Feb. 23, 1960 C. A. MENDENHALL 2,925,810

TWO-STAGE STARTING SYSTEM FOR INTERNAL COMBUSTION ENGINES

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2 Sheets-Sheet 1

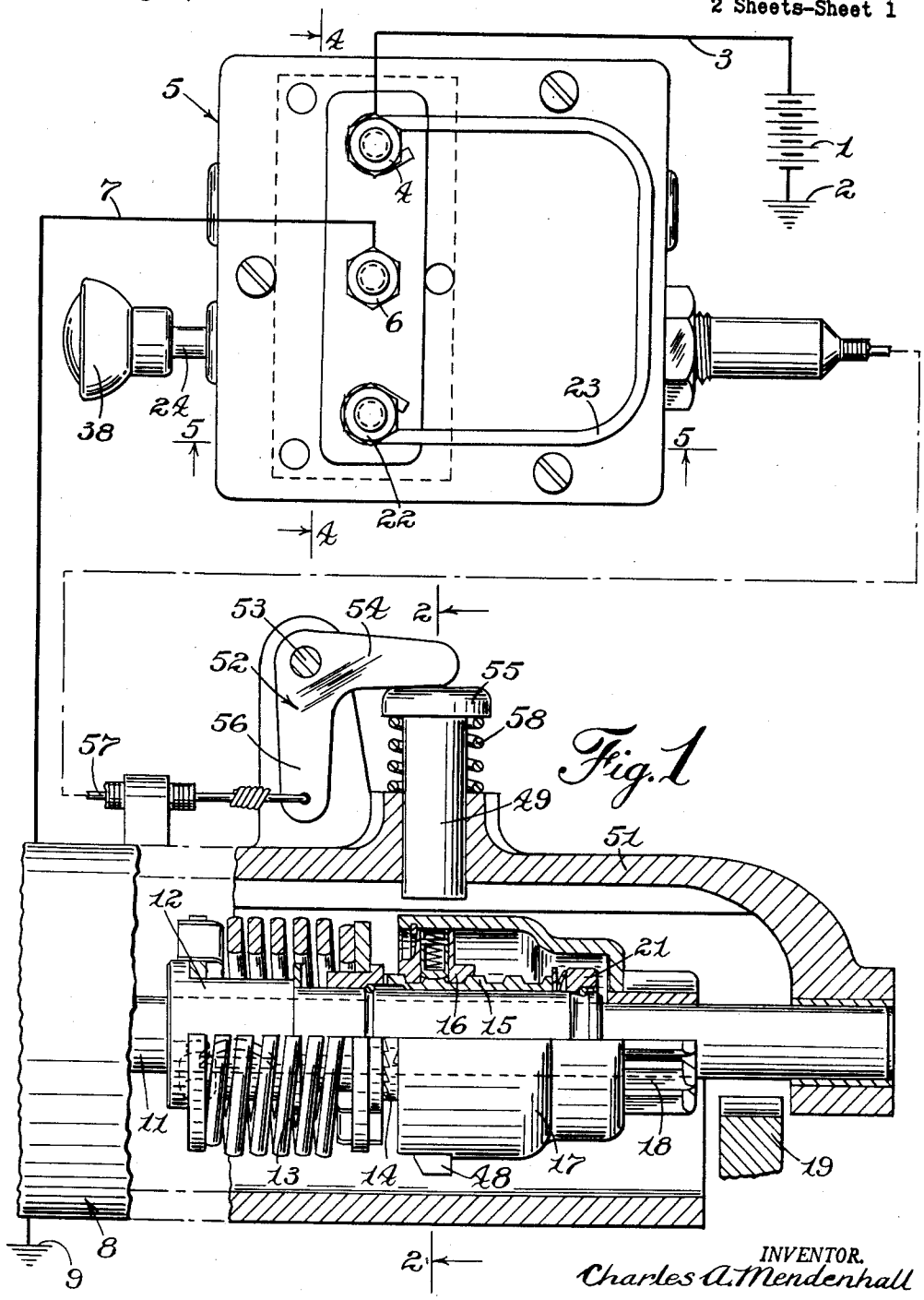


Fig. 1

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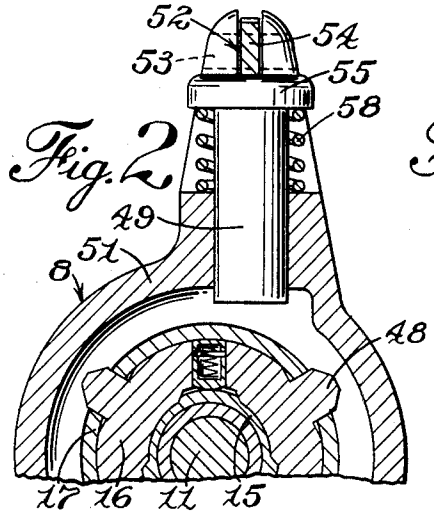


Fig. 2

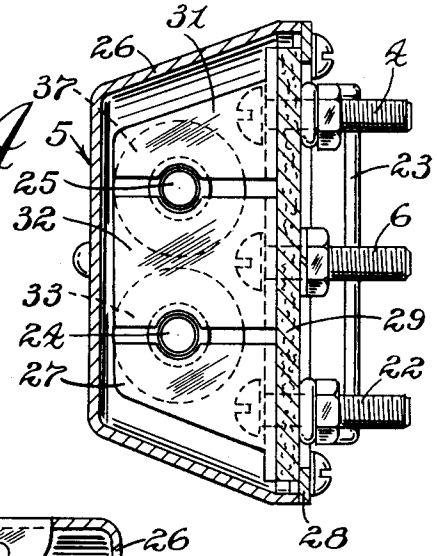


Fig. 4

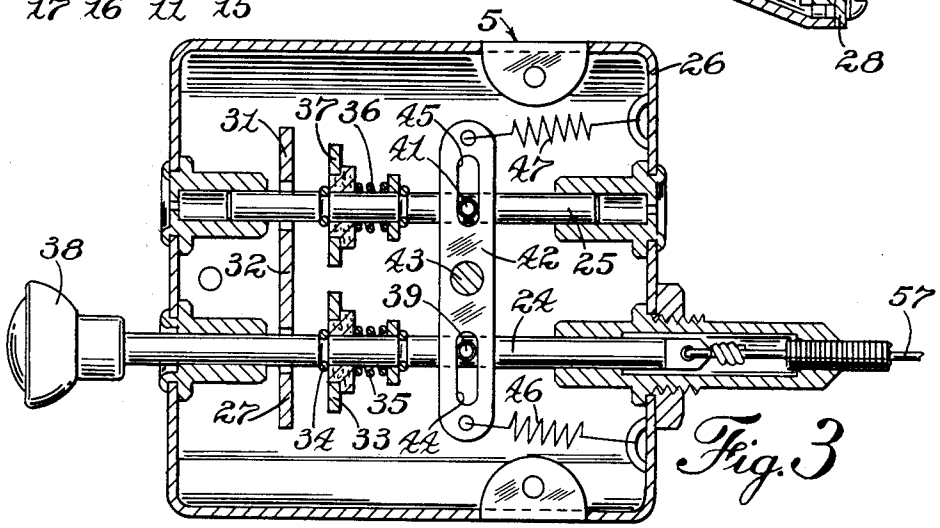


Fig. 3

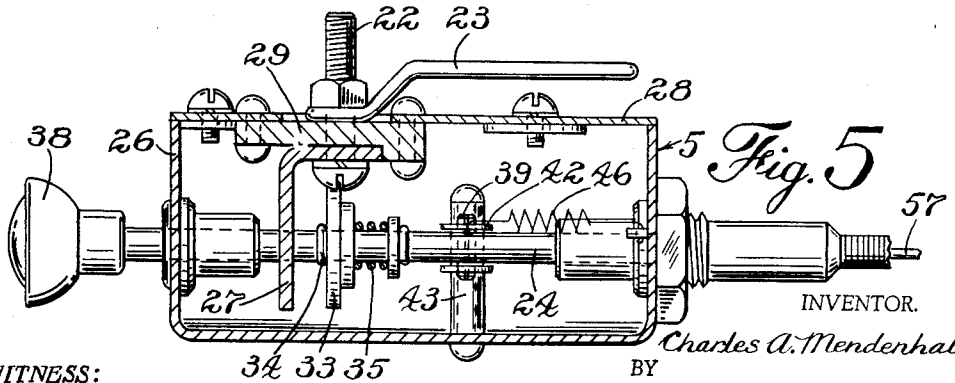


Fig. 5

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TWO-STAGE STARTING SYSTEM FOR INTERNAL COMBUSTION ENGINES

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6 Claims. (Cl. 123—179)

The present invention relates to a two-stage starting system for internal combustion engines, and more particularly such a system including means for optionally energizing the starting system by reduced voltage applied to the starter motor.

It is an object of the present invention to provide a novel two-stage starting system incorporating a unitary manual switching device for optionally energizing the starting motor at either of two operating power levels.

It is another object to incorporate in such a device a manually operated detent means for insuring traversal of the drive pinion into mesh with the engine gear upon initial rotation of the starting motor.

It is another object to provide such a device in which the switching means and the detent means are operated by a unitary controlling device.

It is another object to provide such a device which is so arranged that the detent is rendered operative only while the starting motor is energized at its lower power level.

It is another object to provide such a device in which the meshing detent is rendered inoperative as soon as its function is accomplished.

Further objects and advantages will be apparent from the following description taken in connection with the accompanying drawings in which:

Fig. 1 is a semi-diagrammatic view of a starting system constituting a preferred embodiment of the invention, the switch means being shown in elevation, and the starter gearing being also shown in side elevation, partly broken away and in section;

Fig. 2 is a sectional detail of the starter gearing taken substantially on the line 2—2 of Figure 1;

Fig. 3 is an elevation of the switch means with the cover removed, partly broken away and in section;

Fig. 4 is a section of the switch means taken substantially on the line 4—4 of Fig. 1; and

Fig. 5 is a section of the switch means taken substantially on the line 5—5 of Fig. 1.

In Fig. 1 of the drawings, there is illustrated a battery 1 which is grounded at 2 and connected by a lead 3 to a terminal 4 of a switching device indicated generally by the numeral 5. A second terminal 6 of the switching device is connected by a lead 7 to a starting motor 8 which is grounded at 9 to complete the starting circuit.

The armature shaft 11 of the starting motor 8 has rigidly mounted thereon a driving head 12 which is connected through a drive spring 13 and an overrunning clutch 14 to a screw shaft 15. A control nut 16 is threaded on the screw shaft 15 and rigidly connected by a barrel member 17 to a pinion 18 which is movable thereby into and out of mesh with a gear 19 of the engine to be started, the meshing position of the pinion being defined by a stop ring 21.

The switching device 5 has a third terminal 22 which is connected by a resistor 23 to the battery terminal 4 of the switching device. As best shown in Fig. 3, the switching device incorporates manually operable means

for optionally connecting the motor terminal 6 thereof to either one of the terminals 4 or 22. For this purpose a pair of plungers 24 and 25 are slidably mounted in parallel relation in the casing 26 of the switching device. A contact 27 is fixedly mounted on the cover or terminal plate 28 of the casing which carries the terminals 4, 6 and 22, insulated therefrom as indicated at 29 in Fig. 5, and connected to the terminal 22. A second contact 31 is similarly mounted and connected to the terminal 4, and a third contact 32 is similarly mounted on the plate 28 and connected to the terminal 6, said three contacts being coplanar and being spaced on opposite sides of the plungers 24 and 25 as best shown in Fig. 4.

A movable contact 33 is slidably mounted on the plunger 24 and normally pressed against a stop ring 34 by means of a spring 35, this contact being in the form of a disc adapted to connect fixed contacts 27, 32 when the plunger 24 is drawn to the left in Fig. 3 for that purpose. A movable contact 37 is similarly mounted on the plunger 25, backed up by a spring 36, and arranged to connect contacts 32 and 31 when the plunger 25 is moved to the left.

The plunger 24 has fixedly mounted thereon a manually operable knob 38 whereby the plunger may be moved in either direction from its normal position as illustrated in Fig. 3. The plunger 24 has a pin 39 projecting therefrom and plunger 25 has a similar pin 41 located in a corresponding position. A lever 42 is pivoted to the casing 36 as by means of a stub shaft 43 and is provided with slots 44 and 45 through which the pins 39 and 41, respectively, project. Springs 46 and 47 anchored to the wall of the casing 26 are attached to the ends of the lever 42 and yieldingly maintain the lever, and consequently the plungers 24 and 25, in their normal position as illustrated.

In order to insure traversal of the pinion 18 into mesh with the engine gear 19 by the screw-jack action of the screw shaft 15 and control nut 16, the control nut is formed with a plurality of lugs 48 projecting outside of the barrel member 17 as shown in Figs. 1 and 2, and a detent member 49 is slidably mounted in the motor casing 51 for movement into and out of the path described by the lugs 48 when the pinon 18 is in its idle position. Means for actuating the detent 49 to cause it to engage the lugs 48 is provided comprising a bell crank lever 52, pivoted at 53 on the motor casing, having one arm 54 engaging the head 55 of the detent and its other arm 56 connected by a flexible cable or Bowden wire 57 to the switch plunger 24. A spring 58 normally maintains the detent 49 in retracted position, and movement of the plunger 24 to the left in Fig. 3 to close the switch contacts 27, 33, 32, actuates the lever 52 by means of the flexible cable to move the detent into operative position.

In operation, when it is desired to start the engine, the operator will pull on the knob 38 thereby moving the detent 49 into operative position and then closing the switch contacts 27, 33 and 32 whereby the starting motor 8 is connected to the battery 1 through the resistor 23. The starting motor is thus energized at its lower power level, and the consequent rotation of the screw shaft 15 moves the pinion 18 into mesh with the engine gear 19, since rotation of the pinion is prevented by the detent 49. As soon as the pinion enters into mesh with the engine gear, the lugs 48 move out of contact with the detent 49 which, its function being accomplished, then becomes inoperative to resist rotation of the control nut.

After the pinion has been fully meshed, the operator then pushes on the knob 38 whereby the switch contacts 27, 33, 32 are opened and contacts 32, 37 and 31 are closed, thus connecting the starting motor directly to the battery and consequently energizing it with the full battery voltage for the cranking operation.

When the engine starts, the pinion 18 is returned to its

idle position by the overrunning of the engine gear 19, and, upon release of the knob 38 by the operator, the switch contacts 33, 37 are returned to their normal positions by the springs 46, 47.

Although one form of the invention has been shown and described in detail, it will be understood that changes may be made in the design and arrangement of the parts without departing from the spirit of the invention.

I claim:

1. In a two-stage starting system for internal combustion engines, a starting motor, gearing including a motor-driven pinion and means for traversing the pinion into mesh with a gear of the engine to be started responsive to acceleration of the motor; an electrical circuit for energizing the motor including a battery, a resistor and a switch in series therewith, a second switch arranged, when closed, to short-circut the resistor, a manually operable switch-actuating member, and means whereby movement of said member in one direction closes one of said switches and movement of the same in the opposite direction closes the other of said switches.

2. A starting system as set forth in claim 1 including further a detent moveable into and out of position to resist rotation of the pinion prior to its engagement with the engine gear, and means operated by said manual switch-actuating member to move said detent into and out of operative position.

3. A starting system as set forth in claim 2 in which the means for moving the detent is actuated by said

manual member to move the detent into operative position responsive to movement of the manual member to close said first mentioned switch.

4. A starting system as set forth in claim 2 in which the detent is arranged to become inoperative when the pinion enters into mesh with the engine gear.

5. A starting system as set forth in claim 1 in which said switches each comprise a plunger and a movable contact mounted thereon, said manual member being mounted on one of said plungers, and means including a lever so connecting said plungers that movement of said one plunger in a switch-opening direction causes movement of the other plunger in a switch-closing direction.

6. A starting system as set forth in claim 5 including further means connecting said one plunger to the detent to move the detent into operative position responsive to movement of said one plunger to close its switch contacts.

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