Nov. 6, 1956 R. E. TAYLOR 2,769,437

STARTER GEAR MECHANISM

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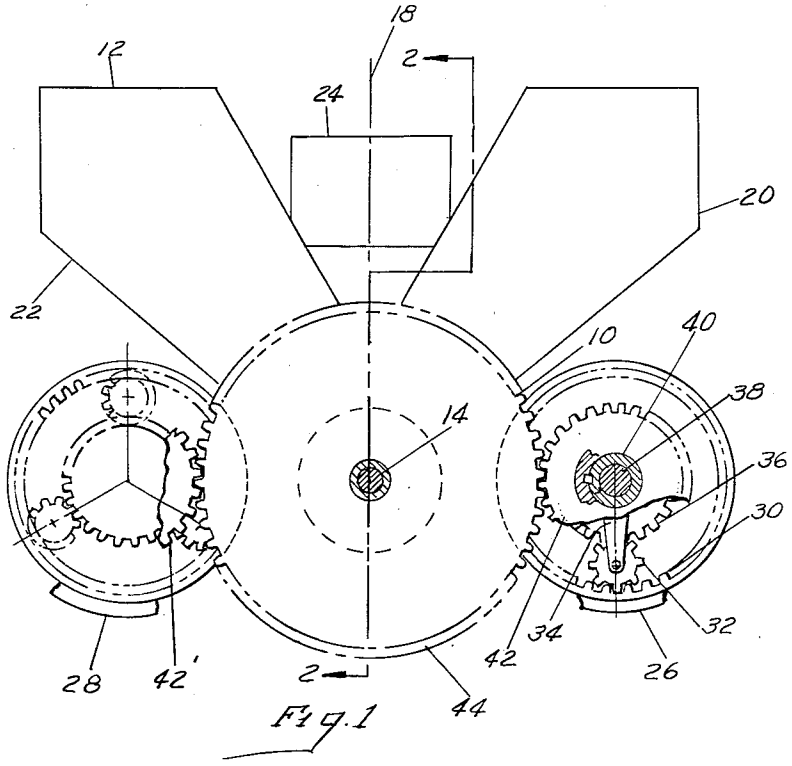


Fig. 1

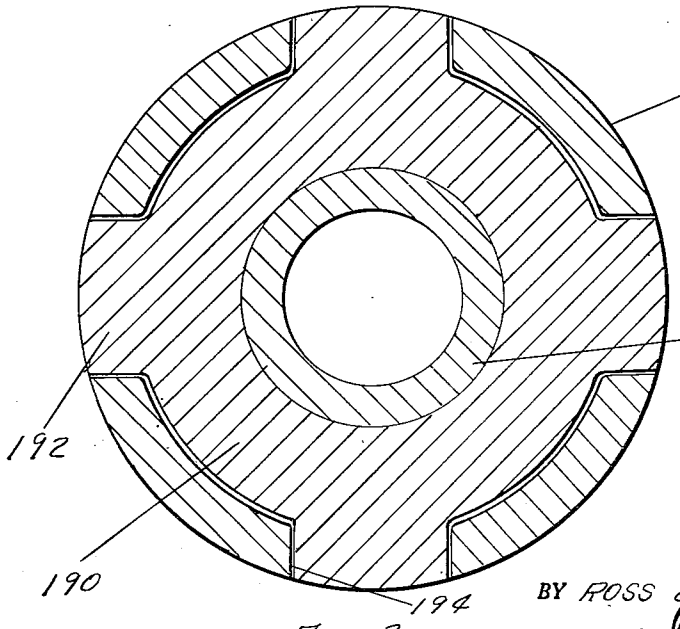


Fig. 3

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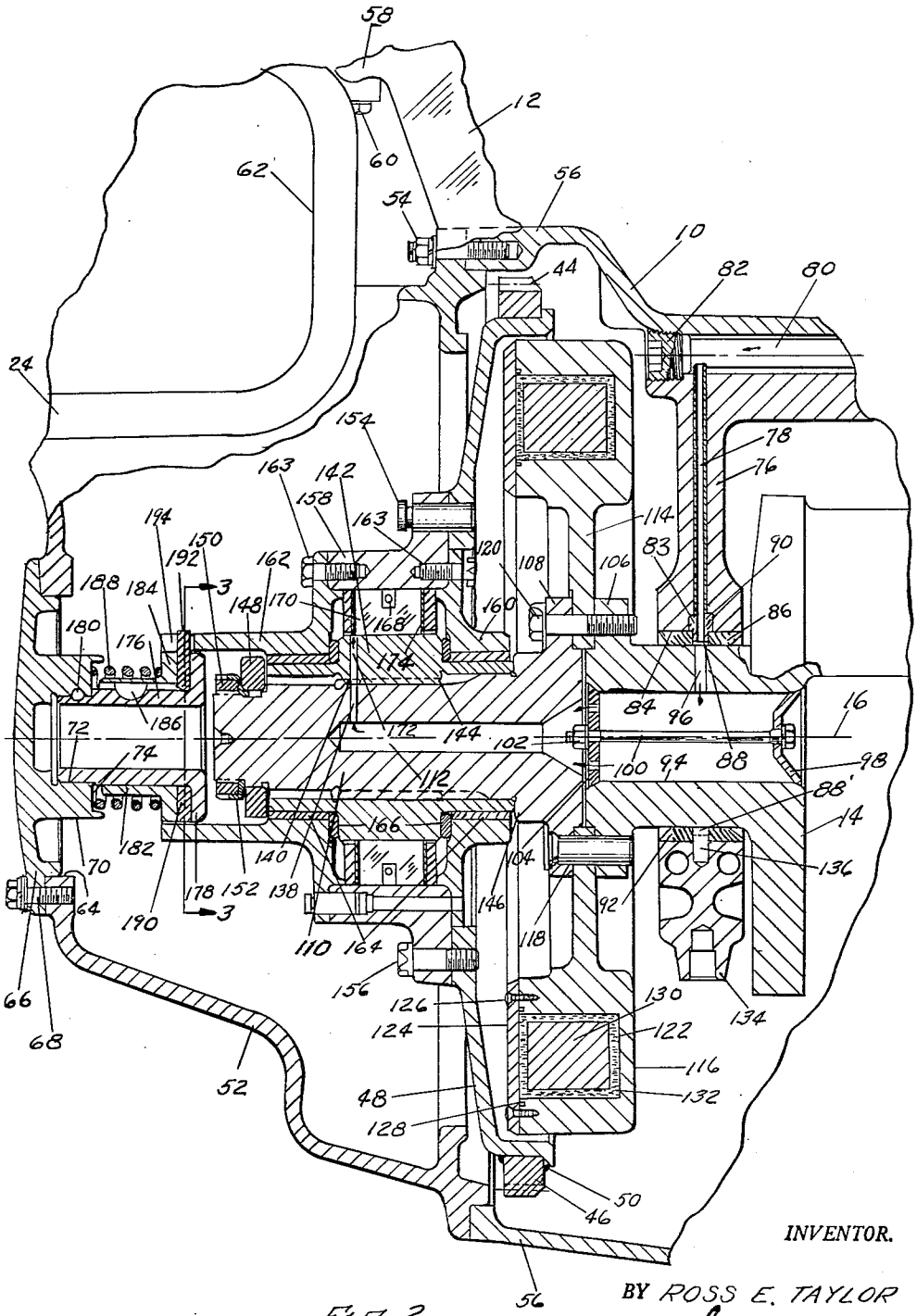
Wilson, Redrow, and Haines

HIS ATTORNEYS

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STARTER GEAR MECHANISM

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INVENTOR.

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Fig. 2

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United States Patent Office

2,769,437

Patented Nov. 6, 1956

2,769,437

STARTER GEAR MECHANISM

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Application September 1, 1954, Serial No. 453,658

15 Claims. (Cl. 123—179)

The present application relates to starter gear mechanism, particularly to an engine starter gear or combined starter gear and fly wheel structure arranged for coupling a plurality of starter motors in load sharing relationship to an engine to be started, and further arranged so as to be in continuous mesh with the starter motors, so as to be in continuous engagement with a lightly biased brake, and so as to be disengageably connected to the engine and rendered rotatably free of the latter when the engine is normally running.

Starter gears for self-started engines are customarily made fast to the main or crankshaft of the engine to be started, either directly so or else indirectly by being carried by various means such as an engine connected fly wheel, an engine connected fluid slip drive device, or else an engine connected vibration damper or the like. The orthodox motor driven starter gear is rotatable at all times conjointly with the engine crankshaft but is active in its primary capacity for self-starting of the engine only during the actual engine starting period when the energizable starter motor which is provided, temporarily engages the gear to crank over the engine. The referred to engine starter motor in its conventional form has an interruptable gear connection to its companion starter gear which is brought into mesh with the gear during the first few degrees of initial rotation of the motor upon being energized and which automatically withdraws from mesh after the starter motor is de-energized. The latter process of withdrawing from mesh occurs while both the starter motor and the gear are in motion but on the other hand the meshing process in conventional structure can occur only when the gear is stationary or nearly so; otherwise the proportional peripheral speed of the customarily large diametered gear becomes in fact too high for gear engagement to be effectuated properly, if at all. A potential point of difficulty in multi-starter units for engines as opposed to a single motor self-starter engines inheres in the very fact just noted in that the first starter or starters engaged may tend to bring the engine and the starter gear to an initial speed too great for a remaining sluggish starter motor or motors to catch up to the gear, thereby losing the advantage of a load sharing relationship among the individual motors and introducing the disadvantage of possibly overloading one or more of the individual active motors or motor.

It is an object of the presently disclosed invention to provide a multi-motor engine self-starter system wherein the above disadvantages are eliminated and the load sharing advantage is realized and wherein even the most sluggish or ill timed starter motor is given full chance to catch up to the normally functioning starters during engine cranking.

Another object of the invention is to provide a self-starter gear system for an engine having a plurality of starter motors as defined in the preceding object, wherein the plurality of starters is continuously individually meshed to a common starter gear and wherein the starter

gear is interruptably drivingly connected to the engine to be started.

A further object of the invention is to provide an interruptably connected starter gear system for an engine as defined in the preceding objects, in which the interruptably connected starter gear is combined with a fly wheel provided for the engine and in which the interruptable connection between the engine and the thus combined fly wheel and starter gear unit serves to isolate the rotatable inertia of the latter from the mass of the engine during engine running with the result of lowering the engine bearing loads and frictional drag therein and reducing the total effective mass of the rotating system thereby changing the period of the critical vibration frequency thereof to a shorter more desirable critical value. It is appreciated, of course, that relatively longer periods for the critical vibration frequency tend to conflict with and fall naturally within the engine operating ranges in particular engines.

Another object is to provide an interruptably connected starter gear system for a plural starter engine to be started as defined in the preceding paragraphs, in which a continuously acting brake is operative at all times to oppose motion of the gear or the gear in combination with the fly wheel as appropriate and to prevent unnecessary and unproductive rotation of the same and the starter motors continuously meshed therewith.

Another object of the invention is the provision of adjacent first and second bipartite engine members for use in conjunction with the starter train and crankshaft of an engine, the first member of which has loose and fixed parts whereof the fixed part is fast to an engine crankshaft and the second member of which has gear and flange parts fast to one another but disengageable as a unit with respect to the rotating engine crankshaft. According to a feature of the invention, the first and second members are concentric to one another and for the sake of compactness are disposed in substantially a common plane, the first member being a continuously active vibration damper and fly wheel constantly rotating and effective during crankshaft operation, and the second member being a starter ring gear or a combined ring gear and fly wheel which is only interruptably active and remains inactive during normal engine running conditions.

Further features, objects and advantages will either be specifically pointed out or become apparent when for a better understanding of the invention, reference is made to the following written description taken in conjunction with the accompanying drawings in which:

Figure 1 is a schematic end view in elevation of an engine and a starter mechanism therefor;

Figure 2 is a longitudinal section in elevation of the starter mechanism of Figure 1 along the section lines 2—2 thereof; and

Figure 3 is a transverse section of a detail of Figure 2 taken along the section lines 3—3 thereof.

In the drawings, the front or non-driving end 10 of an illustrative V–16 engine 12 is shown which has a multi-throw crankshaft 14 journaled for rotation about an axis 16 forming the principal longitudinal axis of the engine 12 and contained in the central vertical plane of the latter as indicated at 18. The V–16 engine 12 may be of diesel construction having the 16 cylinders divided into respective left and right banks 22 and 20 of eight cylinders each and defining an included angle totaling 60° in which a supercharger 24 is received and of which a 30° portion of the angle is disposed on the side of the central vertical plane 18 on which the left bank 20 is located and of which the equal remaining 30° portion of the angle is disposed on the side of the central ver-

tical plane 18 on which the right bank 22 of cylinders is disposed. Adjacent the front or non-driving end 10 of the engine 12 and at the sides thereof, a pair of left and right electric starting motors 26, 28 is disposed each of which drives a reduction gear set through an internally toothed ring gear 30. The electrically driven starter motors are interruptably energized in conventional fashion to drive these ring gears 30 simultaneously which mesh with a plurality of planetary pinions 32 preferably three in number which are carried by a planetary carrier 34 in each gear set. The planetary pinions 32 of each plurality mesh with a centrally located fixed sun gear 36 in the associated gear set which is secured fast to a stationary shaft 38 and about which the planetary pinions 32 orbit and accordingly set the carrier 34 in motion. The carrier 34 is made fast to a rotatable hollow shaft 40 concentric with and relatively rotatably journalled with respect to the stationary sun carrying shaft 38. Likewise fast to the shaft 40 for rotation conjointly with the carrier 34, a starter gear pinion 42 for the motor 26, for instance, is provided which meshes with a set of starter gear teeth 44 for the engine 12. A similar starter gear pinion 42' is provided for the gear set for the starter motor 28 which engages the set of starter gear teeth 44 at a separate location equally circumferentially spaced apart from and diametrically opposed to the point of tooth mesh engagement between the starter gear pinion 42 and the set of starter gear teeth 44.

Particularly as seen in Figure 2, the set of starter ring gear teeth 44 is mounted to an annular ring structure 46 which is closed on itself and welded to a fly wheel flange 48 around adjacent portions of their peripheries as at 50. The fly wheel flange 48 is mounted in a manner hereinafter described for rotation within a starter gear case 52 secured as by a plurality of studs and nuts 54 to a tapped and bored thickened attaching flange 56 provided at the mouth of the case of the front end 10 of the engine 12. The case of the engine 12 has another attaching flange 58 to which there is secured, as by means of a set of bolts 60, the attaching flange of the inlet 62 for the supercharger 24 previously considered. The starter gear case 52 has an opening 64 at its forward end over which a flanged cover 66 is attached as by means of a plurality of bolts 68 which pass through the peripheral flange of the cover 66 and into the margins of the opening 64. The cover 66 has a central tubular hub 70 extending inside the starter gear case 52 through the opening 64 which defines a cylindrical recess 72 having a transversely surfaced mouth 74.

The forward end portion 10 of the structure of the engine 12 incorporates a depending centrally hollow crankshaft bearing pedestal 76 integral with the case and containing a tube insert therein defining an oil conducting passage 78 for crankshaft bearing lubrication. The oil conducting passage 78 commuicates with a distributing passage 80 formed within the case of the engine and plugged adjacent its downstream end as by means of an end plug 82 which is threadably secured within one end of the passage 80. The depending bearing pedestal 76 adjacent its lower end has a shallow cylindrical socket 83 provided therein adjacent an upwardly concave semi-cylindrical surface 84 formed at the lower end of the pedestal. The semi-cylindrical surface 84 receives a main bearing shell 86 of babbitt or similar material having a circumferentially continuous inner annular groove 88 formed therein. A radial port or opening formed in the bearing shell 84 in the floor of the groove 88 confronts the shallow cylindrical socket 82 in the bearing pedestal 76 and mutually receives therewith a hollow bearing shell anchor or pin 90 which commuicates at one end with the oil passage 78 and which at the other end serves to key the bearing shell 86 rotatably fast to the semi-cylindrical surface 84 formed in the latter. The hollow pin 90 introduces oil from the passage 78 into the annular groove 88 which communicates with a similar annular groove 88' formed in a lower companion bearing cap shell 92. The annular grooves 88 and 88' are circumferentially continuous about an end journal of the crank shaft 14 and communicate with the hollow interior of the latter indicated at 94 through a short transverse passage 96 formed in the journal end of the crank shaft 14. The hollow interior 94 of the end journal of the crank shaft 14 is closed off by means of an oil tight disk or plug at 98 and has a plug retaining bolt 100 which engages the plug 98 and extends through the hollow interior 94 of the journal end under tension. The tension in the bolt 100 is maintained by means of a nut 102 seated on a perforated disk or plate 104 which allows oil to flow out of the hollow interior 94 of the crank shaft 14 and forwardly therefrom. The extremity of the end journal of crankshaft 14 is formed with a transversely disposed radial attaching flange 106 adjacent to which a confronting attaching flange 108 is provided and formed on a stub shaft 110 having an open ended cavity therein at 112 which receives lubricating oil from the perforated disk 104. The inner periphery of the web 114 of a combined damper and fly wheel 116 is clamped between and separates the two attaching flanges 106, 108 and a plurality of dowels as at 118 and bolts as at 120 secure together the inner periphery of the web 114 and the attaching flange 106, 108 for conjoint aligned rotation. The combined fly wheel and damper wheel 116 comprises a heavy fly wheel member which is fast to and integral with the web 114 and which defines an axially open sided annular socket 122 closed at its open side as by means of a cover 124 which is screwed to and sealed to the fly wheel member as at 126 and 128 respectively. An inertia wheel or inertia element 130 is loosely received within the thus enclosed cavity or socket 122 and together therewith defines gaps or included spaces as at 132 adapted to contain a body of liquid silica preparation known as silicone. The body of silicone functions in conventional fashion to form a viscous slip drive connection between the loose inertia wheel 130 and the fixed fly wheel member whereby the combined damper and fly wheel 116 effectively acts to dampen crankshaft torsional vibrations.

A main bearing cap 134 disposed adjacent the combined damper and fly wheel 116, is arranged to received therewithin the lower bearing shell 92 and is in turn secured to the depending main bearing pedestal 76 as by means of a plurality of bearing cap bolts, not shown. A lower shell anchor or locking pin as at 136 is received jointly within an opening or aperture in the floor of the lower bearing shell groove 88' and within a complementary socket formed in the bearing cap 134. The stub shaft 110 is provided with a radial oil passage 138 which communicates at its one inner end with the cavity 112 and which communicates at its opposite outer end with an annular groove 140 formed in an elongated sleeve 142 having an internally splined thick body portion between its opposite ends which is made fast to a set of external splines 144 formed in the periphery of the stub shaft 110. One of the just noted opposite ends of the sleeve 142 engages a transverse radial shoulder 146 formed on the stub shaft 110 and the remaining one of the opposite ends of the sleeve 142 engages a spacer ring 148 held axially fast to the stub 110 as by means of a retaining nut 150 and a radially tabbed lock washer 152 which are held in place on an appropriate threaded end portion of the stub shaft 110. The fly wheel flange 48 is secured as by means of a plurality of dowels at 154 and bolts as at 156 to a three part hub structure having a central relatively large diametered ring part 158 and a pair of opposite end bearing parts 160 and 162 bolted respectively at the rear and front thereof as by means of a plurality of bolts 163 and dowels as necessary.

Means is provided between the just named rear and front bearing parts 160, 162 of the hollow hub structure

and the sleeve 142 fast to the stub shaft 110 for mounting the hub structure and the stub shaft for anti-frictional relative rotation to one another.

Illustrative of one form of such anti-frictional means is a pair of radial sleeve bearings 164 and a pair of ring like thrust bearings 166, the latter of which are clamped between opposed shoulders on the rear and front bearing parts 160, 162 and the centrally splined thick body portion of the sleeve 142. The radial sleeve bearings 164 separate the opposite end portions of the sleeve 142 and the adjacent hollow interior portions of the rear and front hub parts 160, 162.

One way drive means between the centrally splined thick body portion of the sleeve 142 and the large diametered hub ring part 158 may be provided for transmitting drive from the set of starter gear teeth 44 ultimately to the stub shaft 110 and to the coaxially and conjointly rotating crankshaft 14 which is secured to the latter in rotatably fast relationship by means of the dowels and the bolts 118, 120.

Illustrative of one example of such one-way drive means is a sprag clutch comprising a garter spring retainer 168 surrounding a plurality of friction engaging sprag elements 170 providing a non-return drive between the inner cylindrical surface of the large diametered hub ring part 158 and the central outer cylindrical surface on the body portion of the centrally splined sleeve 142. The sleeve 142 is formed with a radial oil passage 172 formed in the thick body portion thereof communicating at its inner end with the annular oil distributing groove 140 and communicating at its outer end with the sprag elements 170. The ends of the respective sprag elements 170 engage a pair of annular thrust rings 174 resting against a pair of opposing shoulders formed on the respective hub bearing parts 160, 162.

Friction braking means effective to stop the rotation of the hub structure and the starting gear teeth 44 whenever the one-way clutch 170 is disengaged may be provided between hub front bearing part 162 and the tubular hub 70 of the starter case cover 66.

Illustrative of one example of the hub braking means is a continuously active friction brake having an inner sleeve 176 which is transversely flanged at 178 at one end and which is received in the cylindrical recess 72 at its opposite end and keyed rotatably and axially fast to the tubular hub 70 in which the recess 72 is formed by means of a straight locking pin 180. A concentric outer sleeve 182 included in the brake having an end flange 184 surrounds the inner sleeve 176 and is slidably related therewith but rendered rotatably fast thereto by means of a flat semicircular key 186 secured to the latter and extending into an axially milled key way in the interior of the outer sleeve 182. An elastically compressed coil spring 188 seats at one end against the transversely surfaced mouth 74 of the cylindrical recess 72 and thrusts at its opposite end against the outer sleeve flange 184 which confronts the inner sleeve flange 178 in closely spaced adjacency imposed by the spring 188. Disposed between and separating the confronting flanges 178, 184, a disk 190 is provided which is clamped therebetween such that its opposite faces rotatably frictionally engage the respective flanges 178, 184. At its periphery the disk 109 has a plurality of radiating fingers 192, four in number for example, each of which is received within and floats with slight axial movement with respect to an individual axially extending slot 194 which is formed in the end of the adjacent front hub bearing part 162. The disk 190 in effect thereby floats in frictional engagement between the relatively stationary confronting flanges 184, 178 when the hub structure rotates and is axially slidable to a slight degree in the axial slots 194 to seek a centered balanced position.

Lubrication of the sprag elements 170 is accomplished due to the flow of oil through the path respectively defined by the series connected axial distributing passage 80 in the case, the tube defined pedestal passage 78, the hollow pin 90, the radially extending passage 96 in the crankshaft 14 and the hollow interior 94 of the end journal of the latter, the perforations in the perforated plate 104, the socket 112 in the stub shaft 110 and the radial passage 138 therein, and the annular groove 140 in the sleeve 142 and the radial passage 172 therein. The annular sprag rings 174, the ring-like thrust bearings 166, and the radial sleeve bearings 164 are similarly lubricated from the flow of oil supplied to the sprag friction elements 170.

In one physically constructed embodiment of the invention the sprag elements 170 were made of steel as were respectively the sleeve 142, the large diametered hub ring structure 158, the inner and outer flanged brake sleeves 176, 182, and their corresponding transverse end flanges 178, 184, whereas the rotatable floating brake disk 192 was made of bronze.

The following is given as an example of the numbers, rates, and ratios of the elements below identified.

Number of sprag elements 170: 18 elements.

Rate of coil spring 188: 80 lbs. per inch.

Total effective thrust of the coil spring 188: 120 lbs.

Number of teeth in each of the starter pinions 42, 42'; 14 teeth.

Number of teeth 44 in ring gear 46: 117 teeth.

Gear reduction ratio between pinions and ring gear: 8.35:1.

Gear reduction ratio in planetary gear set, 30, 32, 36: 1.57:1.

Starter motor to engine, overall gear ratio: 13.1:1.

In the operation of the self-starter mechanism for the engine 12 of Figures 1, 2 and 3, the starter motors 26, 28 are simultaneously electrically energized for rotation in the same direction so as to drive the set of ring gear teeth 44 in a common direction of rotation at the overall reduction gear ratio of 13.1:1. The rotative motion of the set of starter gear teeth 44 and of the fly wheel flange 48 is transmitted to the one-way sprag clutch elements 170 which frictionally wedge against and inwardly engage the sleeve 142 splined to the stub shaft 110 and thereby cause the crank shaft 14 to be cranked over at the same speed as the starter gear teeth 44 and at a proportionate speed to the speed of the oppositely rotating motors 26, 28. The bronze floating brake disk 190 is dragged rotatably along with the front hub bearing part 162 against the continued opposition of the confronting friction brake flanges 184, 178 continuously engaged with the latter under the biasing force of the coil thrust spring 188. When the engine crankshaft 14 becomes self-sustaining in its operation due to the engine 12 running under its own power, the sleeve 142 over speeds or over runs the set of sprag elements 170 which disengage and whose clutching effect is discontinued. Re-engagement of the sprag elements 170 does not occur until the circumstances are such that large diametered hub ring 158 is rotated in a positive direction with respect to the sleeve 142 which in such circumstances may be static, reversely rotated, or rotated at a positive but lesser speed than the speed of the hub ring 158. Subsequent de-energization of the starter motors 26, 28 causes the starter motor driving force to be removed from the starter teeth 44 and the frictionally dragging brake disk plate 190 causes the hub structure, the set of ring gear teeth 44, and the starting motors 26, 28, to be brought to a frictionally produced stop. The crankshaft 14 while it continues to run is thereafter free of the rotational inertia of the starter ring teeth 44 and the fly wheel 48 and its resulting period of vibration frequency is considerably lessened or shortened as compared to what the period would be in the equivalent system but which continuously included the fly wheel flange 48 and the starter ring 46 among the mass of rotating crankshaft system. The loosely mounted annulus or inertia ring 130 in the silicone filled chamber 122 within the combined damper and fly wheel 110 is effective

to eliminate critical frequencies of vibration having relatively shorter periods which would otherwise tend to manifest themselves in torsional vibration of the rotating crankshaft mass. The starting motor pinions **42**, **42'** offer the convenience of being continually meshed with the set of starter gear teeth **44** inasmuch as the starter gear teeth **44** rotate only during the transient starting period for the engine **12** and are otherwise not subjected to drag and wear.

As herein disclosed, the starter gear mechanism is shown to incorporate two electric starter motors which are equally circumferentially spaced apart with respect to one another on diametrically opposite sides of the starter gear. It is evident that a different number than two motors may be employed and if instead of the possible choice of a single motor, a group of motors greater than two in number is employed, the resulting motors can be equally or unequally circumferentially spaced apart with respect to one another about the gear. So also the drawing shows a rotating friction brake plate of bronze cooperating with a spaced apart pair of non-rotating confronting brake flanges which drag thereagainst, but a self-evident reversal of parts immediately suggests itself whereby the friction brake plate is made the stationary part and the confronting friction surfaces separated thereby are rendered rotatable and tend to be dragged upon and braked by means of the newly made stationary plate part. The hub bearing front part **162** is shown to be axially slotted for interdentally receiving the radiating fingers **192** of the rotating bronze brake plate **190** connected fast thereto, but self-evidently a set of splines or equivalent rotatably fast but axially free connection means may be equally well employed between the part **162** and the brake plate **192**.

Variations within the spirit and scope of the invention disclosed are equally comprehended by the foregoing description.

What is claimed is:

1. In combination, a starter ring gear, an engine crankshaft to be started in motion thereby and concentric therewith, and one-way means for drivingly connecting the crankshaft for rotation in one direction conjointly with the starter ring gear at all speeds of the latter tending to exceed the speed of the crankshaft comprising friction engaging elements carried by a portion of the ring gear engageable to couple together the starter ring gear and the crankshaft in non-return drive.

2. In a starter mechanism, a starter ring gear rotatably mounted to cooperate with a stationary structure and connectable to an engine to be started thereby, a plurality of power driven means continuously separately meshed with the ring gear structure in load sharing relationship, and continuously energized brake means dragging against the stationary structure to oppose any motion of the ring gear produced by the plurality of power driven means.

3. Starter mechanism for an engine having a main power shaft, comprising a starter connected gear mounted for rotation with respect to the shaft, brake means continuously effective to apply a drag against the gear tending to hold the same against rotation, and one way clutch means between the gear and the shaft effective to drive the latter in non-return drive when the gear is set in motion in spite of the brake means at any speed tending to exceed that of the shaft.

4. In combination, an element to be driven, a gear mounted for relative rotation with respect thereto, non-return drive means between the gear and the driven element comprising first friction engaging surfaces which when engaged in one way force the driven element into conjoint rotation with the gear at any positive speed up to the speed of the latter and which disengage when the driven element overspeeds the gear, rotation resisting means including second friction engaging surfaces continuously effective to resist rotation of the gear during disengagement of the first friction engaging surfaces and otherwise, and a plurality of load sharing starting motors circumferentially spaced apart about the gear having individual continuously meshed connections thereto and energizable to drive the driven element through the first friction engaging surfaces and the gear against the continued resistance of the second friction engaging surfaces.

5. In combination, an element to be driven, a gear mounted for relative rotation with respect thereto, non-return drive means between the gear and the driven element comprising first friction engaging surfaces interruptably engageable in one way drive to force the driven element into conjoint rotation with the gear at any positive speed of the latter up to the actual speed thereof, rotation resisting means including second friction engaging surfaces continuously effective to resist rotation of the gear, a plurality of starting gear pinions circumferentially spaced apart about the gear individually continuously meshed thereto, a like number of starting motors associated therewith, and individual continuously meshed gear trains between and connected to each pinion and its associated starting motor for driving the gear against the continued resistance of the second friction engaging surfaces to engage the first friction engaging surfaces and force the driven element into positive conjoint rotation with the gear.

6. In a device of the character described, an element to be driven, a gear mounted for relative rotation with respect thereto, non-return drive means between the gear and the driven element comprising friction engaging surfaces interruptably engageable in one way drive to force the driven element into conjoint rotation with the gear at any positive gear speed tending to exceed the speed of the driven element, rotation resisting means including two friction engaging surfaces continuously engaged to resist rotation of the gear, and power driving means for the gear energizable to drive the two interruptable friction engaging surfaces and the driven element therefrom against the continued resistant of the continuously engaged two friction engaging surfaces aforesaid.

7. In a starting gear train for an engine connected shaft means having concentric starter gear and inertia wheels associated therewith through which the shaft means at least part way extends, said wheels having means affixed to portions thereof for attachment fast to the shaft means in the case of the inertia wheel and for journaled relative rotation to the latter in the case of the starter gear wheel, the combination of friction engaging elements adjacent the wheels normally engageable to couple the same together in one-way drive, but being otherwise disengaged, and friction engaging elements remote to the wheels and continuously engaged to commence to set the starter gear wheel at rest immediately upon the normally engageable friction elements become disengaged.

8. In a starting gear train including concentric starter gear and inertia wheels, said starter gear wheel having hollow gear hub structure affixed to a portion thereof and rotating therewith, the combination therewith of rotatable shaft means fast to the inertia wheel and extending at least part way into the gear hub structure and carrying one way friction engaging elements engageable to couple the wheels together in ony way drive, and means including friction engaging elements extending at least part way into the gear hub structure and continuously engaged to resist any motion of rotation of the starter gear wheel.

9. In a starting gear train, the combination of engine connected shaft means, substantially coplanar inner and outer wheels axially aligned therewith, said inner wheel being fast to the shaft means and said outer wheel being mounted for relative rotation with respect thereto, friction engaging elements adjacent the plane of the wheels normally engageable to couple the same together in one way drive, but being otherwise disengaged, and friction engaging elements remote to the plane of the wheels and continuously engaged to resist any motion of rotation of one of the wheels for slowing and setting the same at rest

immediately upon disengagement of said normally engageable elements.

10. In a starting gear train, the combination of engine shaft means, substantially coplanar wheels of differing diameters disposed in axial alignment with the engine shaft means, one of said wheels having means affixed to a portion thereof for attachment fast to the shaft means, and the other of said wheels being mounted for relative rotation with respect to the shaft means, and sets of friction engaging surfaces disposed at different distances from the plane of the wheels, one effective to couple the wheels together in one-way drive but otherwise being disengaged and the other continuously engaged and immediately effective to retard motion of rotation of the larger diametered wheel whenever the one-way drive surfaces are disengaged in the aforesaid manner.

11. Engine and starter mechanism comprising an engine having a shaft, a starter connected gear mounted for relative rotation with respect thereto, one-way clutch means disengageably positioned between the gear and the shaft but effective to engage and drive the latter in non-return drive when the gear is set in motion at a speed above that of the shaft, and spring loaded means continuously biased to apply a drag against the gear tending to hold the same static and effective to retard the motion of the same immediately upon the one-way clutch means becomes disengaged.

12. Starter mechanism comprising an engine connected shaft, a starter connected gear having hollow hub structure therefor containing bearings for mounting the same for relative rotation with respect to and above the shaft means, between the gear hub and the shaft operable to drive the latter when the gear is set in motion, and brake means continuously effective to apply a drag against the gear tending to hold the same static, comprising a pair of rotatably stationary confronting flanges within the hollow hub structure continuously biased toward one another, and a floating friction plate separating the flanges and having radiating fingers received in axial slots in the hub structure for rotating therewith.

13. Geared starter mechanism including starter gear and shafting elements, mounted for independent rotation adjacent a stationary starter member, first friction engaging parts effective to drag and tending to hold the starter gear element rotatably fast to the stationary starter member, and a friction engaging part connected to each of the two-said relatively rotatable elements and mutually engageable to overcome the drag of the first friction engaging parts and drive one such element from the other.

14. The combination with a starter train having stationary and rotatable elements therein, a shaft having a part extending into the starter train and being relatively rotatable in adjacency to a part of the rotatable starter element, means including a clutch portion connected to each of the just said adjacent starter and shaft parts effective to couple together the rotatable starter element and the shaft in one-way drive, and a brake portion connected to each of the aforesaid stationary and rotatable starter train elements and engageable to resist the rotation of the latter.

15. The combination with a starter mechanism having stationary and rotatable elements therein, a shaft having a part extending into the starter mechanism and being conjointly rotatable with the rotatable starter element, and a brake portion connected to each of the aforesaid stationary and rotatable starter train elements and engageable to resist the rotation of the latter, the portion of the brake connected to one of the just said elements comprising confronting friction engaging surfaces continuously biased toward one another and the portion connected to the other of the starter train elements being clamped between and separating the continuously biased together friction engaging surfaces aforesaid.

References Cited in the file of this patent

UNITED STATES PATENTS

2,593,933	Strawn	Apr. 22, 1952

FOREIGN PATENTS

23,355	Great Britain	of 1911