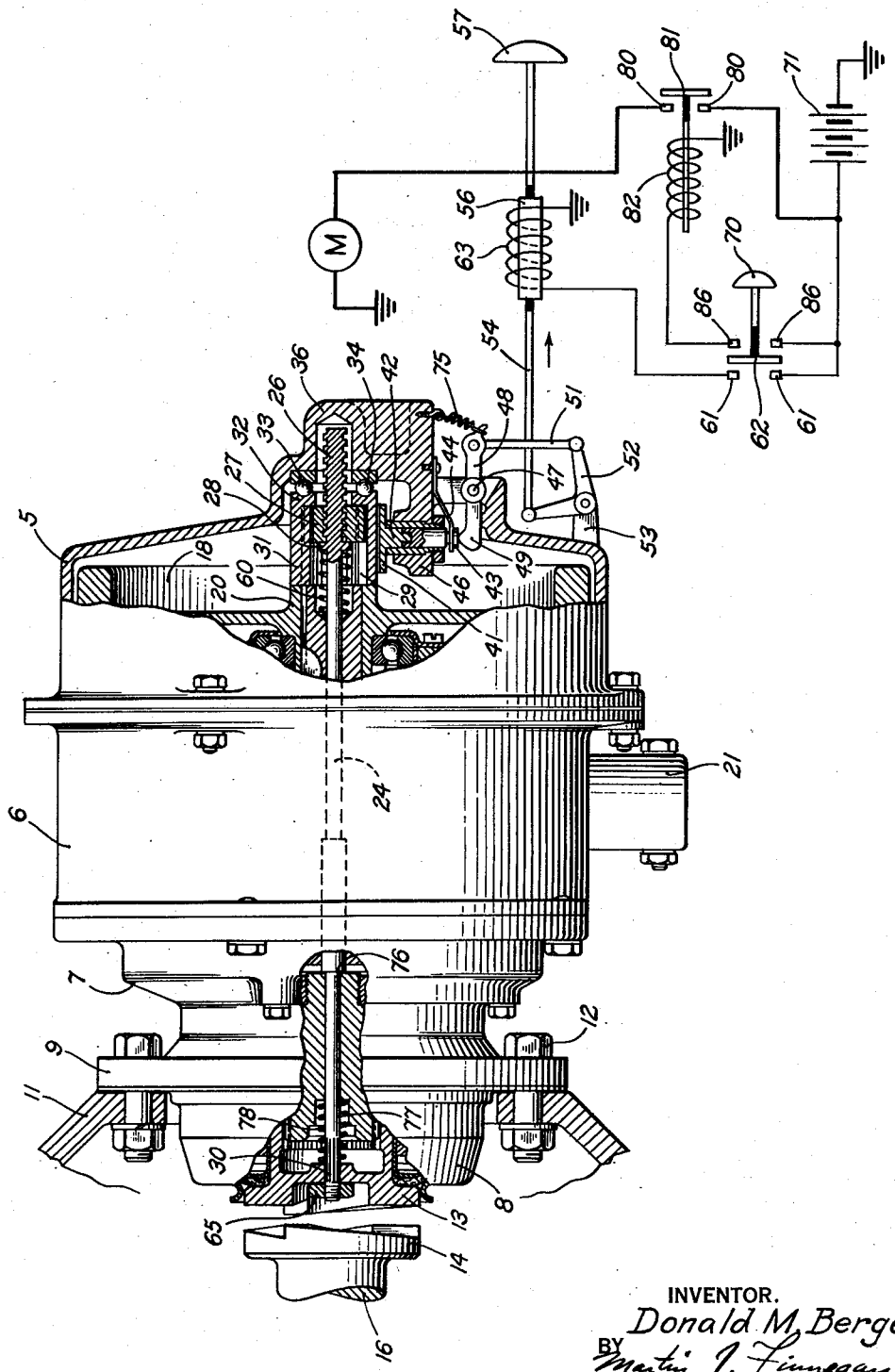
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ENGINE STARTING MECHANISM

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ENGINE STARTING MECHANISM

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This invention relates to internal combustion engine starting apparatus, and more particularly to engine starting apparatus of the inertia type, wherein there is considerable rotation of the driving elements, for momentum or "inertia" producing purposes, in advance of establishment of torque transmitting connection between said driving elements and the engine crankshaft. The establishment of such connection is commonly referred to as "meshing."

Where the meshing is brought about through the agency of linkage, the actuation of said linkage—whether manually or electro-magnetically induced—requires expenditure of considerable energy as it is necessary to overpower a comparatively sturdy opposing element such as, for example, a torsion spring similar to the one indicated by reference numeral 106 in Fig. 4 of the drawings of Patent No.1,833,948 granted Dec. 1, 1931.

The purpose of this opposing spring, or its equivalent, is to insure a return of the engine engaging clutch or gear element to the "de-meshed" position, and/or to insure the retention thereof in the "de-meshed" position at all times other than the period of the actual engine cranking operation; and as the opposition of such spring or its equivalent must be overcome in order to "mesh" the starter with the engine, it is apparent that considerable force is required.

In electromagnetically induced meshing—as in the Lansing patent above identified—the current drawn by the electro-magnet is considerable, for the reasons above indicated; and where the meshing is manually effected, the effort required is correspondingly high.

An object of the present invention is to provide, in a starter of the character indicated, a novel method of meshing, involving utilization of previously stored energy to produce the meshing movement, under the control of the operator as to the time of such meshing movement, whereby there is secured the advantage of delayed meshing (to permit the building up of "inertia" or momentum) but without the necessity of introducing a separate source of energy to produce such delayed meshing.

Another object is to provide novel meshing means for an inertia starter of the character indicated.

A further object is to provide novel means for converting rotary into rectilinear movement, to produce corresponding rectilinear movement of the engine-engaging member.

Another object is to provide meshing mechanism that can be operated electro-magnetically or by hand, at the choice of the operator.

These and other objects of the invention will become apparent from inspection of the following specification when read with reference to the accompanying drawing wherein is illustrated the preferred embodiment of the invention. It is to be expressly understood, however, that the drawing is for the purpose of illustration only, and is not designed as a definition of the limits of the invention, reference being had to the appended claims for this purpose.

In the drawing, the single figure is a view, partly in elevation, partly in section, and partly schematic, of the invention as applied to an engine starting mechanism of the "inertia" type.

Referring principally to Fig. 1, there is shown therein a built-up starter housing, including a flywheel containing section 5, intermediate sections 6 and 7, and a forward section 8, the latter provided with a flange 9 to register with a corresponding flange 11 on the engine crankcase, and to receive mounting bolts 12 for attachment of the starter to the engine, in such position that clutch element 13 of the starter may engage—that is, "mesh" with—correspondingly shaped engine member 14 to impart initial rotary movement to the engine crankshaft, or an extension thereof, indicated at 16, the method of producing such meshing movement of the member 13 being one of the features of the present invention, as above noted.

In addition to electrical means for acceleration of flywheel 18—such electrical means being shown diagrammatically in the form of an electric motor M, which in practice is usually disposed adjacent housing section 5, with its rotor drivably connected to flywheel 18 by means, not shown, but well known in the art—the starter preferably includes a manually operable accelerating means in the form of a shaft 21 adapted to receive a handcrank (not shown) at its outer end, said shaft 21 being disposed with its axis transverse to the axis of rotation of flywheel 18, and with its inner end drivably connected to said flywheel by way of intervening speed multiplying gears (not shown) corresponding to those which drivably connect the homologous parts 13 and 11, for example, in Patent No. 1,962,398 granted to Raymond P. Lansing on June 12, 1934, and illustrative of a widely used type of inertia starter to which the present invention is applicable.

Instead of terminating short of the flywheel,

as in the Lansing patent above identified, the clutch actuating rod 24 of the present disclosure continues rearwardly through the hub 20 of flywheel 18 to receive on its screw-threaded end 26 a correspondingly threaded nut 27 against which abuts the flange 28 formed on the rod 24 at the point where the screw threads terminate. On its outer surface the nut 27 is longitudinally grooved to form splines adapted to register with corresponding splines 29 of outer shell 31 of the mesh controlling assembly. As shown, this outer shell has an end portion 32 formed as a ball-race for balls 33 and cooperating with the complementary ball-race 34 which fits within a recess in the end portion 36 of housing section 5, and thereby facilitates free rotation of shell 31 with nut 27 and rod 24, the latter being splined or equivalently related to the clutch element 13, as indicated at 30, and therefore rotatable with said clutch element during the initial (flywheel accelerating) stage of operation.

Means are provided for arresting the rotation of shell 31 at the conclusion of the flywheel accelerating stage of operation, whereby motion translation may occur as between nut 27 and screw portion 26 of rod 24, to produce longitudinal movement of the latter and thus move clutch element 13 into the forward (engine-cranking) position. As shown, this mesh-producing control means includes a brake-shoe 41 having a broad, concave, cylindrical surface for engagement with the corresponding cylindrical outer surface of shell 31, and a shank 42 terminating in a head 43 whose neck-portion receives a spring arm 44 which, due to the anchorage of its other end on the housing end portion 36, tends to hold the brake 41 disengaged from shell 31; the brake shank 42 being slidable in a guide-bracket 46 integrated with said housing portion 36. Also integrated with said housing portion 36 is a rock-pin 47 adapted to pivotally support a rocker 48 whose inner end 49 abuts head 43 of the brake assembly, and whose outer end receives a part 51 o fthe actuating linkage. This actuating linkage is shown as including a bell-crank 52, pivotally mounted from housing bracket 53, and a rod 54 having a magnetic portion 56 and a hand-grip portion 57, the latter being for manual operation of the brake 41 and the former being for remote control by way of switch contacts 61, 62 and solenoid 63, of which member 56 constitutes the magnetic plunger or core.

The operation of the device is as follows:

Assuming manual acceleration of flywheel 18 is desired, the operator rotates the hand-cranked shaft 21, and this motion is transmitted through gears (within housing section 6) to the flywheel 18, wherefore the latter is rotated for storage of starting (and meshing) energy therein. Rotation of these gears is accompanied by proportionate rotation of clutch element 13, as in the aforesaid Lansing Patent 1,962,398; but said clutch element is maintained out of driving engagement with the engine member 14 by the action of opposing spring 60 upon flange 28 of the mesh-rod 24—it being understood that nut 65 on the clutch-jaw end of rod 24 prevents forward motion of clutch jaw 13, longitudinally, unless and until rod 24 itself is caused to move longitudinally, during the second stage of operation, now to be described.

In the second stage of operation rod 54 is moved to the right—either by actuation of hand-grip 57 or by moving hand-switch 70 to cause current to flow from source 71 through contacts 61 and 62 to the solenoid 63. In either case the result will be to cause rocker arm 48 to swing in a clockwise direction, as viewed, (overcoming the opposition of spring 75) and cause application of brake-shoe 41 to shell 31. The resulting cessation of rotation of nut 27 will produce a "jacking" action upon screw-threads 26 of rod 24, to urge said rod in a leftward direction and thereby produce engine-engaging movement of clutch element 13, by way of rod shoulder 76, screw 77, and the spring 78, (corresponding respectively to parts 37, 35 and 38 of the aforesaid Lansing Patent 1,962,398). The energy stored in the flywheel—minus that consumed in the "jacking" action just described—is now transferred to the engine; and as spring 60 limits the forward travel of rod 24, the latter will resume its rotational movement, carrying nut 27 and shell 31 around with it during the remainder of the cranking cycle—the brake 41 being insufficient to restrain the rotation of the parts after the limited longitudinal movement required for meshing has been completed.

To employ motor M as the flywheel accelerating means, in lieu of manually operable shaft 21, the operator may utilize the same source of current as for energization of solenoid 63, and the motor control switch contacts 80 may be bridged by remotely disposed control, to permit use of a short heavy cable from source 71 to said switch contacts 80, and the installation of said switch in proximity to the motor housing. To this end there is provided a second solenoid 82 energizable to close switch 80, 81, the flow of current to said solenoid being by way of normally open contacts 86, in shunt with the contacts 61, and bridgeable by the same manually operable contact maker 62 as are the said contacts 61, athough the said contact maker 62 is normally disposed in an intermediate position of non-engagement with either the set 61 or the set 86.

What I claim is:

1. In an engine starter, in combination, an engine-engaging member, a mesh rod rotatable therewith, means including a part surrounding said mesh rod for normally opposing movement of said engine-engaging member to engine-engaging position, and means including a motion translating element mounted upon and initially rotatable with said mesh rod for producing movement of said engine-engaging member to engine-engaging position, said last-named means further including means permanently separated from said mesh rod for retarding rotation of said motion translating element and thereby inducing mesh-producing movement of said mesh rod.

2. In an engine starter, in combination, an engine-engaging member, a mesh rod rotatable therewith, means including a part surrounding said mesh rod for normally opposing movement of said engine-engaging member to engine-engaging position, means including a motion translating element mounted upon and initially rotatable with said mesh rod for producing movement of said engine-engaging member to engine-engaging position, said last-named means further including means permanently separated from said mesh rod for retarding rotation of said motion translating element and thereby inducing mesh-producing movement of said mesh rod, and remotely controlled means for energizing said retarding means.

3. In combination with a flywheel and engine-engaging member, means including co-acting

screw and nut elements, the former of which is rotatable with said engine engaging member and the latter of which is initially rotatable with the former and subsequently becomes effective for moving said engine-engaging member to engine-engaging position, said means further including a brake operable to retard rotation of said nut element and thereby induce mesh producing movement of said screw element, and common means for controlling energization of said flywheel and brake, to produce operation thereof in sequence.

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