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STARTING MECHANISM

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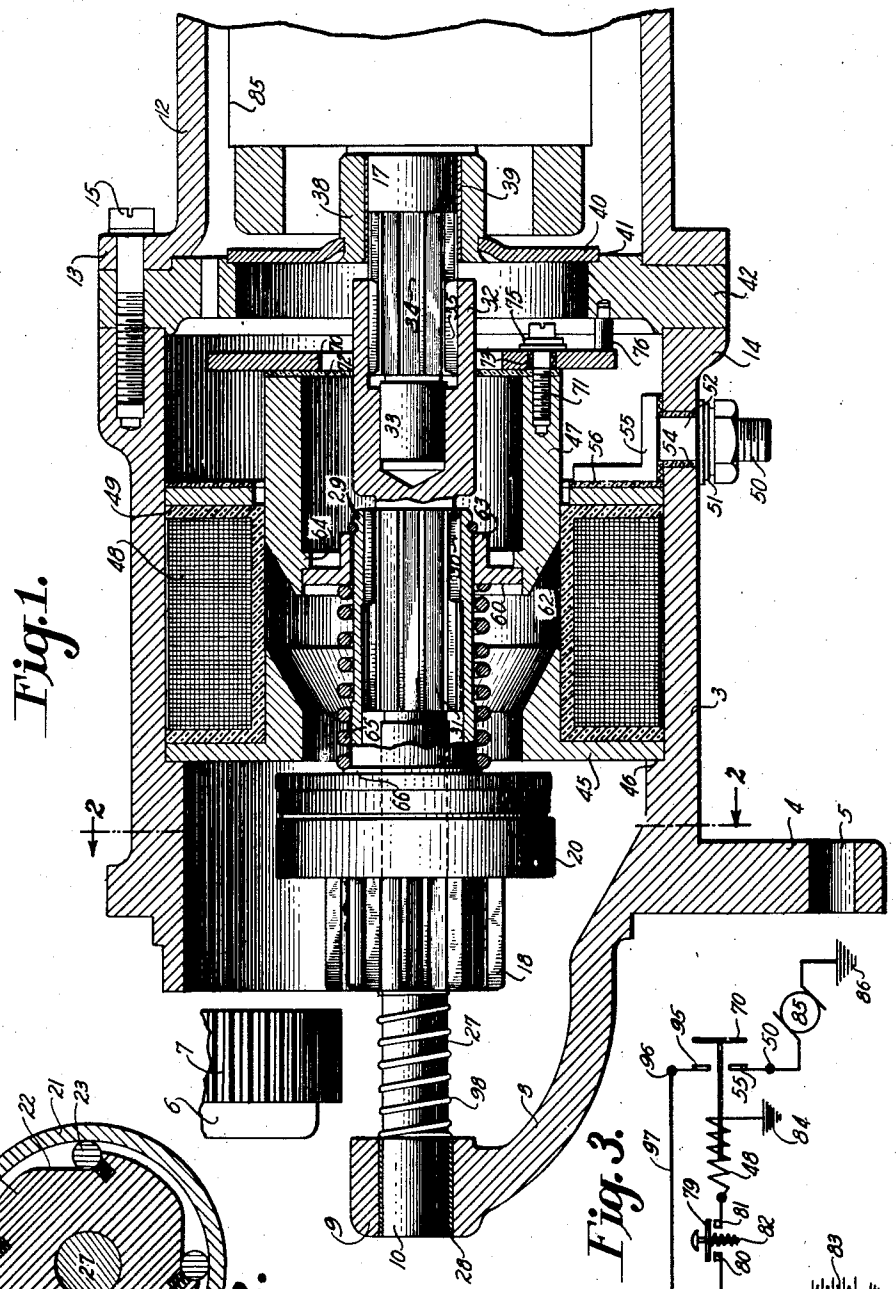


Fig. 1.

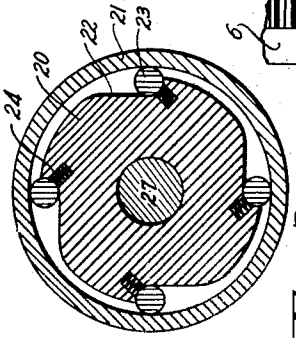


Fig. 2.

Fig. 3.

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STARTING MECHANISM

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3 Claims. (Cl. 290—38)

This invention relates to starting mechanisms and more particularly to starters for engines of the internal combustion type.

One of the objects of the invention is to provide, in an engine starter, novel means for producing engagement between the cranking member and a member of the engine to be started.

Another object of the invention is to provide, in an engine starter of the motor-driven type, novel means for controlling the energization of the driving motor.

A further object is to provide, in a device of the foregoing character, novel means for automatically energizing the motor driving means in response to a predetermined movement of the engagement producing means above referred to.

Another object of the invention is to provide means serving to establish a definite relationship in the operation of the motor energizing, engagement producing, disengaging and motor deenergizing means.

Another object of the invention is to provide novel electrically controlled means for achieving the objects above set forth.

A further object of the invention is to provide in a motor-driven starter of the type above described, novel means for energizing the motor, said means being operable automatically in response to the establishment of driving relation between the starter and the engaged member of the engine.

A further object of the invention is to provide novel engagement producing means operative upon the engine-engaging member to cause the latter to move directly forward into engine-engaging position prior to imparting any rotary movement thereto.

A further object of the invention is to provide novel electro-magnetically controlled means for operating the engine-engaging means.

Another object is to provide apparatus of the foregoing character which is of relatively simple construction, readily accessible, and positive in its operation.

Other objects and advantages to be derived from the use of the invention disclosed herein will become evident on an inspection of the following description when read with reference to the accompanying drawing illustrating one embodiment of the invention. It is to be expressly understood, however, that said drawing is for the purpose of illustration only, and is not to be construed as a definition of the limits of the invention, reference being had for this purpose to the appended claims.

In the drawing,

Fig. 1 is a view in sectional elevation of a device embodying the invention;

Fig. 2 is a transverse sectional view taken along the line 2—2 of Fig. 1; and

Fig. 3 is a schematic illustration of the electrical parts and circuits.

Referring more particularly to Fig. 1, the invention is therein shown embodied in a casing 3 having a flange 4 provided with suitable apertures 5 through which may be inserted suitable means for fastening the flange to the crank case (not shown) of an engine to be started, a rotatable member of which is indicated at 6. The member 6, which may be a flywheel or other suitable member connecting with the engine crankshaft, is preferably provided with gear teeth 7 for a purpose which will appear hereinafter.

The casing 3 is further provided with an inwardly extending portion 8 terminating in a cylindrical boss 9 having a suitable aperture for reception of the end portion 10 of a member adapted to be driven in response to energization of suitable driving means. As shown such driving means comprises an electric motor having a casing 12 provided with a flange 13 adapted to be secured to the flange 14 on casing 3 by suitable means as indicated at 15.

One of the novel features of the invention is the provision of a one-way drive between the motor and the engine-engaging member which, in the embodiment illustrated, preferably takes the form of a pinion 18 drivably associated with an armature shaft 17 and movable axially into mesh with teeth 7 of the engine flywheel 6. The one-way driving connection is constituted by the provision of a roller clutch assembly 20 comprising an outer race 21 and an inner race 22 having tapering recesses disposed at equal intervals about its periphery for the reception of rollers 23 adapted to be forced by the springs 24 into wedging driving engagement with the outer race 21 upon clockwise rotation (as viewed in Fig. 2) being imparted to the inner race 22.

Any suitable means may be employed for drivably connecting the outer race 21 with the pinion 18, but in the embodiment herein disclosed such connection is preferably effected by providing a splined hub extending slightly forward of the outer race 21 to engage corresponding splines on the pinion 18, the latter being bored centrally to provide for the passage therethrough of shaft 27, the end portion 10 of which is ro-

tatably received in a bearing sleeve 28 in the boss 9 previously referred to.

A driving connection is effected between the inner race 22 of the over-running clutch assembly and the shaft 27 by the provision of suitable driving connections comprising, in the embodiment illustrated, an elongated centrally disposed hub or sleeve 29 extending from the inner race 22 and preferably integral therewith, the outer end of the hub 29 being provided interiorly with splines 30 adapted to engage corresponding splines 31 on the outer surface of the shaft 27, the said shaft being enlarged and having a counterbore at its outer end 32, to form a socket 3 for the reception of the end 33 of the armature shaft 17, the intermediate portion 34 of which is splined to the shaft 32 as indicated at 35.

Suitable supporting means are provided for the shaft 27 and the armature shaft 17, and as illustrated such supporting means preferably takes the form of a hub 38 provided with a bearing sleeve 39 rotatably receiving the armature shaft 17, the hub 38 being supported by an annular disc 40 which is in turn secured on a shoulder 41 formed in the transversely disposed annular plate 42 which is secured in place between the casings 12 and 3 by the screws 15 previously referred to.

The means for producing engagement between the pinion 18 and flywheel 7 prior to energization of the motor, and therefore prior to any rotation of the shafts 17 and 27, comprises a novel electro-magnetic mechanism upon the energization of which a resilient pressure is brought to bear upon the over-running clutch assembly, and, through such assembly, upon the pinion 18 to cause axial movement thereof into mesh with the teeth of flywheel 6. Such novel electro-magnetic means preferably includes an annular stationary core 45 adapted to register with a shoulder 46 provided on the internal cylindrical surface of casing 3, and a movable core 47 adapted to move toward the stationary core 45 in response to the magnetic force created upon the energization of a winding 48 provided on insulated spool 49 located in the annular space between the casing 3 and the members 45 and 47.

Suitable circuit control means are indicated at 50 as taking the form of a binding post having means 51 for attachment of a lead wire, the post 50 being received in an opening 52 in casing 3 and insulated therefrom by suitable means 54, the inner end of the post being in contact with an L-shaped metallic plate 55 secured adjacent the outer washer 56 of the electro-magnetic assembly, the purpose of which plate 55 will appear more fully hereinafter.

Novel means for resiliently actuating the pinion 18 in response to energization of the winding 48 further comprises a spring 65 bearing against an annular disc 60 adapted to register with a shoulder 64 provided on the internal cylindrical surface of the tapered end 62 of the core 47, the said disc having a centrally disposed hub 63 adapted to slide along the outer surface of the sleeve 29 in response to inward movement of the core 47. Spring 65 extends along sleeve 29 and presses upon a circumferential shoulder 66 on the member 22. As shown, the spring 65 is normally unstressed and is therefore adapted to be compressed somewhat while producing a positive actuation of the clutch assembly, and to produce a yielding axial pressure thereupon in response to inward movement of the core 47.

The novel motor energizing means preferably takes the form of a member movable with the core 47 to establish contact with the plate 55 and thereby closes an electrical circuit to the motor after the core 47 has moved inwardly sufficiently to produce engagement between the pinion 18 and the flywheel 7. As shown in Fig. 1 this contact member preferably takes the form of an annular plate 70 of suitable conducting material secured to the outer end of the core 47 by suitable means as indicated at 71, the plate 70 being insulated from the said core by a disc 72 and an insulating sleeve 73 held in place by washers 75. A stop 76 is provided in transversely disposed wall 42 to limit the rearward movement of the plate 70 and the core 47.

Any suitable means may be employed for energizing the winding 48 of the electro-magnetic assembly, but as indicated schematically in Fig. 3, such means preferably takes the form of a switch 79 adapted to bridge the contacts 80 and 81 upon manual operation, a spring 82 being provided to return the switch to open position on release of the manual pressure. As shown in Fig. 3 the contact point 81 of the switch is connected electrically with the winding 48, while the terminal 80 is connected to the battery 83 or other suitable source of current, the opposite end of the winding 48 being grounded as indicated at 84.

It will also be seen from Fig. 3 that the lead attached to the binding post 50 is connected at its other end to the brushes of armature 85, the opposite side of said armature being suitably grounded as indicated at 86. The circuit to the motor is also shown as being closable upon movement of the plate 70 into contact with the contacts 55 and 95, the latter being preferably a flanged plate similar to that shown at 55 in Fig. 1, and located in abutment with washer 56 in spaced angular relation to the plate 55. The plate 95 is further provided with a terminal post 96, not shown in Fig. 1, but preferably similar to that indicated at 50 in Fig. 1, from which post a suitable conductor 97 leads to the source 83.

Having thus enumerated the parts entering into the preferred embodiment of the invention as illustrated in the accompanying drawing, the operation thereof will now be described. Upon closure of switch 79 the electro-magnet is energized to cause axial movement of the core 47 toward the stationary core 45, thereby transmitting through spring 65 an axial pressure on the clutch assembly 20 which moves the pinion 18 forward into mesh with the teeth of the engine flywheel 7.

During this forward movement there is no rotation of any of the parts since the circuit to the motor is not closed until a completion of the inward movement of the core 47, at which time the contact of plate 70 with the contact pieces 55 and 95 closes the circuit to the motor armature 85, over an electrical path as indicated in Fig. 3. The resultant rotation of the armature shaft 17 produces, through the splined connections indicated at 35 and 30 and the one-way driving connections 23 of the over-running clutch 20, a rotation of the pinion 18 which is thus effective through the intermediary of the flywheel 6 to turn over the engine and by this means effect starting thereof under its own power.

In the event that the teeth of pinion 18 strike those of flywheel 7 during the forward meshing movement of the former, the resulting compression of the spring 65 will permit completion of the inward movement of the core 47, whereupon

the closure of the circuit to the motor and the resultant rotation of the shafts 17 and 29 will cause sufficient rotation of the pinion 18 to bring the teeth into registry with the spaces between the teeth of flywheel 6. Thereupon the previously compressed spring 65 will become effective to snap the pinion into full meshing engagement with the flywheel and thus establish cranking relation therebetween.

When the engine starts under its own power, the resultant superior speed of the flywheel 6 relative to the pinion 18 allows the latter to be returned to its former position by action of the spring 98 which was compressed during the forward movement of the pinion. In the event, however, that the operator is maintaining switch 79 in closed position, such a return of the pinion 18 will be delayed until such manual pressure is removed from the switch 79, since until such time the magnet remains energized and therefore the spring 98 is ineffective. Meanwhile, due to the provision of the over-running clutch, the starter elements are protected from reverse drive at excessive speed, and the shafts 17 and 29 will continue to rotate only at the normal speed of the motor.

As soon as the operator relieves the pressure on switch 79, the spring 82 is effective to open the circuit to the solenoid, whereupon spring 98 acts (through spring 65) to return core 47 to the position indicated in Fig. 1 and simultaneously return the pinion 18 to its normal disengaged position.

There is thus disclosed a novel engine starter of the electrically driven type wherein engagement of the starter mechanism with the engine is produced by electrical means of novel construction so inter-related with the electrical driving means that both are effective in response to a single act on the part of the operator, the inter-relation between the parts being such that the operation of the parts proceeds automatically in predetermined sequence in response to such single manual act.

While the particular embodiment of the invention which is here illustrated is considered to possess a high degree of merit and is commercially acceptable in the form illustrated, it is to be expected that those skilled in the art may modify the structure and arrangement of the component parts, and therefore the claims are not to be narrowed in construction by reference to the accompanying drawing. Thus, for example, the claims are intended to include as a substitute for the direct driving means herein shown, any suitable driving mechanism employing gears or other equivalent driving connections. Moreover, if desired, a yielding clutch mechanism may be interposed between the motor and the engine-engaging member either in place of, or in addition to, the overrunning clutch mechanism illustrated in Fig. 2.

It is to be understood that various other changes may be made in the construction, arrangement and inter-relation of the parts constituting the invention without departing from the spirit thereof, the extent of the permissible variations being ascertainable by reference to the appended claims.

What is claimed is:

1. In an engine starting mechanism of the type employing an electric motor and an engine engaging member movable forward into engagement with a member of the engine to be started, the combination with said motor, engine member and engine engaging member of a driving shaft extending through the latter, a compressible spring surrounding one end of said driving shaft and tending to move said engine engaging member rearwardly, a second compressible spring coiled about the other end of said driving shaft, and acting to oppose rearward movement of said engine engaging member, a solenoid having a winding extending around said second named spring and in spaced relation thereto, and means responsive to passage of current through said winding to move said spring and engine engaging member along said shaft to drivably connect said motor and engine member.

2. In an engine starting mechanism of the type employing an electric motor and a pinion movable axially into engagement with a member of the engine to be started, the combination with said motor, engine member and pinion of a driving shaft extending through the latter, a compressible spring surrounding one end of said driving shaft and tending to move said pinion toward said motor, a second compressible spring coiled about the other end of said driving shaft and acting to oppose movement of said pinion toward said motor, a solenoid having a winding extending around said second named spring in spaced relation thereto, means responsive to passage of current through said winding to move said spring and pinion along said shaft to drivably connect said motor and engine member, said last named means including a magnetizable part, which also controls the passage of current to said motor.

3. In an engine starting mechanism of the type employing an electric motor and a pinion movable axially into engagement with a member of the engine to be started, the combination with said motor, engine member and pinion of a driving shaft extending through the latter, a compressible spring surrounding one end of said driving shaft and tending to move said pinion toward said motor, a second compressible spring coiled about the other end of said driving shaft and acting to oppose movement of said pinion toward said motor, a solenoid having a winding extending around said second named spring in spaced relation thereto, means responsive to passage of current through said winding to move said spring and pinion along said shaft to drivably connect said motor and engine member, said last named means including a magnetizable part which also acts to short-circuit said winding after traversing a predetermined distance.

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