

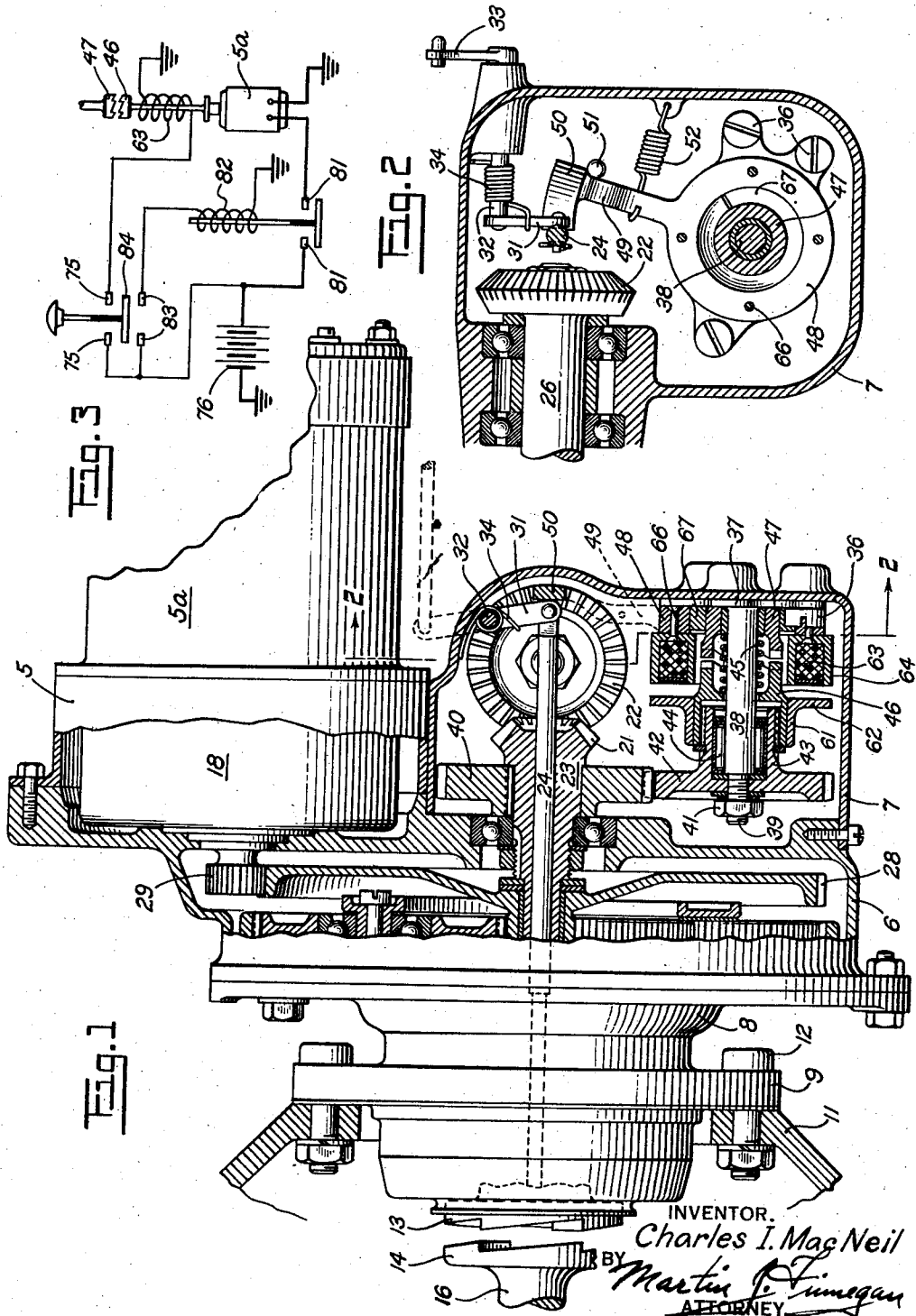
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C. I. MacNEIL

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ENGINE STARTING MECHANISM

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ENGINE STARTING MECHANISM

Charles I. MacNeil, East Orange, N. J., assignor to
Bendix Aviation Corporation, South Bend, Ind.,
a corporation of Delaware

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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 crank-shaft. 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:

Fig. 1 is a view, partly in elevation and partly in section, of an inertia starter by means of which the invention may be practiced;

Fig. 2 is a transverse view along the line 2-2 of Fig. 1; and

Fig. 3 is a diagrammatic representation of electrical connections that may be employed for energization of the electrical parts.

Referring principally to Fig. 1, there is shown therein a built-up starter housing, including a motor 5a and 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 crank-case, 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 15, 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 preferably disposed in the rearwardly extending portion 5a of housing section 5, and including a motor having a rotor (not shown) drivably connected to flywheel 18 by means well known in the art—the starter, as shown, includes a manually operable accelerating means in the form of bevel gear combination 21 and 22, the former being shown as integral with a long shaft 23 which is centrally bored to receive the mesh rod 24, and the latter being integral with a shaft 26 (Fig. 2) rotatably mounted in housing section 7 and projecting therefrom for reception of a suitable handcrank (not shown) whereby rotation may be imparted to the flywheel 18 through the intervening speed multiplying gear train, of which the bevel gears 22 and 21 constitute the low speed

- end, and spur gears 28 and 29 the high speed end, the latter being shown as an integral extension of the flywheel assembly 18, and therefore rotatable therewith, whether the drive be by way of manually operable shaft 26 or motor 5a. The details of the connections between shaft 23 and gear 28, and between shaft 23 and clutch 13, are not fully illustrated in the drawing as it is within the skill of those familiar with the art to supply said details, particularly in view of complete disclosures of suitable connections for such purposes in patents heretofore granted as, for example, Lansing Patent No. 1,784,190 of December 9, 1930.
- As in said Lansing patent, the mesh rod 24 terminates in hand-crank housing 7 and to its end is pivotally connected a lever arm 31 that is rigidly attached to a rock shaft 32. One end of shaft 32 projects exteriorly of housing 7 and carries a lever arm 33. A torsion spring 34 is coiled about shaft 32, within the housing 7, and one end of said spring is engaged with lever arm 31 while the other end is engaged with the housing, the spring being so disposed as to act through rod 24 and clutch element 13 to maintain the latter normally in the illustrated "demeshed" position, with respect to engine member 14. It is the opposing force of this relatively sturdy spring 34 that must be overcome, as above suggested, in order to engage the member 13 with the member 14, following acceleration of flywheel 18, and at the discretion of the operator. The illustrated means for producing such engagement will next be described.
- Mounted on the rear wall of housing section 7, by suitable means 36, is a plate 37 having a central extension 38 terminating in a threaded end portion 39 to receive a nut 41 serving to retain thereon a spur gear 42 having a hub portion 43 rotatable, with the aid of rollers 44, about the supporting axle 38, and externally splined for registry with corresponding splines formed internally of clutch element 43. A companion clutch element 47 is also journaled on axle 38 and has frictional driving relationship to a ring 48 carrying a radially projecting arm 49 terminating in a cam element 50 that is normally held against a suitable stop 51 by a spring 52, but is adapted to move away from said stop and into camming engagement with the lower end of lever 31 when such movement is induced by a torque applied to said ring 48. This camming movement has the effect of swinging the lever 31 in a clockwise direction, as viewed in Fig. 1, thereby shifting rod 24 and clutch element 13 to the left, and bringing clutch element 13 into meshing, driving relationship to engine member 14, the opposing torsion spring 34 being overpowered by the superior force of the energy previously stored in flywheel 18 and applied to cam ring 48 at the discretion of the operator, and in the manner next to be described.
- Application of torque to cam ring 48 occurs when clutch elements 46 and 47—normally held disengaged by a coiled compression spring 45 interposed therebetween—are brought into engagement, and such engagement is produced by shifting clutch element 46 to the right of the position indicated in Fig. 1. To produce such shifting there is integrated with element 46 a shifter plate 61 having a flange 62 engageable by a shifter yoke (not shown) for manual shifting thereof, and also shiftable by electromagnetic means, under manual control. To this end the member 61 is of magnetizable material, and acts as an armature with respect to the solenoid winding 63 and its magnetic retainer element or pole-piece 64, the latter housing the coil 63 and being in turn fixedly mounted on cam ring 48, by suitable rivets 66 or their equivalent. The drive from clutch 46, 47 to the cam ring 48 is a frictional one, as above noted, and includes a longitudinally split friction ring or clamp 67 having frictional engagement with the outer cylindrical surface of clutch element 47 and also with the inner cylindrical surface of cam ring 48. The drive from flywheel-driven shaft 23 to clutch element 46, on the other hand, is a positive one, and includes the inter-engaged spur gears 40 and 42, the former being splined to shaft 23 and the latter to clutch element 46, as heretofore noted.
- The operation of the device is as follows:
- Assuming manual acceleration of flywheel 18 is desired, the operator rotates the hand-cranked shaft 26 and this motion is transmitted through gears including 22, 21, 28 and 29 to the flywheel 18, whereby 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 1,784,190; but said clutch element is maintained out of driving engagement with the engine member 14 by the action of opposing spring 34 on lever 31 and mesh rod 24. At this stage the clutch elements 46, 47 likewise remain disengaged, due to spring 45 therebetween.
- When the flywheel has been brought to a sufficiently high speed the operator shifts clutch element 46 to the right either by actuation of the shifter yoke (not shown) or by closing switch contacts 75 (Fig. 3) to cause current to flow from source 76 through solenoid winding 63. In either case the result will be to cause clutch element 47 to turn with the driving clutch element 46. This turning movement will be transmitted to the cam-ring 48 by way of friction ring 67, and will produce the heretofore-described cam action between members 50 and 31, whereby mesh rod 24 is shifted to the left to mesh element 13 with engine member 14. The energy stored in the flywheel (minus that consumed in the camming action just described) is now transferred to the engine crank-shaft by way of the gear train and clutch elements 13, 14. This energy facilitates combustion in the engine cylinders, and when such combustion occurs the operator may re-open the switch contacts 75 (or release the shifter yoke, according to which means of operation is employed), whereupon spring 45 will be effective to disengage clutch elements 46 and 47, spring 52 will become effective to return cam 50 to the position of non-engagement with lever 31, and spring 34 will concurrently become effective to return mesh rod 24 and clutch element 13 to the non-meshing position shown.
- After clutch elements 13, 14 have been fully meshed, friction ring 67 permits rotation of clutch elements 46, 47 in relation to cam-ring 48; therefore there is no need to disengage said clutch elements 46, 47 in advance of completion of the cranking process.
- To employ motor 5a as the flywheel accelerating means, in lieu of manually operable shaft 26, the operator may utilize the same source of current as for energization of solenoid 63, and the motor control switch contacts 81 may be bridged by remotely disposed control, to permit use of a short heavy cable from source 76 to said switch

contacts 81, 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 81, the flow of current to said solenoid being by way of normally open contacts 83, in shunt with the contacts 75, and bridgeable by the same manually operable contact maker 84 as are the said contacts 75, although the said contact maker 84 is normally disposed in an intermediate position of non-engagement with either the set 75 or the set 83. As the elements above described co-operate in the specified manner to produce operation of the meshing rod 24 independently of any reliance upon externally disposed lever 33 (representing a type of mesh control that has heretofore been used extensively on starters of the character illustrated) the said lever 33 may of course be dispensed with, or, if desired, it may be retained for use in the event of a possible failure, for any reason, of the normal mesh controlling elements 46, 47 or associated parts.

What is claimed is:

1. In combination with a driving gear and engine-engaging member, means including a mesh-producing cam element having a limited range of movement for moving said engine-engaging member to engine-engaging position, and means including normally disengaged clutch elements for drivably connecting said driving gear and cam-element to actuate the latter by energy transmitted by said driving-gear, said cam actu-

ating means also including a slip connection between said cam element and one of said clutch elements whereby continued rotation of said clutch elements is possible after the cam element has reached the limit of its range of movement.

2. In combination with a driving gear and engine-engaging member, means including a driven clutch element for moving said engine-engaging member to engine-engaging position, means including a driving clutch element rotatable by said driving gear to actuate said first-named clutch element and thereby cause engine-engaging movement of said engine-engaging member, and means for producing rotation of said engine engaging member, said last-named means also operating to produce rotation of said clutch elements.

3. In combination with a driving gear and engine-engaging member, means including a mesh-producing element having a limited range of movement for moving said engine-engaging member to engine-engaging position, and means for drivably connecting said driving gear and mesh-producing element to actuate the latter by energy transmitted by said driving gear, said last-named means including a yielding connection between said driving gear and mesh-producing element whereby continued rotation of the driving gear is possible after the mesh-producing element has reached the limit of its range of movement.

CHARLES I. MACNEIL.