Feb. 15, 1938. D. COLLINS 2,108,579

ENGINE STARTING DEVICE

Filed April 16, 1935 2 Sheets-Sheet 1

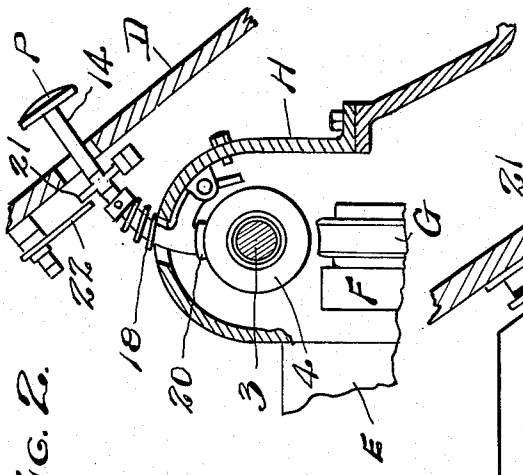


FIG. 2.

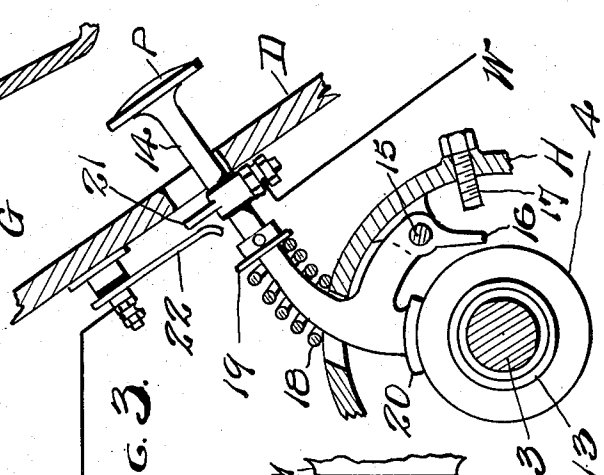


FIG. 3.

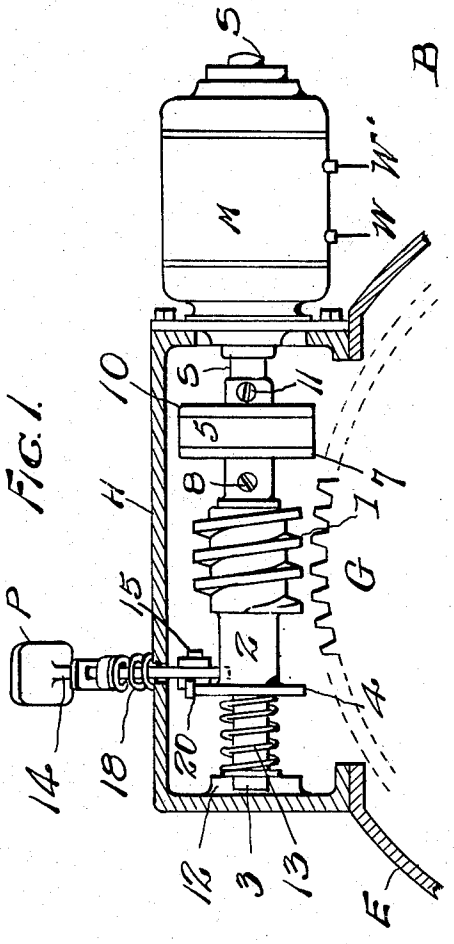


FIG. 1.

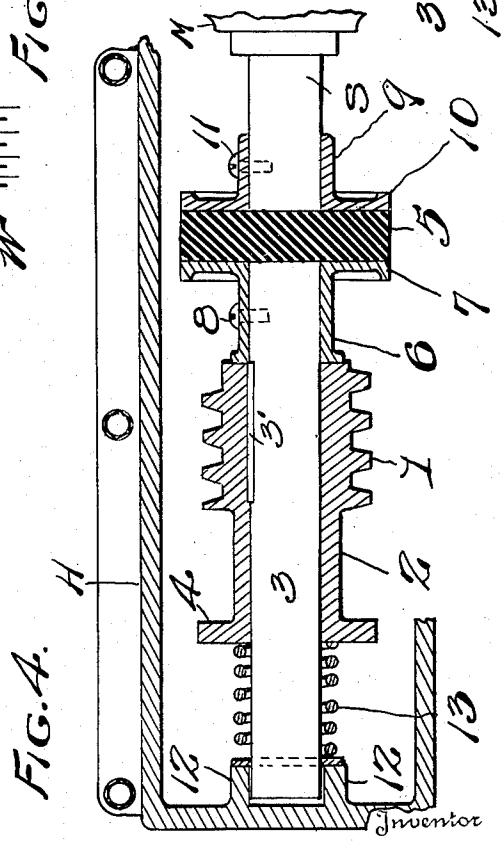


FIG. 4.

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ENGINE STARTING DEVICE

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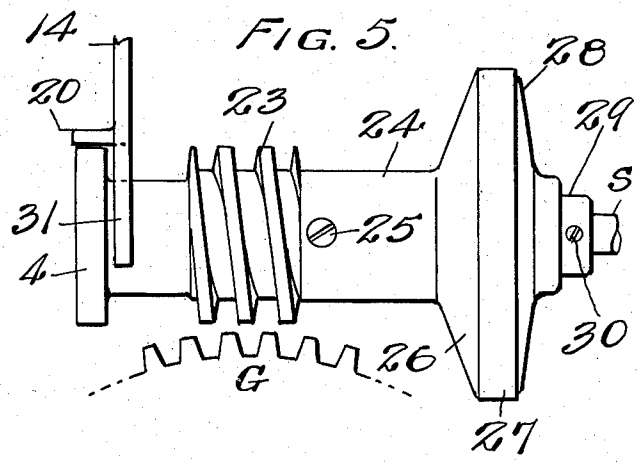


FIG. 5.

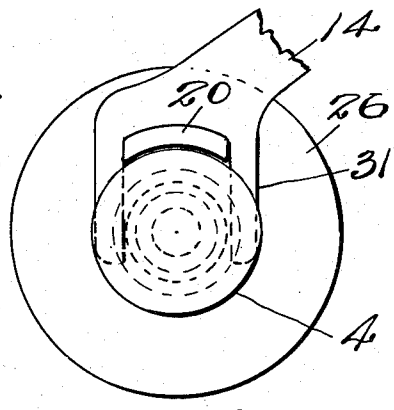


FIG. 6.

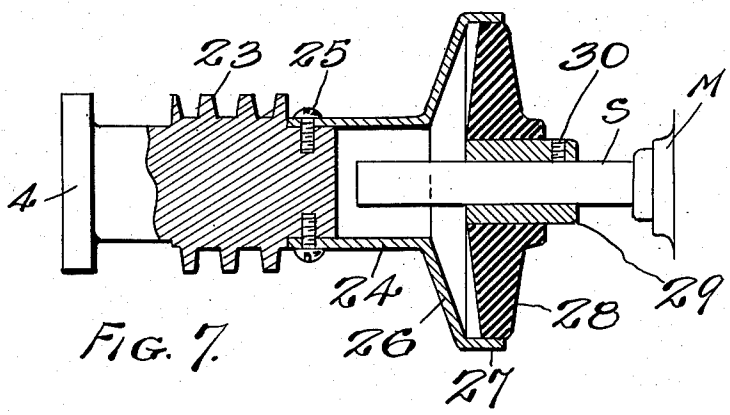


FIG. 7.

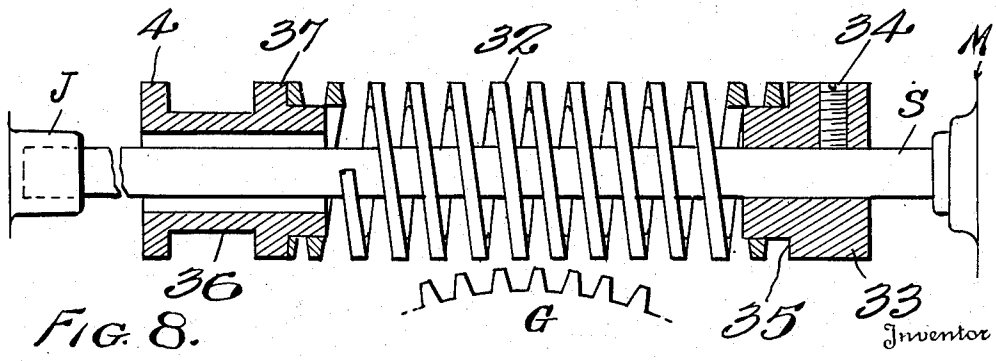


FIG. 8.

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UNITED STATES PATENT OFFICE

2,108,579

ENGINE STARTING DEVICE

Douglas Collins, Salisbury, N. C.

Application April 16, 1935, Serial No. 16,585

12 Claims. (Cl. 74—8)

My present invention relates to improvements in engine starting devices for use with the usual or standard types of electric starting motors and the gear ring of the fly wheel, or other driven member, of an internal combustion engine. While the invention is especially adapted for use in starting the engines of automotive vehicles, it will of course be understood that the starting device and engine may be used in other relations.

The starting device of my invention is of that type utilizing a flexible drive member, as a flexible, resilient, worm drive, combined with the shaft of the starting motor, and means are employed for flexing or oscillating the worm-drive in the same plane as that of the gear-ring of the engine fly-wheel for engagement of the worm-drive with and for disengagement of the worm-drive from the gear ring.

As here illustrated the flexible resilient worm-drive is pedal controlled for engagement with the gear-ring; and automatically operating means are employed for disengaging the drive member or worm-drive from the driven member or gear-ring, when the engine starts running under power.

In operating the starting device, the pedal is depressed for the purpose of engaging the worm-drive with the gear ring; the engine is started by the operation of the energized electric starting motor and the fly wheel or its gear ring, and thereafter the worm-drive is thrust by the gear ring to position where it is free of the depressed pedal, and then the worm-drive is automatically returned to inoperative position. Thereafter the pedal-starting operation cannot be performed until the depressed pedal or lever has been released and automatically returned to depressible position. In this manner safety is assured, a silent and noiseless action is accomplished in meshing and demeshing the worm-drive and the gear-ring, liability of stripping the teeth from the gear ring is eliminated, and a smooth operating power-transmission between the drive member and the driven member is assured.

Due to the minimum number of parts employed and their compact arrangement with direct action, as well as to the comparatively slight resistance-force encountered in the starting operation, the engine may with facility be started by either manual or pedal control, or through other combinations of instrumentalities, as for instance, through a combined throttle and starter control.

The parts of the device, which are simple in construction, may be manufactured at low cost of production, assembled with facility and installed for use with convenience, and the simplicity in operation renders the device reliable in action and durable.

The starter switch, or control switch for the electric starting motor is automatically closed by the depression of the pedal to energize the starting motor at a suitable time in advance of the engagement of the worm-drive with the gear-ring, and the control switch of the starting circuit is automatically opened to break the circuit when the actuating pedal is released.

The invention consists in certain novel combinations and arrangements of parts as will hereinafter be more fully set forth and claimed. In the accompanying drawings I have illustrated one complete example of the physical embodiment of my invention wherein the parts are operatively arranged, and in addition I have illustrated two modified forms of the worm-drive embodying my invention.

It will be understood that changes and alterations may be made in these exemplifying structures within the scope of my claims, without departing from the principles of my invention.

Figure 1 is a view in elevation showing one form of the invention, the fly-wheel casing and the worm-drive housing being shown in section. Figure 2 is a transverse sectional view of the starting mechanism showing the relation of the dash-board of an automotive vehicle, the demeshed or disengaged position of the worm-drive, and the gear ring of the fly wheel. Figure 3 is an enlarged view similar to Figure 2, and in addition indicating the starter circuit, with the starter switch open. Figure 4 is a horizontal sectional view, enlarged, of the worm-drive of Figure 1.

Figure 5 is a view in elevation showing a modified form of the worm drive; Figure 6 is an end view of Figure 5; and Figure 7 is a sectional detail view of the worm-drive of Figure 5.

Figure 8 is a detail view partly in section, showing another modified form of the invention.

In order that the general arrangement and relation of parts, and the utility of the invention may readily be understood, I have indicated as B, a battery or current source, for the starting circuit W, W', in which the electric starting motor M is included. The letter D indicates the slotted dash board of an automotive vehicle having a standard type of internal combustion engine E, which is provided with the fly wheel F and gear ring G forming part of the starting mechanism. The worm drive is enclosed in a housing H, which is bolted to the fly wheel casing, and the motor M which is provided with a shaft S, is bolted to the housing.

The worm-drive, or flexible, resilient, drive member, which is located directly over or above the gear-ring G is depressed in the plane of the gear-ring by foot pressure applied to the pedal P.

In the form of the invention illustrated in Figures 1–4 a worm gear 1, which is fashioned with a sleeve 2 integral therewith, is mounted on the

worm shaft 3, and splined at 3' in order that the worm and its sleeve may turn with the worm shaft, and also slide thereon, as to the left in Figure 1. The worm-drive, as indicated, is enclosed within the housing H, and extends horizontally in the same plane with, and directly above the gear ring G, and the worm sleeve 2 is fashioned with an end, annular flange 4 against which pressure is applied for flexing the worm drive.

Between the outer end of the motor shaft S and the inner end of the worm shaft 3, a disk 5 is mounted, which provides for flexure between the motor shaft and the worm-shaft. This disk is fashioned of rubber or similar flexible, resilient, material, and the disk forms a substantial coupling between the two axially alined shafts S and 3, which permits flexing, or oscillating movement of the shaft 3 with relation to shaft S, in the plane in which the gear-ring G is located. At one side the coupling disk 5 is fastened to the worm shaft or operating shaft 3 by means of a hub-sleeve 6 having an enlarged, integral attaching flange 7 that is fixed to the disk 5 by vulcanizing the latter against the adjoining face of the flange, and one or more screws or bolts 8 are employed to fix the hub-sleeve with its flange to the worm shaft or operating shaft 3. At its other side, the coupling disk is fastened in similar manner to the motor shaft or power shaft S, where a complementary hub-sleeve 9 is provided with an attaching flange 10, and the adjoining face of the coupling disk 5 is vulcanized to the face of flange 10. The hub sleeve 9 is rigidly mounted on the power shaft or motor shaft S as by means of a screw or screws 11.

As thus combined and arranged it will be apparent that, while the power shaft or motor shaft S remains at all times in its axial alinement with the motor M, the worm shaft and its worm gear may be oscillated or flexed with relation to the motor shaft for engagement of the worm-gear with and its disengagement from the gear ring G.

The free or outer end of the worm shaft is retained between and guided by a pair of vertically arranged and laterally spaced guide lugs 12, 12, which may be fashioned integrally with the inner face of one end of the housing H, as indicated.

The longitudinally movable worm-drive 1, which at one end abuts against an annular shoulder formed by the hub-sleeve 6, is slidable, through its splined connection with the shaft 3, to the left in Figure 4 against the tension of a return spring 13 that is coiled about the shaft and interposed between the flange 4 of the worm-drive and a washer abutting against the lugs 12, 12 of the housing H. Thus, when the worm-drive is engaged with the gear-ring and the engine starts, the gear-ring thrusts the worm-drive to the left in Figures 1 and 4 against the tension of the return spring 13, as will be described.

When engaging the worm-drive with the gear-ring and before the engine starts, the rotary movement of the worm-drive in engagement with the gear ring causes a thrust toward the flexible and resilient disk 5, and the shock of this thrust, together with the strain due to torque in the transmission of power, are absorbed by and in the flexible resilient coupling disk 5. With the motor M in operation the thrust is carried through the worm-drive, through the hub-sleeve 6, its flange 7, and the shaft 3, to the rubber disk where the strain is absorbed or cushioned.

For depressing the worm-drive into engagement with the gear ring and flexing the otherwise alined shafts S and 3, a lever 14 is employed. This lever, which is rigid with the pedal P passes through a slot in the dash-board D, and also through a guide slot in the top wall of the housing H, and the lever is pivoted at 15 within the housing at one side of the worm-drive. The lever is fashioned with a stop arm 16, which will abut against an adjustable stop or bolt 17, mounted in the adjoining wall of the housing H, and thereby the movement of the lever may be determined and limited.

By pressure of the foot on the pedal P the lever may be depressed or swung on its pivot against the tension of a return spring 18 coiled about the lever and interposed between an adjustable collar 19 and the slotted top wall of the housing.

For direct co-action of the lever with the worm-drive, the former is fashioned with a laterally off-set lug or presser plate 20, of arcuate shape to conform to the flange 4, and in position to engage the periphery of the flange when the pedal and lever are depressed, to start the engine.

By depressing the pedal with the lug 20 in contact with the periphery of the revolving flange 4, the driving mechanism is flexed at the coupling disk 5, and the worm-drive is engaged with the gear-ring to "turn over" the engine. When the engine starts the fly wheel teeth or gear ring G cause the worm-drive to slide to the left against tension of spring 13, and removing the flange 4 from contact with the presser lug 20. This removal of the flange 4 from under the lug 20 frees the depressed drive from the pedal pressure, and then, due to the resiliency of the coupling disk 5 the worm shaft and its worm are returned to alinement with the motor shaft S.

The starting operation cannot be repeated until pressure is released from the pedal thereby permitting the compressed spring 18 to lift the pedal to operative position, and the lifting of the pedal also enables the return spring 13, which has been compressed, to slide the worm-drive on its shaft 3 into its position abutting against the shoulder of the hub sleeve 6, as in Figures 1 and 4.

The starting circuit, which is normally open, is closed to energize the electric starting motor M in advance of the meshing of the worm-drive with the gear-ring, by suitable means, as for instance by a switch in the circuit, and comprising a movable contact point 21 mounted on and insulated from the depressible lever 14. A stationary contact point, as a spring blade 22, is located in the path of movement of the contact 21, and the terminals of these two contact points connect the respective wires of the circuit with the motor and the battery for energizing the motor. The stationary contact 22 is shown as mounted on the dash board D, while the movable contact is mounted on the lever, it will be understood however that other arrangements may be made for making and breaking the electric circuit of the starting motor M.

In the resilient, flexible, worm-drive shown in Figures 5, 6, and 7, worm-gear 23, which is provided with flange 4, is shown as a solid cylinder with an exterior worm or spiral tooth, and one end of the worm gear which is fitted into a hub-sleeve 24, is securely fastened to and rigid with the hub-sleeve, screws as 25 being employed for rigidly joining the worm gear with its hub-sleeve.

The hub-sleeve 24 is fashioned with a preferably integral enlarged, conical or flaring disk 26, and the latter is finished with an annular flange 27, the whole forming a large pocket or cup in the

nature of a hollow metallic coupling head having a reduced neck, the latter formed by the sleeve 24.

The power shaft, or motor shaft S of the motor M, which is shown in Figure 7 as axially alined with the worm-gear, projects through the hollow metallic coupling head and terminates a suitable distance from the end of the worm-gear. A flexible resilient connection between the worm drive and the motor shaft is effected by the use of a rubber disk 28, which at its outer periphery is vulcanized to the inner face of the flange 27 of the rigid head of the coupling. This rubber disk is provided with a central hub or bushing 29, of metal, and the bushing is securely fastened to the motor shaft S as by a screw 30. The open center of the rubber disk or resilient flexible coupling head 28 is vulcanized to the exterior of the bushing and a comparatively long bearing on the bushing is afforded for the flexible coupling head by thickening the material of the head 28 about its central portion.

As indicated in the drawings the flexible resilient coupling member or head tapers off in thickness toward its outer periphery, and the face of the head within the rigid metallic head tapers on lines substantially parallel with the tapered inner face of the metallic head, these adjoining faces being spaced apart to permit the required freedom of relative movement between the rigid head and the resilient head of the coupling when the latter is flexed.

The worm drive is depressed by action of the pedal through contact of the presser lug 20, and the lever 14 is fashioned with a forked end 31 that straddles the plane portion of the solid cylindrical worm 23, the lug 20 being struck from the end of the lever to form the fork and resting on the periphery of the flange.

The flexible resiliency of the coupling member 28 permits the worm gear 23 to be depressed into engagement with the gear ring, and the resiliency of the member 28 permits the fly wheel, after the engine starts, to thrust the worm gear to the left in Figure 5, out from under the lug or presser plate 20, after which, due to the elasticity or resiliency of the coupling head 28, the worm gear is returned, both vertically and longitudinally, to its alined position in its axial arrangement with the motor shaft S.

When the worm gear is depressed to engage the gear ring, the bell-end or hollow coupling head of the worm gear swings slightly about the flexible coupling head, and as the motor M is turning, the thrust developed through the gear ring and the worm moves the worm-gear to the right in Figure 7, against the resiliency or elasticity of the rubber coupling head. The strain of the thrust is thus absorbed and the thrust movement ceases if or when the rigid worm gear 23 abuts against the end of the motor shaft or power shaft S. In this position, with the flexible coupling head under compression, the latter transmits power from the motor shaft through the worm gear to revolve the gear ring of the fly wheel. The compression force is sufficient to transmit more power than is necessary to overcome the inertia of the worm gear when the latter is being thrust to the left by the fly wheel gear as before explained.

Side thrust of the worm gear is absorbed by the yoke or forked end 31 of the lever 14, and the yoke guides the worm-gear in its flexing movements.

This compact arrangement of a minimum number of parts insures simplicity in construction and in the operation of this type of starter, and the resilient, flexible starting device may be manufactured at comparatively low cost of production. The flexible drive may be housed in a casing or housing H, and the motor may be attached to the housing, as shown in Figure 1.

In the form of the starter or flexible drive illustrated in Figure 8, a steel spring 32, which performs the functions of a worm-gear in combination with the gear ring G of the fly wheel, is mounted on the motor shaft S, and the outer end of the motor shaft is journaled at J in a fixed bearing. One end of the spring-worm is attached to or anchored to the motor shaft by means of a hub 33 that is fastened on the shaft by means of screw 34. The hub is fashioned with a reduced end and annular shoulder 35, and the end of the spring-worm is welded or otherwise secured to the hub.

On the free end of the spring-worm 32 is mounted a ferrule or bushing 36 surrounding the motor shaft and having an interior bore of sufficient dimensions to permit flexing of the spring-worm so that it may be depressed into engagement with the gear-ring G of the fly wheel of the engine. The free end of the spring surrounds the periphery of the bushing and abuts against an annular shoulder 37 of the bushing, and the spring is welded or otherwise fixed to the bushing in the same manner that the inner end of the spring is fixed to the hub 33.

The bushing is fashioned with the annular flange 4, which is employed in the same manner in connection with the pedal lever 14 and its lug 20 for the performance of the same functions as complementary parts in Figure 5.

The spring-worm, or its convolutions, are of such shape and strength, at the point of contact with the teeth of the gear-ring G, as to present to the gear ring a solid or rigid worm-drive, while the two end portions of the spring-worm are characterized by sufficient resiliency as to permit flexing of the drive, and to cushion and absorb the starting drive and the thrust developed thereby. The right-end portion of the spring-worm, through its elasticity or resiliency, permits the gear-ring G to thrust the flange 4 from beneath the lug 20, for demeshing or disengaging the drive, as heretofore explained.

While cranking or starting the engine the right-end portion of the spring-worm is under compression, and the left-end portion is under tension, which overcomes any inertia when the drive is being demeshed or disengaged.

The pedal operation for engaging the drive member and the driven member is the same as heretofore described, and the drive mechanism is also automatically disengaged in manner heretofore described.

In the various forms of the invention, shown in Figures 1, 5, and 8 it will be apparent that I have provided a resilient, flexible, driving member, or worm-drive, of a self-contained, or inherent type, in which various sections or parts of the drive member are permanently united in axial arrangement.

In Figures 1, 4, 5, 7, the rubber disks 5, 28, form resilient sections, or couplings that are permanently united in axial arrangement with other sections of the drive member as a whole. In Figure 8, the steel, spring 32, which performs the functions of a worm-gear, is a resilient section of the drive member, which is permanently united in axial arrangement with other sections, as 33 and 36 of the drive member.

In all cases the flexible resilient worm-drive is located directly over, or above the gear ring of the fly wheel and in the same plane therewith to insure smooth meshing and demeshing of the complementary parts, and the worm-drive in disengaged position is held concentric to and in axial alinement with the motor or power shaft.

It will be noted that I have dispensed with the use of links in the actuating mechanism, and that the flexing of the worm-drive is accomplished, directly, through the depressing or pivotal movement of the pedal-lever, with the latter in contact with the worm-drive, thereby eliminating excess motion and loss motion otherwise present in connecting-parts.

Having thus fully described my invention, what I claim as new and desire to secure by Letters Patent is:—

1. In an engine starting device, the combination with a gear-ring, a motor, and its shaft, of a worm having a resilient coupling with said shaft, means for moving the worm into engagement with the gear-ring, and means for automatically disengaging the worm from the gear-ring when the engine is started.

2. In an engine starting device, the combination with a driven member, a motor, and its shaft, of a drive member having a resilient coupling with the shaft, means for engaging said members, means whereby the drive member is thrust longitudinally by the driven member against the resiliency of the coupling while said members are engaged, and means for automatically disengaging said members.

3. In an engine starting device, the combination with a driven member, a motor, and its shaft, of a drive member having a resilient connection with said shaft, a pedal-lever and coacting means on the drive member whereby the latter is depressed into engagement with the driven member, means whereby the depressed drive member is thrust longitudinally against the resiliency of said connection, and means whereby the drive member is automatically disengaged from the driven member.

4. In an engine starting device, the combination with a driven member, a motor and its shaft, and a drive member, of a resilient and flexible coupling head joining the drive member and shaft, means for flexing said drive member into engagement with the driven member, and means for automatically disengaging said members when the engine is started.

5. In an engine starting device, the combination with a driven member, a motor and its shaft, and a drive member, of a resilient and flexible coupling head between the drive member and shaft, means for flexing said drive member into engagement with the driven member, means whereby the flexed drive member is thrust longitudinally against resiliency of the coupling head, and means for automatically disengaging said members while the drive member is in thrust position.

6. In an engine starting device, the combination with a driven member, a motor, and its shaft, of a drive member having a bearing flange and a resilient connection with the shaft, a pedal-lever having a bearing lug for engagement with said flange whereby said members are engaged, and means for automatically disengaging said members when the engine is started.

7. In an engine starting device, the combination with a driven member, a motor, and its shaft, of a drive member having a bearing flange at one end, a resilient connection between the other end of said member and said shaft, a pedal-lever having a bearing lug for engagement with said flange whereby said members are engaged, means whereby the drive member is shifted to release the flange from the lug, and means for automatically disengaging said members when the engine is started.

8. In an engine starting device, the combination with a driven member, an electric starting motor, a starting circuit including a current source and an open starting switch, and a motor shaft, of a drive member having a flexible, resilient connection with the power shaft, means for flexing said drive member into engagement with the driven member, means whereby the switch is closed with the initial flexing movement of the drive member, and means for automatically disengaging said members when the engine is started.

9. In an engine starting device, the combination with a driven member, a motor, and its shaft, of a drive member, a transversely arranged flexible and resilient coupling head joining said members, means for flexing said drive member into engagement with the driven member, means whereby the meshing element of the drive member is thrust longitudinally by the driven member, and said resilient coupling providing means whereby the drive member is automatically disengaged from the driven member when the engine is started.

10. The combination with an internal combustion engine and its driven member, a starting motor and its power shaft, of a resilient, flexible, drive assembly operated by the power shaft and including a resilient coupling capable of axial expansion and contraction and also capable of longitudinal flexure, means for flexing the drive assembly into engagement with the driven member, and means for disengaging said assembly from the driven member when the engine is started.

11. Engine starting mechanism comprising a worm wheel for connection to the driving shaft of an engine, a power shaft tangential to the worm wheel, a flexible and resilient power-transmitting assembly mounted on the power shaft and including a worm for engagement with the worm wheel, said power-transmitting assembly being capable of axial expansion and contraction and also capable of longitudinal flexure, and means for flexing said assembly to engage said worm with the worm wheel.

12. The combination with an internal combustion engine and its driven member, a starting motor and its power shaft, of a drive assembly having incorporated therein means for flexibly and resiliently connecting the same to the power shaft whereby the drive assembly may be axially extended and contracted and also flexed longitudinally, means for flexing the drive assembly into operative engagement with the driven member, and means for disengaging said drive assembly from the driven member.

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