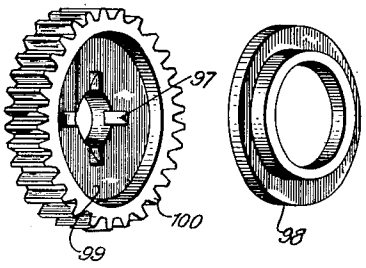
June 12, 1934. F. LINDER 1,962,962

STARTING MECHANISM

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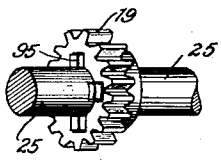


Fig. 3

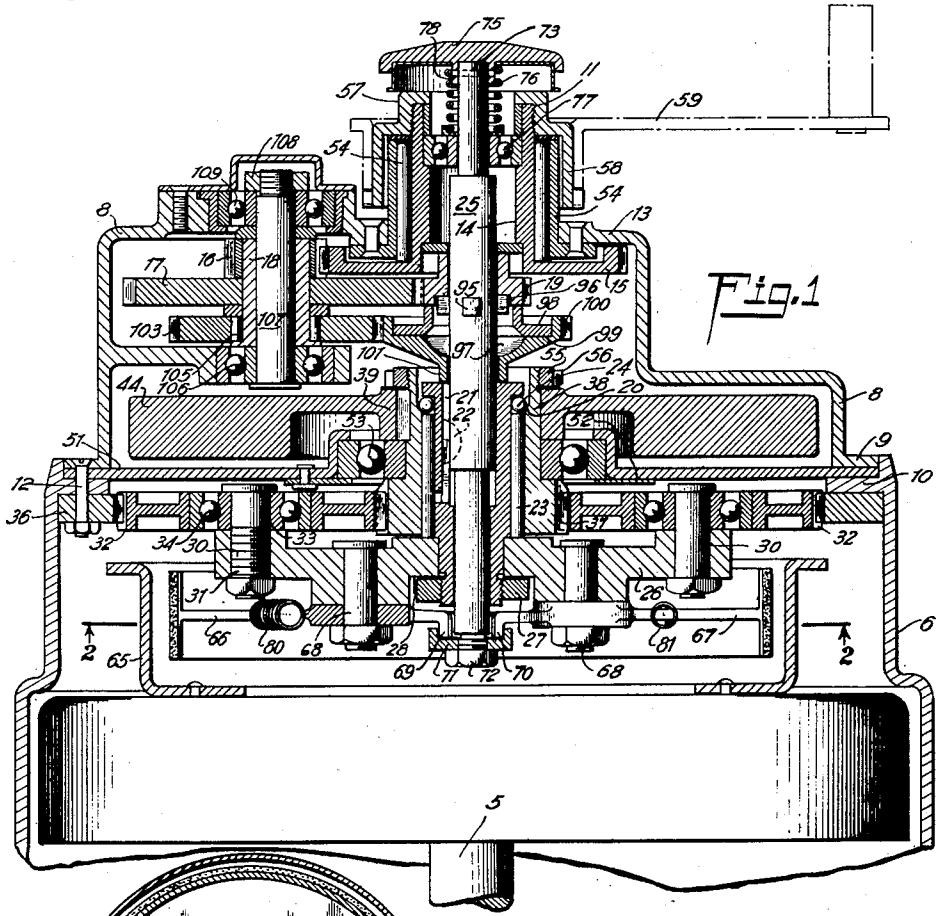


Fig. 1

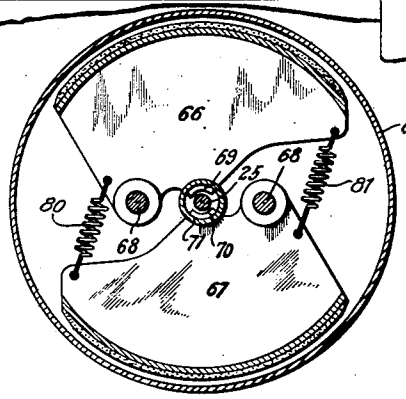


Fig. 2

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Fig 4

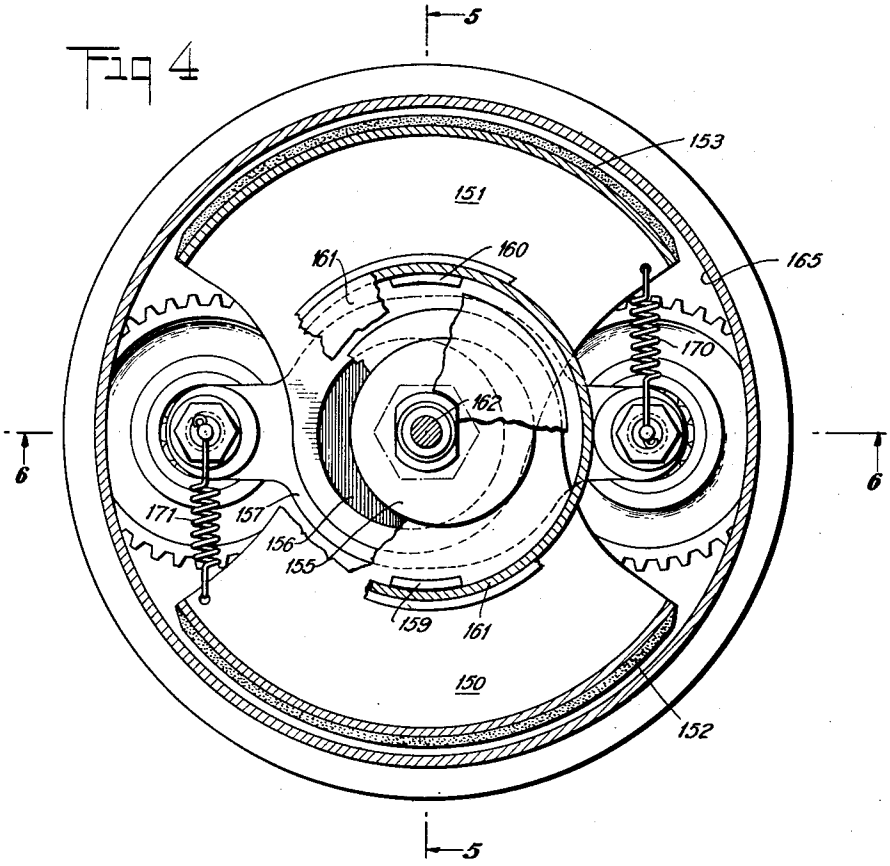


Fig 5

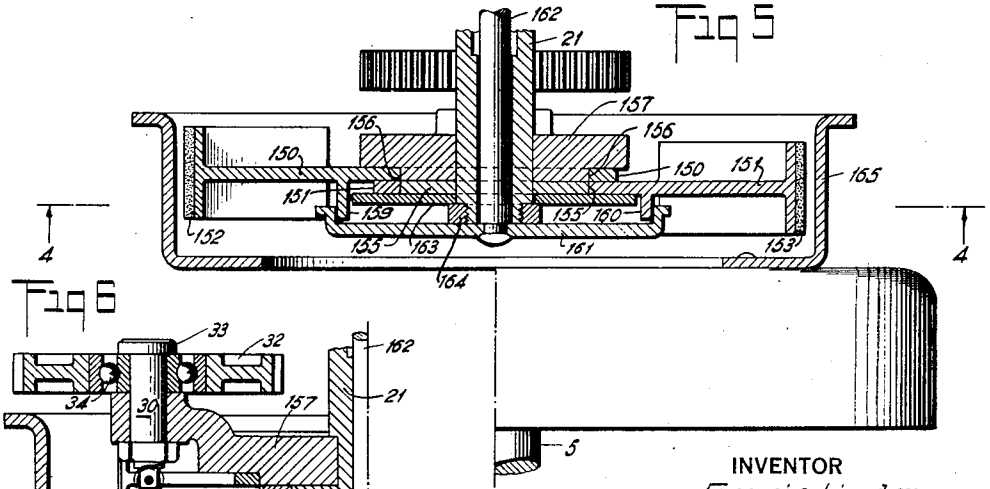


Fig 6

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UNITED STATES PATENT OFFICE

1,962,962

STARTING MECHANISM

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Application June 30, 1931, Serial No. 548,001

16 Claims. (Cl. 123—179)

This invention relates to starting mechanism for internal combustion engines, and more particularly to engine starters of the inertia type.

An object of the present invention is to provide novel means for operatively connecting a starter of the foregoing type to the engine to be started, whereby energy which has been stored in the inertia member of the starter is rendered effective to start the engine.

A further object of the invention is to provide in an inertia starter embodying manually operable means for energizing the inertia element, novel engine-engaging means so disposed and inter-related with said energizing means as to permit operation of both through the same agency.

Another object of the invention is to provide a novel inertia starter which is particularly adapted for use in starting outboard motors of the type now extensively employed on small boats.

A further object is to provide a novel construction in a starter of the type in which driving relation is established by a radial movement of normally withdrawn surfaces into frictional driving engagement with a member of the engine to be started.

In conjunction with the novel means just described, a feature of the invention is the provision of novel ratio changing means whereby the cranking operation may be continued after connection of the inertia member to the engine, such continued cranking being effected at a lower gear ratio than that existing during acceleration of the inertia member.

A further object of the invention is to provide novel variable ratio cranking means of the foregoing character including a one-way clutch mechanism to prevent return transmission of torque from the inertia member to the manually operable energizing means, after driving engagement with the engine has been established.

A further object is to provide an engine starter of the foregoing type embodying a novel construction possessing practical merit and insuring efficiency and reliability in operation.

These and other objects will becomes apparent upon inspection of the following specification and the accompanying drawings, wherein is illustrated the preferred embodiment of the invention. It is to be expressly understood, however, that the drawings are intended merely to serve as an illustration of one mode of embodying the invention in a practical form and are not designed as a definition of the limits of the invention, reference being had for this purpose to the appended claims.

In the drawings,

Fig. 1 is a central vertical section of the device embodying the invention;

Fig. 2 is a transverse sectional view along the lines 2—2 of Fig. 1 but on a smaller scale;

Fig. 3 is an exploded view of the novel ratio changing mechanism;

Fig. 4 is a transverse view of a modified form of the invention;

Fig. 5 is a section partly in elevation along the lines 5—5 of Fig. 4; and,

Fig. 6 is a view similar to Fig. 5 but taken at right angles thereof.

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 engine 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 a starting torque to said member whereby the engine may be cranked. As shown, such means includes a housing 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 screw members 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 opening through which extends the cylindrical hub 14 of a gear 15 rotatable through a bearing 54, provided for a purpose to be presently described.

Novel 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 gear 15 above referred to is adapted to mesh with a pinion 16 rotatable together with a larger gear 17 both of which have a forced fit, keyed or flat-sided connection with a sleeve 18 to be further described, the gear 17 being in turn adapted to mesh with a sun gear or pinion 19 which, in the

position indicated in Fig. 1, is drivably connected to a centrally disposed shaft 25, the gears 15, 16, 17 and 19 thus constituting the first and second stages respectively of the speed multiplying mechanism by which the inertia means to be described is brought up to a cranking speed.

Novel means are provided for drivably connecting the shaft 25 with the third stage of gearing leading to the inertia member. As shown, such means comprises the provision of a sleeve 21 rotatable through bearing 23, and keyed to shaft 25 by suitable means 22 having limited longitudinal movement relatively to said sleeve. The means further includes a recessed plate or spider 26 rotatable in unison with sleeve 21 by virtue of a keyed or flat-sided connection therewith. 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 sleeve 21, 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 is located a plurality of (as shown two) supporting posts or bolts 30 having threaded lower ends 31 for a purpose to be described, said bolts being adapted to retain on their upper portions a corresponding number of gears 32, the bolts being preferably enlarged as indicated at 33 to retain these gears in place, and bearings 34 being provided to facilitate rotation of said gears. The rotation of these gears about their own axes is preferably brought about by providing an internal gear 36 secured to the housing by the bolts 12.

The novel 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 formed on the upwardly extending sleeve 38, and being splined or otherwise secured for rotation in unison with the hub 39 formed on the flywheel 44; the latter being an inertia member of suitable mass and weight for the purpose. The aforementioned sleeve 38 is provided with an internal radially disposed shoulder 20 forming a support for member 21 through suitable ball bearings 24. The flywheel is rotatably supported by the provision of a transversely disposed plate or partition 51 resting on flange 10 and in conjunction with a disc 52 secured thereto, retains in place a ball bearing member 53, on which the hub 39 is rotatable. The supporting means just described also supports the sleeve 38 by virtue of the provision of a threaded nut 55 and locking member 56 on the upper end thereof.

Novel manually operated means are provided for engagement with the hub 14 to cause rotation thereof and consequent storing of 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 11 on member 14 for engagement with an internally threaded member 57 having a transversely extending section which, at its outer edge, turns in a downward direction to form a sleeve 58 having projections suitable for engagement of the handcrank, such as that indicated in broken lines at 59. The member 57 is rotatably supported, with the aid of bearing 54.

Novel means are provided for operatively connecting the flywheel 44, after the desired amount of energy has been stored therein through operation of the cranking means just described, to the engine member 5 to produce starting of the engine through cranking action. Stated broadly, such novel means comprises the provision of a cylindrical member or drum, such as that indicated at 65, preferably rigidly secured to the engine member 5, in combination with a plurality of elements such as those indicated at 66 and 67 (Figs. 1 and 2) having convex frictional surfaces adapted to be moved radially into engagement with the inner surface of the drum 65 following operation of the manually controlled meshing means to be described.

These radially movable elements 66 and 67 are pivotally suspended from bolts 68 extending through spider 26, and are normally restrained from outward movement into engagement with the drum 65 in response to centrifugal force set up by the rotation of the member 26 and corresponding rotation of the sectors 66 and 67, the restraining means constituting one of the novel features of the present invention now to be described.

Still referring to Figs. 1 and 2, it will be seen that the members 66 and 67 are provided, along the surface passing near the center of rotation, with downwardly extending lugs or fingers 69 and 70, adjacent which fingers there is provided a cup-shaped member 71, the upper cylindrical wall of which is adapted to enclose the fingers 69 and 70 and thereby prevent radial movement of the members 66 and 67 to effect driving contact with the surface of drum 65 so long as the cup member 71 remains in the position shown in Figs. 1 and 2. The latter is held to shaft 25 by means of a nut 72 threaded to the lower end of shaft 25.

The shaft 25 constitutes part of the means whereby the operator may, when desired, release the members 66 and 67 from the restraining influence of the cup member 71 and thereby permit driving engagement to be effected between the rotating elements of the starter mechanism and the engine to be started. When such engagement is desired, the operator after removing the handcrank 59, presses downwardly upon knob 75 thereby overcoming the force of spring 76, which, resting on ball bearing 77 normally presses upwardly against the thimble 78 in which the shaft 25 is held by suitable means, such as pin 73. As a result of the downward pressure on knob 75 thus manually exerted, the shaft 25 descends to a sufficient extent to permit withdrawal of cup member 71 from the path of fingers 69 and 70 and thereby permits the sector elements 66 and 67 to move outwardly into driving engagement with drum 65 in response to the centrifugal force, created by the rotation of the flywheel 44 and the members driven therefrom.

The novel ratio changing means constituting an important feature of the invention as above explained are shown in the embodiment of Fig. 1 as preferably associated with the shoe releasing means just described so as to be operated by the same downward movement of rod 73 which is effective to release the shoes 66 and 67. Referring to Figs. 1 and 3, it will be seen that the shaft 25 is provided with a series of radially spaced projections 95 normally registering with correspondingly spaced recesses 96 cut in the pinion 19 but adapted to register on downward movement of the shaft with similar recesses 97 formed in the hub 101 of a gear 100 as shown best in Fig. 3. A spacer plate 98 has a driving fit on a ledge 99 formed on the interior surface of gear 100.

The hub 101 surrounds the shaft 25 and is rotatable relative to the parts in the position shown in Fig. 1, the gear 100 being permanently in mesh with a gear 103, rotatable about sleeve 18.

In order to prevent return torque transmission to the gear 15 and manually operable sleeve 58, after the teeth 95 have been moved into registry with gear 100, a one-way driving connection is provided between the sleeve 18 and the gear 103. As shown, this one way driving connection is in the form of a plurality of rollers 105 disposed in tapering recesses in the sleeve 18, formed in proper manner to cause the rollers 105 to wedge against the inner surface of the gear 103 when the drive is from sleeve 18, but permitting the rollers 105 to roll freely on said recesses whenever the gear 103 is driven at a greater speed by virtue of its connection, under such circumstances, with the shaft 25. The sleeve 18 is rotatably supported in any suitable manner, as by the provision of a bearing member 106 held in place at the lower end of a centrally disposed pin or countershaft 107, the latter having a threaded upper end for attachment of a retaining nut 108 which is in turn rotatably supported on bearing member 109 provided in a recess in the upper surface of section 8 of the housing.

Figs. 4, 5 and 6 show a modified form of engine-engaging mechanism which may be employed as a substitute for the members 66 and 67 of Figs. 1 and 2. As shown in this embodiment, the engine-engaging mechanism encloses a pair of driving shoes 150 and 151 having outer rims 152 and 153 respectively similar to the rims on the driving shoes of Fig. 1, but in this embodiment the shoes are disposed with their surfaces in different planes, as indicated in Fig. 5, with the upper shoe 150 overlapping to a certain extent the lower shoe 151 and both being provided with apertures permitting their assembly rotatively registered with eccentrically disposed hubs or bosses 155 and 156. As shown the latter is integrally formed on the lower surface of the spider 157, and the eccentric member 155 may be superimposed upon the latter to provide a similar eccentricity at a position diametrically opposite that of the eccentric hub 156. The member 157 is held to the member 21 with the aid of washer 163 and nut 164 threaded thereon, the member 157 corresponding in function and method of operation to the spider 26 of the embodiment shown in Fig. 1. The shoes are also shown provided with depending annular rims 159 and 160 respectively adapted to be engaged by the cup-shaped member 161 secured to the lower end of rod 162 having a function and method of operation similar to that of cup 71 and shaft 25 of Fig. 1. With this construction it is apparent that on release of the cup-shaped member 161 the shoes 150 and 151 will pivot about the bosses 155 and 156 respectively, and in response to the centrifugal force exerted thereto will move into contact with the inner surface of the drum 165 of the engine to be started, to be returned to the inoperative position by the action of springs 170 and 171 on the occurrence of self-operation of the engine in the manner above explained with reference to the action in the embodiment previously described.

In operation, the handcrank 59 is engaged with sleeve 58, and the flywheel 44 is accelerated through the driving connection 14, 15, 16, 17, 19, shaft 25, spider 26, planetary gears 32 and 37, and sleeve 38. When the flywheel has by this means been brought up to a sufficient speed, the shaft 25 is moved downwardly whereupon shoes 66 and 67 engage the inner surface of drum 65 by action of the centrifugal force developed therein due to their rotation with the spider during the flywheel accelerating operation. During the latter operation, the clutch 105 is of course effective to transmit the drive from gears 15, 16 and sleeve 18 to the gears 103 and 100, and through connections 97 and 95 to the shaft 25, from which member the drive is through the sleeve 21, spider 26 and shoes 66 and 67 to the engine drum. By such rotation there is added to the energy stored in the flywheel, the further energy resulting from the driving connection now existing between the handcrank and engine drum, such driving connection being supplemental to the driving connections from the flywheel and including the gears 15, 16, 103 and 100. During the first portion of the period of engagement with the drum, in view of the fact that the shaft 25 is rotating faster than the gear 17, for example, or sleeve 18, the rollers 105 of the overrunning clutch will overrun, thereby preventing return torque transmission back to the handcrank. As soon, however, as the dissipation of energy has proceeded to such a point as to reduce the speed of shaft 25 to that of the manually rotated gear 103, the continued rotation of the handcrank 59 at the corresponding speed will be effective to continue the rotation of the drum 65 indefinitely or until starting of the engine under its own power.

During the latter operation, the clutch 105 is of course effective to transmit the drive from gears 15, 16 and sleeve 18 to the gears 103 and 100 and through connections 97 and 95 to the shaft 25, from which member the drive is through the sleeve 21, spider 26 and shoes 66 and 67 to the engine drum.

It will be noted that during cranking of the engine, the starter elements remain drivably connected to the engine crankshaft. This is due to the nature of the engagement between the members 66 and 67, on the one hand, and drum 65 on the other hand, and also the shape and tendency of these members which is to maintain driving contact so long as clutch members 66 and 67 are rotating at a speed sufficiently high to overbalance the opposing effects of springs 80 and 81. When the engine is started under its own power, the springs 80 and 81 will of course act to withdraw the elements 66 and 67 and return the fingers 69 and 70 to the position shown in Fig. 1, thereby permitting the spring 76 to return cup member 71 into locking relation with respect to the fingers 69 and 70, such return having theretofore been prevented by the centrifugal action of the elements 66 and 67 as they continued to rotate the drum 65.

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 will be obvious that the invention is not limited in form to the embodiment above described, nor is it limited to the specific use described, but is capable of a variety of mechanical embodiments and uses. For example any suitable arrangement of gears may be substituted for the specific gear train shown and described, and other clutch locking and lock releasing means may be employed in place of the means shown and described for these purposes. Hence it is within the scope of the invention to actuate the lock-releasing rod 25 automatically or by power, instead of manually. The same is true of the means for initially energizing the inertia element.

Also the invention may be used in internal combustion engines other than those of the outboard type, while certain sub-combinations may be applied to devices other than internal combustion engines, as above noted.

It is to be understood that various other changes may be made in the form, details of construction, arrangement of the 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 a device of the class described, a driven member, an inertia member in which energy may be stored for subsequent transmission to said driven member, means normally preventing establishment of driving relation between said members, said preventing means including a shaft extending through said inertia member, and means for energizing said inertia member comprising a manually operable member and driving connections between said manually operable member and said inertia member, said driving connections including said shaft.

2. In a device of the class described, a driven member, an inertia member in which energy may be stored for subsequent transmission to said driven member, means for drivably connecting said members comprising a gear train and friction clutch mechanism, a member controlling the operation of said clutch mechanism, and means for manually energizing said inertia member, said means including a rotatable member to drive said inertia member through said clutch controlling member and said gear train.

3. In a device of the class described, a driven member, an inertia member in which energy may be stored for subsequent transmission to said driven member, means for drivably connecting said members comprising a friction clutch mechanism, a member controlling the operation of said clutch mechanism, means for manually energizing said inertia member, said means including a rotatable member to drive said inertia member through said clutch controlling member.

4. In a device of the class described, a driven member, an inertia member in which energy may be stored for subsequent transmission to said driven member, a friction clutch mechanism interposed between said inertia member and driven member and normally separated therefrom, means for controlling the movement of said clutch mechanism into engagement with said driven member, and means for energizing said inertia member comprising a rotatable member and driving connections between said rotatable member and said inertia member, said driving connections including said clutch controlling means.

5. In a device of the class described, a driven member, an inertia member in which energy may be stored for subsequent transmission to said driven member, a friction clutch mechanism interposed between said inertia member and driven member and normally separated therefrom, means for controlling the movement of said clutch mechanism into engagement with said driven member, and means for energizing said inertia member comprising a rotatable member and driving connections between said rotatable member and said inertia member, said driving connections including said clutch controlling means, and a portion of said driving connections being operable to drivably connect said rotatable member with said driven member independently of said inertia member following the movement of said clutch mechanism into engagement with said driven member.

6. In a device of the class described, a driving member, a driven member, normally disengaged clutch mechanism interposed between said members, an inertia member interposed between said driving member and clutch mechanism, and means for establishing different driving ratios between said driving member and inertia member on the one hand, and driving member and driven member on the other.

7. In a device of the class described, a driving member, a driven member, means for drivably connecting said members comprising a plurality of eccentrically mounted friction driving shoes having overlapping portions, and means passing through said overlapping portions for controlling the movement of said driving shoes into driving relation to said driven member.

8. In a device of the class described, a driving member, a driven member, normally disengaged clutch mechanism interposed between said members, an inertia member interposed between said driving member and clutch mechanism, and means for establishing different driving ratios between said driving member and inertia member on the one hand, and driven member and driving members on the other, said means including a member controlling the establishment of driving relations between said inertia and driven members.

9. In a device of the class described, a driving member, a driven member, normally disengaged clutch mechanism interposed between said members, an inertia member interposed between said driving member and clutch mechanism, and means for establishing different driving ratios between said driving member and inertia member on the one hand and said driving member and driven member on the other, said means including a rotatable and longitudinally movable member interposed between said driving and driven members, means for rotating said interposed member in response to rotation of said driving member, and means for moving said interposed member longitudinally to establish driving connection between said inertia and driven members.

10. In a device of the class described, a driving member, a driven member, normally disengaged clutch mechanism interposed between said members, an inertia member interposed between said driving member and clutch mechanism, and means for establishing different driving ratios between said driving members on the one hand and said inertia and driven members on the other, said means including a rotatable and longitudinally movable member interposed between said driving and driven members, means for rotating said interposed member in response to rotation of said driving member, and means for moving said interposed member longitudinally to vary the driving ratios between it and said driving member, to disconnect said inertia member and to connect said driving member with said driven member.

11. In a device of the class described, a driving member, a driven member, normally disengaged clutch mechanism interposed between said members, an inertia member interposed between said driving member and clutch mechanism, and means for establishing different driving ratios between said driving members on the one hand and said inertia and driven members on the

other, said means including a rotatable and longitudinally movable member interposed between said driving and driven member, means for rotating said interposed member in response to rotation of said driving member, and means for moving said interposed member longitudinally to vary the driving ratios between it and said driving member to disconnect said inertia member and to connect said driving member with said driven member, said last named means including a one way torque transmitting connection between said driving and driven members.

12. In a device of the class described, a driving member, a driven member, means for drivably connecting said members comprising a plurality of eccentrically mounted friction driving shoes having overlapping portions, means passing through said overlapping portions for normally preventing movement of said driving shoes into operative relation to said driven member, and manually operable means for releasing said friction shoes from the restraining influence of said last named means.

13. In a device of the class described, a driving member, a driven member, means for drivably connecting said members comprising a plurality of eccentrically mounted friction driving shoes having overlapping portions, and means passing through said overlapping portions for controlling the movement of said driving shoes into operative relation to said driven member.

14. In a device of the class described, a driving member, a driven member, means for drivably connecting said members comprising a plurality of eccentrically mounted friction driving shoes having overlapping portions, means passing through said overlapping portions for normally preventing movement of said driving shoes into operative relation to said driven member, and manually operable means for releasing said friction shoes from the restraining influence of said last named means.

15. In a device of the class described, a relatively low speed driving member, a driven member, a normally disengaged clutch mechanism interposed between said members, a second driving member intermediate said first named driving member and said clutch mechanism and rotatable at relatively high speed in response to rotation of said first named driving member, common means for controlling the action of said clutch mechanism and changing the transmission ratio between said first and second named driving members, said common means including a clutch controlling part extending through both said driving members and into engagement with said clutch mechanism, a pair of gears rotatable about said clutch controlling part, and means projecting from said clutch controlling part engageable alternately with said gears.

16. In a device of the class described, a relatively low speed driving member, a driven member, a normally disengaged clutch mechanism interposed between said members, a second driving member intermediate said first named driving member and said clutch mechanism and rotatable at relatively high speed in response to rotation of said first named driving member, common means for controlling the action of said clutch mechanism and changing the transmission ratio between said first and second named driving members, said common means including a clutch controlling part extending through at least one of said driving members and into engagement with said clutch mechanism, a pair of transmission elements rotatable about said clutch controlling part, means projecting from said clutch controlling part engageable alternately with said transmission elements, and a one way driving connection between said first named driving member and said transmission elements.

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