality of planetary gears 29, the latter engaging at their outer peripheries with a stationary internal ring gear 30 which is secured to the interior of inner section 3 of the starter casing by screws 31 and provided with dowel pins 32 to take up the thrust placed on ring gear 30 and thus avoid shearing screws 31. Planetary gears 29, preferably four in number, are rotatably mounted as by rollers 33 on stub shafts 34 which are countersunk in and secured to end plate 26 as by screws 35, and are maintained in their proper positions thereon by an annular retaining ring 36.

In addition to the gearing just described which constitutes the transmission gear train between the flywheel and the driving member, the actuating gear train for the flywheel includes hollow shaft or sleeve 22 which passes centrally through the hub 21 of gear 20 and which is drivably secured at its inner end to end plate 26 as by a double-D 37, and rotatably supported adjacent its outer end by a ball bearing 38 housed in boss 24 similarly to bearing 23. Similar lock-nuts 39 are threaded onto hub 21 and shaft 22 adjacent bearings 23 and 38, respectively, in order to maintain these elements in their proper operative positions. Shaft 22 is also provided at its outer end with a set of gear teeth constituting a pinion 40 which meshes with a gear 41, the latter beinng splined to a short cranking shaft 42 and secured thereto as by a slotted nut 43.

Cranking shaft 42 is rotatably mounted, as by ball bearings 44, in a boss 45 formed interiorly of outer section 7 of the starter casing, the bearings being retained within the boss in any suitable manner, as by an annular retaining plate 46 secured to casing 7 by bolts 47. The outer end of cranking shaft 42 projects beyond the starter casing and is provided with a pair of diametrically opposite cranking pins 48 which are adapted to be engaged either by an ordinary hand crank, or by a portable electric cranking unit. If desired, cranking shaft 42 may also be provided with a permanent driving connection from an electric motor.

The drive transmission means, or drive proper, which receives energy from the flywheel through the transmission gear train just described and transfers it to the driving or engine-engaging member, preferably comprises the driving barrel 27, previously referred to, an interiorly threaded nut 49, a friction clutch 50 drivably connecting the barrel and nut, and an exteriorly threaded screw shaft 51 which is preferably formed integral with the driving or engine-engaging member 52.

Driving barrel 27 is substantially cylindrical in shape and is rotatably supported within a

cylindrical bore 53 formed in inner section 3 of the starter casing adjacent its point of connection with the engine casing 4. A thrust bearing 54 may also be provided between the end plate 26 of driving barrel 27 and inner casing 3 to avoid frictional contact at this point when the thrust of the clutch springs, later to be described, is transmitted to driving barrel 27. Interiorly threaded nut 49 is positioned centrally within driving barrel 27 and is adapted to be drivably connected therewith through friction clutch 50, the latter comprising a plurality of annular friction disks 55 alternately splined to the interior of driving barrel 27 and to the exterior of nut 49.

The friction disks 55 of clutch 50 normally exert no positive pressure against one another and are thus ineffective as a torque transmission device until, by means later to be described, a positive pressure is applied thereto. Means are provided, however, for retaining the friction disks in close relation to one another even when released, said means comprising an annular outer spacing ring 56, splined to nut 49, which limits the outward spread of said disks and which is prevented from outward movement itself by a retaining ring 57 which is splined to barrel 27 and engages the inwardly turned ends of the splines on the interior of said barrel, and by a similar inner spacing ring 58 splined to barrel 27 which is limited in its outward movement by an annular ring 59. The latter is of Z-shaped cross section and is held within the barrel by a ring nut 60 which is threaded into the interior of the inner end of the barrel and locked in any desired position as by a member 61 secured to nut 60 by a screw 62, the outer end of said member projecting within one of a plurality of longitudinal slots 63 formed in the end of barrel 27.

Longitudinal movement of the driving barrel 27 within the starter casing is prevented by means of a nut 64 which is threaded onto the exterior of the inner end of the driving barrel and abuts the face of inner section 3 of the starter casing, and which is locked thereon by a substantially circular spring 65 retained in a groove 66 in the surface of nut 64, one end of which projects through a radial hole 67 in said nut and engages one of slots 63 formed in the driving barrel.

Suitable means are provided for applying pressure to friction disks 55 of clutch 50 so as to make the clutch effective as a torque transmission device, comprising, in the form shown, a plurality of coil springs 68 circumferentially spaced around and adapted to exert their thrust against outer spacing ring 56 and thereby force the friction disks into contact with one another. Each spring 68 is housed within a recess 69 formed in a carrier member 70 which is normally maintained, by means later to be described, in such a position that springs 68 are out of contact with spacing ring 56 and thus exert no pressure on the friction clutch 50. Springs 68 are of sufficient stiffness to support themselves within recesses 69 but it will be understood that, if desired, any suitable means may be employed for maintaining these springs in their proper position.

Screw shaft 51 is threaded within nut 49 and normally occupies the retracted position shown in the drawings. The pitch of the threads of nut 49 and shaft 51 is so designed that when an axial pressure is applied to the screw shaft, longitudinal movement thereof will take place accompanied by a very slight rotation of said shaft. The outer end of screw shaft 51 is provided with a stop nut 71 which is adapted to abut a shoulder 72 formed on the interior of nut 49 and to thus limit the outward movement of screw shaft 51. Driving member 52, which is shown as being integral with screw shaft 51, is provided with jaw teeth 73 having inclined surfaces which are adapted to engage complementary teeth 74 formed on a jaw carried by a rotatable member 75 of the engine to be started. It will be understood that the shapes of teeth 73 and 74 are such that when the speed of rotation of the engine member 75 exceeds that of the driving member 52, the latter will tend to be moved longitudinally to the right, as viewed in the figures, out of engagement with the engine member.

Means are also provided whereby seepage of oil from the engine into the starter casing is prevented, which, in the form shown, comprise a light metallic member 76 secured to a flange 77 of inner section 3 of the starter casing as by bolts 78, and having a lip 79 which closely encircles the periphery of driving member 52. A flexible washer 80, of any suitable material such as leather, is fastened to the interior of member 76 by an annular reinforcing ring 81 and rivets 82. A ring 83, L-shaped in cross-section, rests upon the outer surface of interiorly threaded nut 49 and compresses washer 80 against the back of driving member 52 when the latter is in its fully retracted position, the parts thus cooperating to form an efficient oil seal between the interior of the engine casing and that of the starter.

Referring now to the means for moving the driving member into engagement with the engine member in order that the latter may be cranked by the application of energy previously stored in the rapidly rotating flywheel, suitable means have been provided, under the control of the operator, for effecting said cranking engagement and for drivably connecting the inertia member with the driving member. In the form shown, a main control rod 84 passes centrally and freely through hollow shaft 22 and has an inner reduced portion 84^a which passes centrally through screw shaft 51 and driving member 52, being provided at its inner extremity with a slotted nut 85 which positively limits the inward motion of driving member 52. Carrier member 70 is freely mounted on reduced portion 84^a of rod 84 between the outer end of screw shaft 51 and a shoulder 86 formed at the junction of reduced portion 84^a and the remainder of rod 84, and is normally maintained against said shoulder by a coil spring 87 surrounding portion 84^a and seated in a recess 88 formed in the inner end of screw shaft 51.

The inner end of control rod 84 may be provided with any suitable means for shifting said rod longitudinally so as to move the driving member into cranking engagement and to apply pressure to the disks 55 of clutch 50, said means comprising, in the present embodiment, a guide block 89 mounted within a boss 90 formed in outer section 7 of the starter casing and adapted for reciprocating movement therein, which movement is transferred to the rod 84 by a novel form of bearing later to be described. A cap 91 is secured to guide block 89 as by screws 92 and cooperates therewith to form a transverse elliptical slot 93 into which there projects a cam 94 carried on the short arm 95 of an operating

lever 96 which is suitably fulcrumed at any convenient point on the starter casing, as at 97. The effective length of travel of guide block 89 is limited by an adjustable stop screw 98 which is adapted to abut a projection 99 formed on rear section 7 of the starter casing, and thus prevent further throw of operating lever 96. The adjustment of screw 98, in limiting the travel of guide block 89, also determines the maximum pressure which can be applied to disks 55 of friction clutch 50, thereby limiting its torque transmission capacity.

The reciprocating movement of block 89, imparted thereto by actuation of operating lever 96 and the cooperation between cam 94 and slot 93, is transmitted to control rod 84 through a radial thrust bearing 100. The outer race 101 of said bearing is held within an annular groove 102 formed within block 89 by means of a nut 103 which is threaded into the interior of the inner end of block 89 and locked against rotation by a circular spring 104 similar to spring 65 previously described. The inner race 105 of bearing 100 is retained within an annular groove 106 formed in the periphery of a bearing retainer member 107, which is carried by rod 84 and abuts a shoulder 108 formed thereon, by means of a cooperating retaining plate 109 threaded onto the outer end of rod 84. Nut 103 is also provided with an inner lip 110 which projects over and is adapted to engage the inner face of bearing retaining member 107. A coil spring 111 surrounds control rod 84 adjacent its outer end and is seated in a recess 112 formed in the outer end of hollow shaft 22, and exerts its thrust against shoulder 108, thereby tending to maintain the rod in its outermost position.

A second embodiment of the invention is shown in Fig. 2, one of the distinctions being that in this second form the inertia member is mounted on a vertical rather than a horizontal axis, thereby producing a somewhat more compact structure. As shown, the flywheel 9' may be made integral with its shaft 13' which is rotatably mounted in a vertical position by means of bearings 14' and 16' in a boss 113 which is formed integrally with a flywheel casing 114, the latter being made integral with the middle section 6' of the starter casing.

The actuating gear train for flywheel 9' also differs from that disclosed in Fig. 1 principally by the exclusion therefrom of the planetary gears. In the form shown, shaft 13' is provided at its lower end with a bevel pinion 19' which is drivably secured to said shaft as by splines 115 and a slotted nut 116, and which meshes with a large bevel gear 20' having a hub 21' secured to hollow shaft 22', as by splines 117. Hollow shaft 22' is not secured to end plate 26 but is rotatably supported therein by ball bearing 25', and in a boss 24' formed in middle section 6 of the starter casing by a ball bearing 23'. Hollow shaft 22' is also provided at its outer end with a pinion 40' secured thereto as by a key 118 and nut 119 and engaging gear 41' which is secured to cranking shaft 42 as previously described, and at its inner end with a pinion 28' constituting the sun gear for planetary gears 29'.

Fig. 2 also discloses a slight different manner of mounting planetary gears 29', preferably three in number, in that end plate 26 of driving barrel 27 is provided with integral studs 34' on which the planetary gears 29' are rotatably mounted by means of rollers 33', the rollers and planetary gears being retained on studs 34' as by an annular retaining ring 36' secured to said studs by screws 120.

The operation of the structure disclosed in Fig. 1 is as follows: With the parts of the starter at rest and occupying the positions shown in the drawings, friction clutch 50 is released, driving member 52 is disengaged from the engine member 75, and operating lever 96 is retained in its inoperative position by a suitable detent 121. In order to start the engine it is first necessary that flywheel 9 (or 9') be rotated to a very high speed so as to store sufficient energy thereing for starting the engine when said energy is subsequently transferred to driving member 52. For this purpose, a hand crank, or other suitable cranking means, is applied to cranking shaft 42, and, through the step-up gear train comprising gear 41, pinion 40, shaft 22, barrel 27, planetary gears 29, pinion 28, gear 20 and pinion 19 (or gear 41', pinion 40', shaft 22', bevel gear 20', and pinion 19'), the flywheel is rotated.

During the time in which the flywheel is thus being actuated it will be understood that driving barrel 27 is also being rotated, and that due to the ordinary friction produced by mere contact between adjacent surfaces of the clutch disks 55 of friction clutch 50, interiorly threaded nut 49 and screw shaft 51 are also rotated, even though there is no positive pressure applied to the friction clutch 50. It is to be noted, however, that at this time friction clutch 50 is substantially incapable of transmitting any torque to nut 49 and screw shaft 51, and that their rotation is due solely to the fact that there is no load impressed thereon.

When the flywheel has been rotated sufficiently to insure that adequate energy has been stored therein for the starting operation, operating lever 96 is moved and, through the cooperation of cam 94 and block 89, moves control rod 84 to the left, against the force of spring 111. This movement of rod 84 imposes an axial pressure on the outer end of screw shaft 51 through spring 87 whereby the screw shaft and driving member 52 are moved to the left to engage the latter with engine member 75. Engagement of the driving and engine members is thus effected under substantially no-load conditions.

In addition to the engagement of the driving member with the engine member, this movement of control rod 84 also moves carrier member 70 to the left in order to bring springs 68 into operative position for imposing a pressure on the friction disks 55 of clutch 50. The normal, at rest position of springs 68, however, is such that they do not engage outer spacing ring 56 until control rod 84 has moved a sufficient distance to engage driving member 52 with engine member 75. After the driving member has been fully engaged with the engine member, further movement of operating lever 96 increases the pressure applied to friction clutch 50 until screw 98 abuts projection 99 and the predetermined maximum pressure is applied to the clutch.

If screw 98 were the only means of limiting the clutch capacity and should become unintentionally loosened, it would be possible to move operating lever 96 an amount such that a very large force would be applied to the clutch by springs 68 and the clutch capacity increased beyond the strength of the driving gears. To prevent this possibility, a positive stop or limit to the inward movement of carrier 70 and

springs 68 is provided by the contacting of carrier 70 with the outer end of nut 49.

When the engine starts under its own power, engine member 75 becomes the driving member and increases the speed of starter driving member 52 and screw shaft 51 over that of nut 49, and due to the threaded connection therebetween causes the screw shaft and driving member to be retracted to the right out of engagement with the engine member. The operator then moves operating lever 96 to the left which retracts control rod 84 to its original position, and allows spring 87 to force carrier member 70 inwardly, thus relieving the pressure on friction clutch 50, and rendering said clutch substantially incapable of transmitting torque either to or from the flywheel.

Should the engine backfire during the starting operation, clutch 50 will allow slippage between nut 49 and driving barrel 27, thus preventing injury to any of the positively driven parts of the starter mechanism.

There is thus disclosed by the present invention a heavy duty starter of the inertia type which is especially adapted for use with large, high compression engines, such as Diesels. A high speed flywheel of considerable weight has been combined with a novel transmission mechanism in such a manner that the energy stored in the flywheel may be applied to a rotatable member of an engine to be started, on which there is imposed a very heavy load, without danger of injury to any of the parts of the starter. This result is obtained by the provision of novel means for moving the driving member into cranking engagement, and for regulating the pressure applied to a friction clutch interposed in the drive transmission, whereby said engagement may be effected when the driving member is subject to little or no driving torque. By the use of this novel clutch, the driving member of the starter may be engaged with the engine member without any danger of injury to the teeth of the engaging jaws, and the energy stored in the flywheel may then be gradually transmitted to the starter driving member after the latter has become engaged with the engine member.

It will be obvious that the invention is not limited to the forms shown in the drawings, but is capable of a variety of mechanical embodiments. For example, any suitable arrangement of the flywheel and gear train may be substituted for those shown and described, and any suitable means may be employed for rotating the cranking means, either manual, mechanical, or electrical. Various other changes, which will now appear to those skilled in the art, may be made in the form, details of construction, and arrangement of the parts without departing from the spirit of the invention, and 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 an engine starter, the combination of a driving member, a flywheel, means for yieldingly connecting the flywheel to said driving member comprising a friction clutch having members normally released so as to be incapable of transmitting any substantial torque, resilient means for moving said members into clutching engagement, and means operable at the will of the operator for causing said resilient means to effect engagement of said clutch members.

2. In an engine starter, the combination of a driving member, a driving barrel, a flywheel, means for rotating said flywheel and storing energy therein, means including a gear train for drivably connecting the flywheel to said driving barrel, a friction clutch operatively connecting the barrel and driving member, said clutch comprising a plurality of clutch disks normally disengaged from one another, resilient means for applying engaging pressure to said disks, means for normally maintaining said resilient means ineffective to cause engagement of said clutch disks, and means operable at the will of the operator for causing said resilient means to apply said engaging pressure to the clutch disks.

3. In an engine starter, the combination of a driving member, a flywheel, means including a friction clutch for transmitting the energy thus stored from said flywheel to the driving member, said clutch comprising a plurality of disks normally disengaged from one another, resilient means for applying engaging pressure to said disks, additional resilient means for normally rendering said first mentioned resilient means ineffective, means for moving said driving member into cranking engagement with the engine member, and means carried by said last named means for causing said first mentioned resilient means to apply said engaging pressure to the clutch disks.

4. In an engine starter, the combination of a driving member, an inertia member, means for rotating said inertia member and storing energy therein, means including a friction clutch for drivably connecting the inertia member to said driving member and for transmitting the energy thus stored thereto, resilient means for normally rendering said clutch ineffective as a torque transmission agency, a manually operable member for moving said driving member into cranking engagement with the engine member, and additional resilient means movable by said manually operable member for applying engaging pressure to said friction clutch.

5. In an engine starter, the combination of a driving member, an inertia member adapted to be rotated at high speeds in order to store energy therein for subsequent transfer to the driving member, a yieldable driving connection interposed between the inertia member and said driving member, means normally rendering said connection ineffective as a torque transmission device, means for moving the driving member into cranking engagement with the engine member, and means effective upon said cranking engagement for causing said yieldable driving connection to become effective as a torque transmission device.

6. In an engine starter, the combination of a driving member, a flywheel, means for rotating said flywheel and storing energy therein for subsequent transmission to the driving member, means including a friction clutch for operatively connecting the flywheel to the driving member, said clutch comprising a plurality of clutch disks normally disengaged from one another, a plurality of springs for applying engaging pressure to said disks, a carrier for said springs, means for normally maintaining said carrier in retracted position so that said springs are ineffective to engage the clutch, manually operable means for moving said driving member into cranking engagement, and means effective upon said movement for advancing said carrier and causing said springs to apply engaging pressure to said clutch disks.

7. In an engine starter, the combination of a driving member, a flywheel, means including a friction clutch for drivably connecting the flywheel to the driving member, said clutch comprising a plurality of clutch disks normally disengaged from one another, resilient means for applying engaging pressure to said disks, common means for moving the driving member into cranking engagement and for causing said resilient means to apply engaging pressure to said clutch disks, and means for positively limiting the amount of pressure which can thus be applied.

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