

Aug. 19, 1958

C. D. STRANG

2,847,985

ENGINE STARTING MECHANISM

Filed March 30, 1956

4 Sheets-Sheet 1

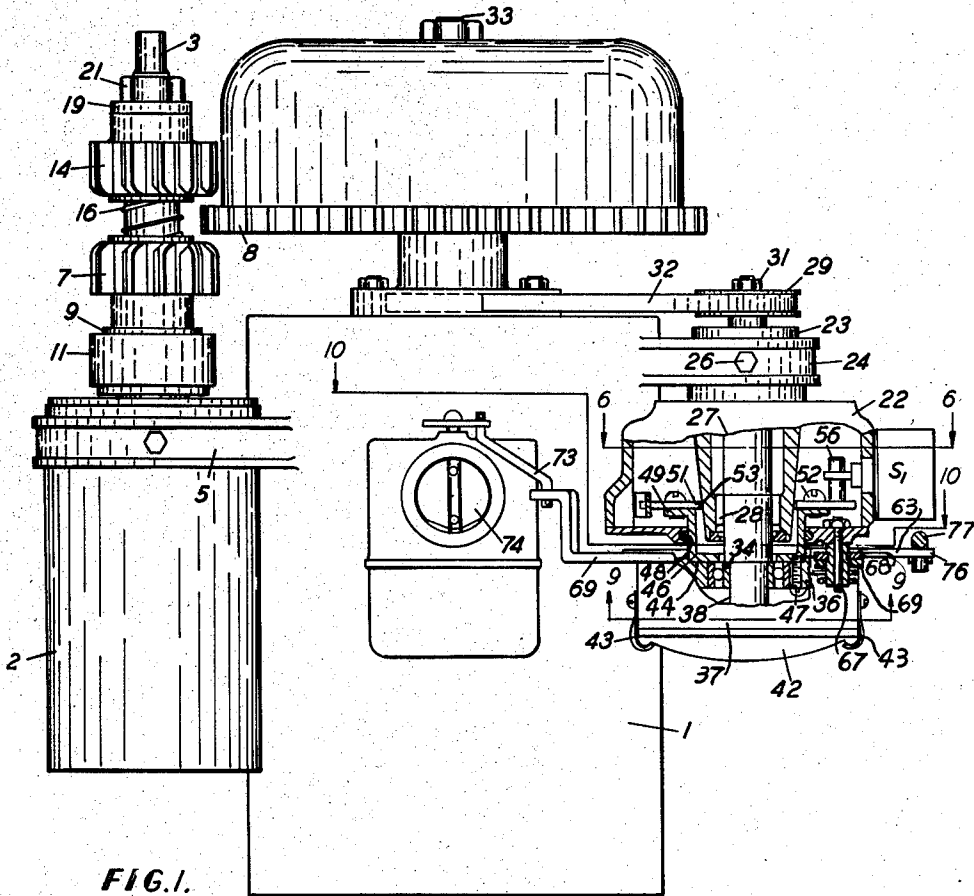


FIG. 1.

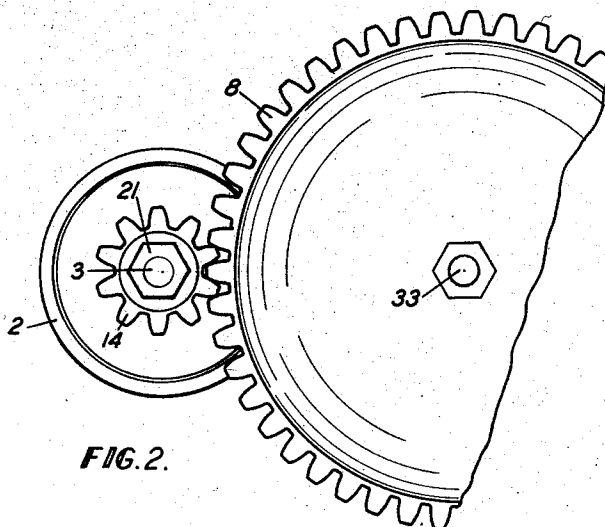


FIG. 2.

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4 Sheets-Sheet 2

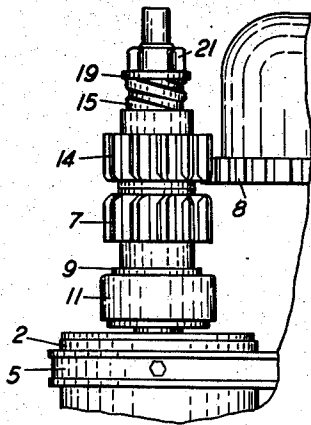


FIG. 3.

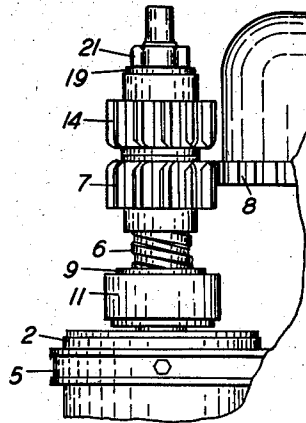


FIG. 4.

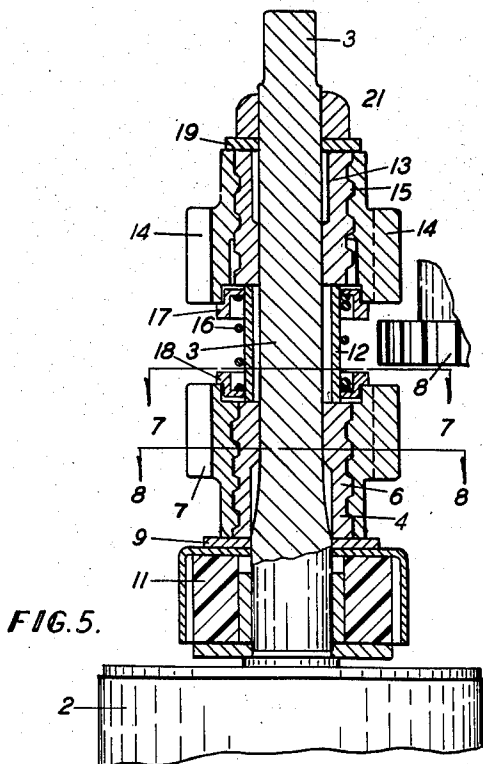


FIG. 5.

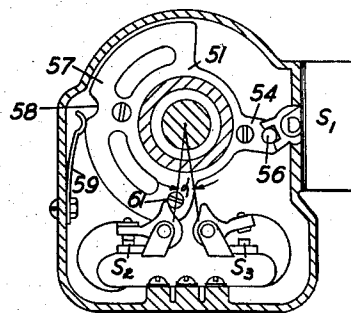


FIG. 6.

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ENGINE STARTING MECHANISM

2,847,985

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4 Sheets-Sheet 3

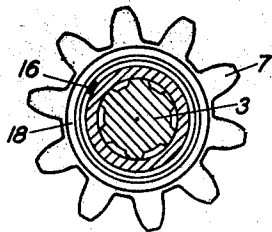


FIG. 7.

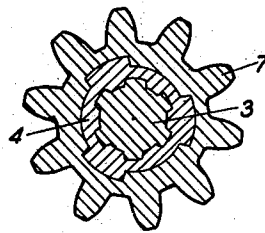


FIG. 8.

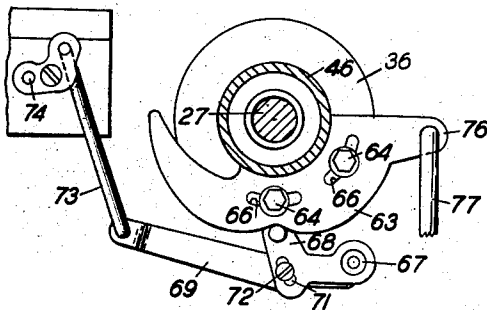


FIG. 10.

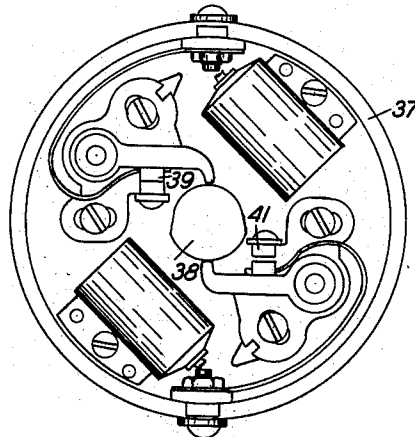


FIG. 9.

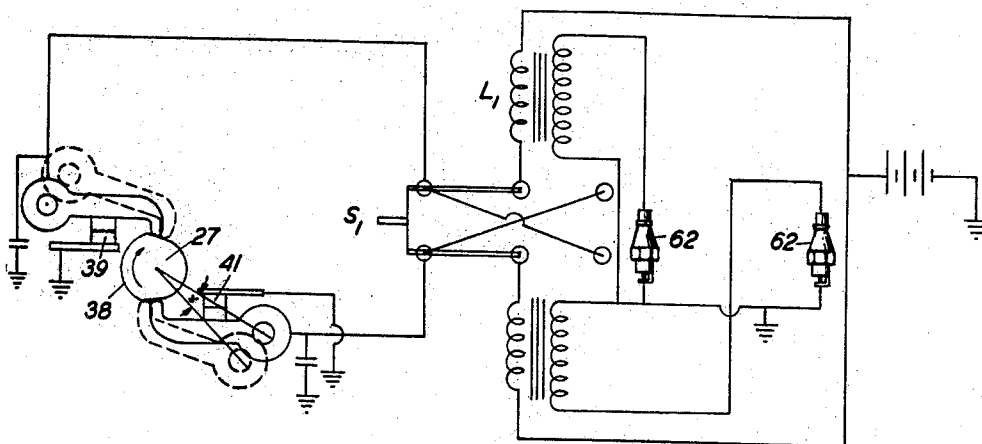


FIG. 11.

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2,847,985

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4 Sheets-Sheet 4

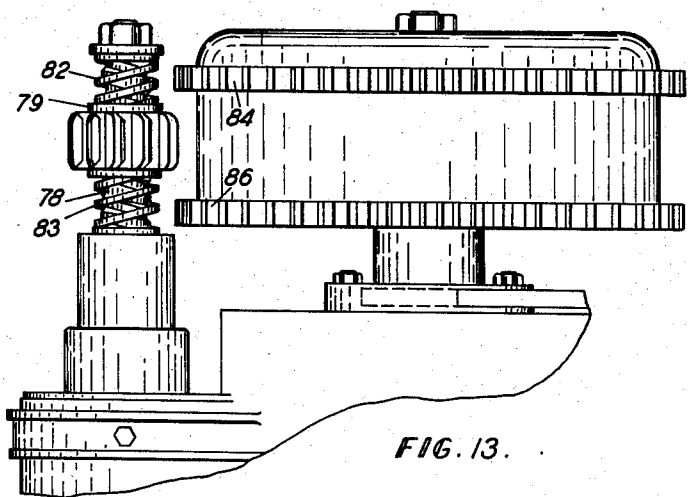


FIG. 13.

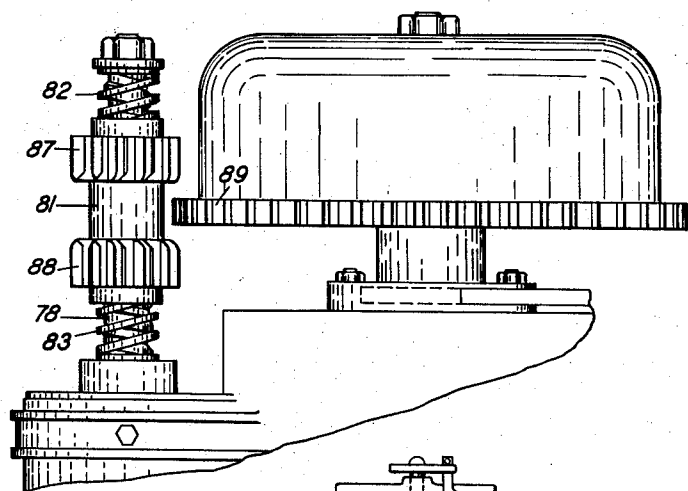


FIG. 14.

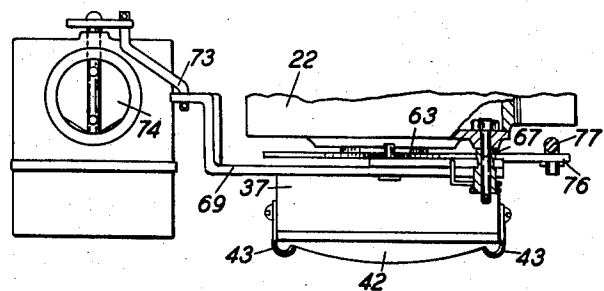


FIG. 12.

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2,847,985

ENGINE STARTING MECHANISM

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Application March 30, 1956, Serial No. 575,107

17 Claims. (Cl. 123—179)

This invention relates generally to starting mechanisms for internal combustion engines and more specifically to an improved starting mechanism for an internal combustion engine wherein the crankshaft of the engine is selectively cranked in a clockwise or counter-clockwise direction for starting the engine in either direction.

It is therefore an object of the present invention to provide an improved engine starting mechanism wherein the crankshaft of the engine is selectively cranked in either a clockwise or a counter-clockwise direction for starting same in either direction.

Still another object of the invention is to provide an improved starting mechanism for an internal combustion engine that eliminates the need to crank the engine manually.

A further object of the invention is to provide an improved ignition and starter gearing switching system for an internal combustion engine adapted to be operated in either direction of rotation.

Another object of the invention is the provision of an actuating mechanism wherein with one single continuous movement of an actuating lever the ignition is turned on, the starter motor is actuated to start the engine, the engine throttle is increased and the ignition spark advanced as the throttle is increased.

Objects and advantages other than those set forth above will be apparent from the following description when read in connection with the accompanying drawing, in which:

Fig. 1 is a front elevation view partly in section of an internal combustion engine embodying the invention;

Fig. 2 is a fragmentary plan view of the structure of Fig. 1;

Fig. 3 is a fragmentary side elevation view showing the starter gearing in engagement with the flywheel to crank the engine in one direction;

Fig. 4 is a fragmentary view similar to Fig. 3 showing the starter gearing in engagement with the flywheel to crank the engine in the opposite direction;

Fig. 5 is a fragmentary section view of the starter mechanism of the engine of Fig. 1;

Fig. 6 is a section view taken on line 6—6 of Fig. 1 showing the ignition and starter motor switch mechanism;

Fig. 7 is a section view taken on line 7—7 of Fig. 5;

Fig. 8 is a section view taken on line 8—8 of Fig. 5;

Fig. 9 is a view taken on line 9—9 of Fig. 1 showing the breaker contact points of the ignition system;

Fig. 10 is a section view taken on line 10—10 of Fig. 1 showing the cam and link mechanism adapted to control the carburetor throttle valve;

Fig. 11 is a diagrammatic view of the ignition system of the engine;

Fig. 12 is an elevation view partly in section of the structure of Fig. 10;

Fig. 13 is a fragmentary elevation view showing a modified starter mechanism for an engine; and

Fig. 14 is a view similar to Fig. 13 showing another modification of the starter mechanism.

As shown in the drawings, a preferred embodiment of this invention is illustrated as applied to an internal combustion engine 1. The engine 1 is of the type adapted to be selectively cranked in either a clockwise or counter-clockwise direction for engine operation in either direction. A novel starter gearing arrangement is shown in Figs. 1, 3, 4 and 5 as comprising essentially an electric reversible starter motor 2 mounted to a flange 5 provided on the engine 1 and having an elongated splined drive shaft 3. An annular sleeve member 4 is slidably disposed on the motor drive shaft 3 and is provided on its periphery with a series of screw threads 6. A pinion 7 is threaded onto the sleeve 4 for longitudinal movement into and out of engagement with a flywheel gear 8 of the engine 1. The longitudinal movement of the pinion 7 relative to shaft 3 is resisted in one direction by a washer 9 and cushioning member 11 mounted on the motor drive shaft 3. An annular spacer element 12 is disposed on the motor drive shaft 3 and has one end thereof abutting the sleeve 4 and the other end abutting a similar sleeve 13 having peripheral screw threads 15. A pinion 14 similar to pinion 7 is carried by the sleeve 13. The pinion members 7, 14 are urged away from one another and from the flywheel gear 8 by means of a spring 16 disposed around the shaft 3 and having its ends mated against respective annular cap members 17, 18. A stop washer 19 and nut 21 is mounted on the end of the drive shaft 3 and secures the sleeves 4, 13 and spacer 12 against the washer 19 to form a solid rotatable unit.

In the operation of the starter gearing mechanism, rotation of the motor drive shaft 3 is transmitted to the sleeve members 4, 13. Since the screw threads 6, 15 on the sleeve members are directionally the same, that is both right hand or left hand, the rotative movement of the sleeve members 4, 13 causes the respective pinions 7, 14 to move longitudinally relative to shaft 3 in the same direction. For one direction of rotation of shaft 3 the pinion 14 engages the flywheel gear 8 to crank the engine 1 in the direction opposite from shaft 3 while the other pinion member 7 engages the washer 9 as shown in Fig. 3. Upon rotation of the motor drive shaft 3 in the opposite direction, the pinion 7 engages the flywheel gear 8 to crank the engine 1 in a correspondingly opposite direction and the pinion 14 engages the stop washer 19 as shown in Fig. 4.

When the engine 1 starts, the acceleration of the engine flywheel gear 8 throws the pinion 7 or 14 in engagement therewith back against the cushioning member 11 or stop washer 19 respectively where it is retained out of engagement with the flywheel gear 8 by the spring 16.

Applicant's invention further contemplates a novel ignition and starter gearing switching system as shown in Figs. 1, 6, 9, 10, 11 and 12. A housing 22 within which an ignition switch S_1 and starter motor switches S_2 and S_3 are disposed is provided with an annular projection 23 extending within a flange 24 provided on the engine 1 and is rigidly secured to the flange 24 by any suitable means such as a screw 26. A shaft 27 is rotatably journaled within suitable bearings 28, only one of which is shown, carried by the housing 22, and one end of the shaft 27 is provided with a pulley 29 secured thereto by means of a nut 31. The pulley 29 is driven by means of a belt 32 connected to a similar pulley, not shown, mounted on the engine crankshaft 33. The shaft 27 further extends through a bearing 34 carried by the base 36 of a rotatable ignition housing 37 and has its other end disposed within the ignition housing 37 and is provided with a cam surface 38 adapted to actuate breaker contact points 39, 41 as shown in Fig. 9.

3

The ignition housing 37 is closed off by means of an ignition cap 42 removably secured thereto by means of spring clamps 43. The base 36 of the ignition housing 37 is provided with an annular recess 44 adapted to receive an annular bracket 46 which is secured to the base 36 by means of studs 47. The bracket 46 extends through an opening 48 of housing 22 and includes a flange 49 which provides a base to which a switch actuating member 31 is secured as by means of cap screws 52. The switch actuating member 51 is an annular plate-like element having a circular opening 53 to provide clearance between the switch actuating member 51 and an axially projecting portion of the housing 22. The switch actuating member 51 is provided with a projection 54 as shown in Fig. 6 having a pin 56 mounted transverse thereto adapted to actuate the ignition switch S_1 shown diagrammatically in Fig. 11 as a double-pole double-throw switch of any suitable type. The switch actuating member 51 further includes an arcuate segment 57 oppositely disposed to the projection 54 which is provided with a peripheral recess 58 adapted to engage a spring member 59 serving as a detent means for maintaining the switch member S_1 in an ignition "off" position. The arcuate segment 57 further carries a pin 61 mounted transverse thereto for selectively actuating the spaced apart starter motor switches S_2 and S_3 upon rotative movement of the switch actuating member.

The switches S_2 and S_3 are electrically connected, not shown, to the reversible starter motor 2 so that closing switch S_2 causes the motor 2 to operate in one direction whereas closing switch S_3 causes the motor 2 to operate in the opposite direction of rotation. The switches S_2 and S_3 are positioned so that when either switch is closed to crank the engine 1, the spark plugs fire when the pistons, not shown, of the engine 1 are at respective top dead center position. To accomplish this, the lateral spacing of the switches S_2 and S_3 must be such that rotatively moving the switch actuating member 51 from a position where switch S_2 is closed to a position where switch S_3 is closed describes an angle α as shown in Fig. 6 equal in degrees to:

$$\alpha = \frac{360}{\text{No. of engine cylinders}}$$

(No. of degrees points open)

where number of degrees points open refers to the number of degrees the shaft 27 must be rotated from a position where the cam surface 38 thereon begins to open one of the breaker contact points 39, 41 to a position where the same cam surface 38 closes the points. The ignition systems to which this formula for computing the value of α is applicable contemplate two sets of breaker contact points 39, 41 as shown in Fig. 11. This is made more clear by reference to Fig. 11 which shows the relative position of the breaker contact points 39, 41 with respect to the cam 38 and shaft 27. Let us assume that with the points 39, 41 and cam 38 as shown, the ignition housing 37 and switch actuating member 51 are in a position where the switch actuating member 51 is about to close the switch S_2 to crank the engine 1 and rotate the shaft 27 and cam 38 in the direction of the arrow as indicated. The cam 38 is shown about to open the points 39 to cause the coil L_1 to produce a spark across the gap of one of the spark plugs 62 which we will assume to be the number one cylinder spark plug with the engine piston disposed at top dead center. To start the engine 1 in the opposite direction, assuming that the cam 38, shaft 27 and the piston remain in their original positions with the piston of the number one cylinder still at top dead center, the ignition housing 37 and switch actuating member 51 are rotated through the angle α to place the breaker contact points 39, 41 in the dotted position shown in Fig. 11 with the switch actuating member 51 about to close the switch S_3 to rotate the shaft 27 and cam 38 in the opposite

4

direction of the arrow. The double-pole, double-throw ignition switch S_1 is moved by the switch actuating member 51 in a position reversing the connection of the points 39, 41 to the coils L_1 , L_2 respectively so that the points 41 are now electrically connected to the coil L_1 . In this dotted position, the cam 38 is about to open the set of breaker points 41 to cause the coil L_1 to produce a spark across the number one cylinder spark plug 62.

A cam member 63 as shown in Fig. 10 is adjustably secured to the base 36 of the ignition housing 37 by means of studs 64 passing through arcuate slots 66. The cam member 63 is provided with a cam surface designed to increase the throttle upon movement of the ignition housing 37 in a clockwise or counter-clockwise direction. The housing 22 is provided with a pin member 67 which forms a pivot for a cam follower 68 and a link member 69. The cam follower 68 is provided with an arcuate slot 71 through which a cap screw 72 extends and engages a tapped opening in the link member 69 to provide a means of relative adjustment between the link member 69 and the cam follower 68. A link rod 73 has one end secured to one end of the link member 69 by any suitable means and the other end connected to a carburetor throttle valve 74 for controlling the speed of the engine 1 as is well known in the art. The cam member 63 is further provided with a projecting portion 76 having an opening adapted to pivotally receive the end of an actuating rod 77 which is provided at its other end by a handle, not shown, or any other suitable actuating means.

The operation of this invention will now be discussed assuming initially that the switch actuating member is disposed with the detent in engagement with the recess to place the ignition switch S_1 in the "off" position as when the engine 1 is not operating. The pin 61 carried by the sector is disposed intermediate the starter motor switches S_2 and S_3 which are both in the open position. Moving the actuating rod 77 in one direction causes the cam member 63, housing 37, bracket 46 and switch actuating member 51 to be rotatively moved about the axis of the shaft 27. This movement places the ignition switch S_1 in an "on" position and further movement causes one of the starter motor switches S_2 , S_3 to be closed actuating the starter motor 2 and causing one of the pinions 7, 14 to be moved into engagement with the flywheel gear 8 to crank the engine 1 in one direction. Once the engine 1 has started, continued movement of the rod 77 causes the pin 61 to override the switch whereupon the switch opens breaking the electrical circuit and stopping the starter motor 2. As the movement of the rod 77 is continued, the ignition housing 37 and breaker points 39, 41 are moved relative to the cam 38 carried by the shaft 27 causing the timing of the spark impulse to the spark plugs to be advanced as the cam member 63 effects further opening of the throttle valve to increase the rotative speed in revolutions per minute of the engine 1. It is to be noted that with one continuous movement of the actuating member 77, the ignition switch S_1 is turned on, the starter motor 2 is actuated to start the engine 1, and the timing of the spark impulse is advanced as the rotative speed of the engine 1 is increased. Movement of the actuating member 77 in the opposite direction from the initial ignition "off" position accomplishes the same action as discussed with the exception that the other starter motor switch is actuated causing the starter motor 2 to operate in the opposite direction to crank the engine 1 in the opposite direction.

In Figs. 13 and 14, applicant shows two modifications of the starter gearing mechanism of the invention. In both of the modifications, the respective shaft units 78 of starter motor 2 are adapted to carry the corresponding gear members 79, 81 which are mounted thereon interposed between two springs 82, 83. In Fig. 13 the pinion

79 forms a single gear which is interposed between two spaced apart flywheel gears 84, 86 and is adapted to selectively engage said gears in accordance with the direction of operation of motor 2. In Fig. 14 the gear member 81 is provided with spaced apart gears 87, 88 which are adapted to selectively engage the flywheel gear 89 interposed therebetween in accordance with the direction of starter motor operation.

Various embodiments of the invention may be employed within the scope of the appended claims.

It is claimed and desired to secure by Letters Patent:

1. An internal combustion engine starting mechanism comprising: a starter gear carried by said engine, a starter motor mounted on said engine, a pinion gear carried by said motor adapted upon rotation of said motor to engage said starter gear to crank same, an ignition housing carried by said engine and pivotal with respect thereto, starter motor switch means actuable by said housing upon pivotal movement thereof to start said motor whereby said pinion gear cranks said starter gear to start said engine, and ignition means mounted in part in said housing for providing a spark for said engine, said spark being advanced or retarded upon pivotal movement of said housing.

2. An internal combustion engine starting mechanism comprising: a starter gear carried by said engine, a reversible starter motor mounted on said engine, spaced apart pinion gears carried by said motor adapted upon rotation of said motor to selectively engage said starter gear for rotating said gear in either direction of rotation, an ignition housing carried by said engine and pivotal with respect thereto, starter motor switch means actuable by said housing upon pivotal movement thereof to selectively start said motor in either direction of rotation whereby one of said pinion gears cranks said starter gear to start said engine in either direction of rotation, and ignition means mounted in part in said housing for providing a spark for said engine, said spark being advanced or retarded upon pivotal movement of said housing.

3. An internal combustion engine starting mechanism comprising: a starter gear carried by said engine, a starter motor mounted on said engine, a pinion gear carried by said motor adapted upon rotation of said motor to engage said starter gear to crank same, a housing carried by said engine and pivotal with respect thereto, starter motor switch means actuable by said housing upon pivotal movement thereof to start said motor, ignition means mounted in part in said housing for providing a spark for said engine, said spark being advanced or retarded upon pivotal movement of said housing, a carburetor mounted on said engine having throttle means for regulating the speed of said engine, cam means mounted on said housing for controlling said throttle means, and means connected to said cam means and adapted upon continuous movement in one direction to pivotably move said housing to actuate said starter motor switch, said throttle means, and to advance the spark as the engine speed is increased.

4. An internal combustion engine starting mechanism comprising: a starter gear carried by said engine, a reversible starter motor mounted on said engine, spaced apart pinion gears carried by said motor adapted upon rotation of said motor to selectively engage said starter gear for rotating said gear in either direction of rotation, a housing carried by said engine and pivotal with respect thereto, starter motor switch means actuable by said housing upon pivotal movement thereof to start said motor, ignition means mounted in part in said housing for providing a spark for said engine, said spark being advanced or retarded upon pivotal movement of said housing, ignition switch means actuable by said housing to control the current flow through said ignition means, a carburetor mounted on said engine having throttle means for regulating the speed of said engine, cam means

mounted on said housing for controlling said throttle means, and means connected to said cam means and adapted upon continuous movement in either of two directions to actuate said ignition switch means, said starter motor switch means, said throttle means and to advance the spark as the engine speed is increased.

5. An internal combustion engine ignition and starting mechanism for engine operation in a clockwise or counter-clockwise direction comprising: a reversible starter motor mounted on said engine and having a shaft; spaced apart pinion gears carried by said shaft and axially movable thereon upon rotation of said shaft; a starter gear carried by said engine transverse to said shaft and positioned intermediate said pinion gears; an ignition housing carried by said engine and pivotal with respect thereto; ignition means mounted in part in said housing for providing a spark for said engine, said spark being advanced or retarded upon pivotal movement of said housing; spaced apart starter motor switches mounted on said engine, one of said switches in a closed position electrically connected to said starter motor to cause said starter motor to operate in one direction and said other switch in a closed position electrically connected to said starter motor to cause said starter motor to operate in the opposite direction; actuating means carried by said housing adapted upon pivotal movement of said housing to selectively close one of said starter motor switches whereby one of said pinion gears is axially moved on said shaft into engagement with said starter gear to crank same in a clockwise or counter-clockwise direction.

6. An internal combustion engine ignition and starting mechanism for engine operation in a clockwise or counter-clockwise direction comprising: a reversible starter motor mounted on said engine and having a shaft; spaced apart pinion gears carried by said shaft and axially movable thereon upon rotation of said shaft; a starter gear carried by said engine transverse to said shaft and positioned intermediate said pinion gears; an ignition housing carried by said engine and pivotal about an axis with respect thereto; ignition means comprising a pair of breaker points and first cam means adapted to open same mounted in part in said housing for providing a spark for said engine, said spark being advanced or retarded upon pivotal movement of said housing; a pair of laterally spaced starter motor switches mounted on said engine, one of said switches in a closed position electrically connected to said starter motor to cause said starter motor to operate in one direction and said other switch in a closed position electrically connected to said starter motor to cause said starter motor to operate in the opposite direction; actuating means carried by said housing adapted upon pivotal movement of said housing about said axis to selectively close one of said starter motor switches whereby one of said pinion gears is axially moved into engagement with said starter gear to crank same in a clockwise or counter-clockwise direction, said starter motor switches being spaced apart a distance such that said actuating means when pivotably moved from a position where one of said switches is closed to a position where said other switch is closed describes an angle

$$\alpha \text{ equal to } \frac{360}{\text{No. of engine cylinders}} \quad \text{---}$$

(No. of degrees points open)

where number of degrees points open refers to the number of degrees said first cam means must be rotated from a position where said cam means begins to open one of said points to a position where said cam means closes said one of said points, whereby said spark when either of said switches is closed to crank said starter gear occurs when the engine piston is in the same position with respect to top dead center position.

7. A starting mechanism for an internal combustion.

engine for cranking said engine in a clockwise or counterclockwise direction of rotation for starting same comprising: a reversible starter motor mounted on said engine and having a shaft, said shaft being provided with splines, spaced apart annular sleeve elements having spline receiving portions carried by said shaft, threads formed on the outer periphery of said sleeve elements, an annular spacer element carried by said shaft intermediate said sleeve elements, a nut threaded on one end of said shaft to bear against one of said sleeve elements to rigidly secure said sleeve elements and said spacer element to said shaft, spaced apart pinion gears threaded onto said threads of said sleeve elements, a pair of annular cap members disposed about said spacer element and having a portion of each thereof abutting one of said pinion gears, resilient means disposed about said spacer element intermediate said cap members, a starter gear carried by said engine transverse to said shaft and positioned intermediate said pinion gears, and means for starting said starter motor in one or the other direction of rotation whereby one of said pinion gears is axially moved into engagement with said starter gear to crank said engine in a clockwise or counterclockwise direction of rotation.

8. An internal-combustion engine starting mechanism comprising: a starter gear carried by said engine, a starter motor mounted on said engine, a pinion gear carried by said motor adapted upon rotation of said motor to engage said starter gear to crank same, a housing carried by said engine and pivotal with respect thereto, starter motor switch means actuatable by said housing upon pivotal movement thereof to start said motor, ignition means mounted in part in said housing for providing a spark for said engine, said spark being advanced or retarded upon pivotal movement of said housing, ignition switch means provided on the engine and being actuatable by said housing to control the current flow through said ignition means, a carburetor mounted on said engine having throttle means for regulating the speed of said engine, cam means mounted on said housing for controlling said throttle means, and means connected to said cam means and adapted upon continuous movement in one direction to pivotally move said housing to actuate said ignition switch and starter motor switch, said throttle means, and to advance the spark as the engine speed is increased.

9. An internal-combustion engine ignition and starting mechanism for engine operation in a clockwise or counterclockwise direction comprising: a reversible starter motor mounted on said engine and having a shaft; spaced apart pinion gears carried by said shaft and axially movable thereon upon rotation of said shaft; a starter gear carried by said engine transverse to said shaft and positioned intermediate said pinion gears; an ignition housing carried by said engine and pivotal with respect thereto; ignition means mounted in part in said housing for providing a spark for said engine, said spark being advanced or retarded upon pivotal movement of said housing; spaced apart starter motor switches mounted on said engine, one of said switches in a closed position electrically connected to said starter motor to cause said starter motor to operate in one direction and said other switch in a closed position electrically connected to said starter motor to cause said starter motor to operate in the opposite direction; and a plate member carried by said housing and having a pin transverse thereto adapted to actuate said starter motor switches upon pivotal movement of said housing to selectively close one of said starter motor switches and start the motor whereby one of said pinion gears is axially moved on said shaft into engagement with said starter gear to crank same in a clockwise or counterclockwise direction.

10. An internal-combustion engine ignition and starting mechanism for engine operation in a clockwise or counterclockwise direction comprising: a reversible

starter motor mounted on said engine and having a shaft; spaced apart pinion gears carried by said shaft and axially movable thereon upon rotation of said shaft; a starter gear carried by said engine transverse to said shaft and positioned intermediate said pinion gears; an ignition housing carried by said engine and pivotal with respect thereto; ignition means mounted in part in said housing for providing a spark for said engine, said spark being advanced or retarded upon pivotal movement of said housing; an ignition switch mounted on said engine; spaced apart starter motor switches mounted on said engine, one of said switches in a closed position electrically connected to said starter motor to cause said starter motor to operate in one direction and said other switch in a closed position electrically connected to said starter motor to cause said starter motor to operate in the opposite direction; and actuating means carried by said housing and adapted upon pivotal movement of said housing to actuate the ignition switch to effect current flow through said ignition means and to selectively close one of said starter motor switches and start the motor whereby one of said pinion gears is axially moved on said shaft into engagement with said starter gear to crank same in a clockwise or counterclockwise direction.

11. An internal-combustion engine ignition and starting mechanism for engine operation in a clockwise or counterclockwise direction comprising: a reversible starter motor mounted on said engine and having a shaft; spaced apart pinion gears carried by said shaft and axially movable thereon upon rotation of said shaft; a starter gear carried by said engine transverse to said shaft and positioned intermediate said pinions gears; an ignition housing carried by said engine and pivotal with respect thereto; ignition means mounted in part in said housing for providing a spark for said engine, said spark being advanced or retarded upon pivotal movement of said housing; a double-pole, double-throw ignition switch mounted on said engine; spaced apart starter motor switches mounted on said engine, one of said switches in a closed position electrically connected to said starter motor to cause said starter motor to operate in one direction and said other switch in a closed position electrically connected to said starter motor to cause said starter motor to operate in the opposite direction; and actuating means carried by said housing and adapted upon pivotal movement of said housing selectively in a clockwise or counterclockwise direction to actuate the ignition switch to effect current flow through said ignition means and to close the starter motor switch corresponding to the direction of pivot of said housing and thereby start the motor whereby the corresponding pinion gear is axially moved on said shaft into engagement with said starter gear to crank same in the desired direction.

12. An internal-combustion engine ignition and starting mechanism for engine operation in a clockwise or counterclockwise direction comprising: a reversible starter motor mounted on said engine and having a shaft; spaced apart pinion gears carried by said shaft and axially movable thereon upon rotation of said shaft; a starter gear carried by said engine transverse to said shaft and positioned intermediate said pinion gears; an ignition housing carried by said engine and pivotal with respect thereto; ignition means mounted in part in said housing for providing a spark for said engine, said spark being advanced or retarded upon pivotal movement of said housing; an ignition switch mounted on said engine and having an "off" position; spaced apart starter motor switches mounted on said engine, one of said switches in a closed position electrically connected to said starter motor to cause said starter motor to operate in one direction and said other switch in a closed position electrically connected to said starter motor to cause said

starter motor to operate in the opposite direction; actuating means carried by said housing for actuating said ignition switch and including an arcuate portion having a recess; and detent means mounted on said engine and being adapted to frictionally engage said recess to hold the ignition switch in said "off" position; said actuating means being disengageable from said detent means upon pivotal movement of said housing and adapted to actuate the ignition switch from said "off" position to effect current flow through said ignition means and to selectively close one of said starter motor switches and start the motor whereby one of said pinion gears is axially moved on said shaft into engagement with said starter gear to crank same in a clockwise or counterclockwise direction.

13. An internal-combustion engine ignition and starting mechanism for engine operation in a clockwise or counterclockwise direction comprising: a reversible starter motor mounted on said engine and having a shaft; spaced apart pinion gears carried by said shaft and axially movable thereon upon rotation of said shaft; a starter gear carried by said engine transverse to said shaft and positioned intermediate said pinion gears; an ignition housing carried by said engine and pivotal with respect thereto; ignition means mounted in part in said housing for providing a spark for said engine, said spark being advanced or retarded upon pivotal movement of said housing; a carburetor mounted on said engine and having throttle means for regulating the speed of the engine; cam means mounted on said ignition housing for controlling said throttle means upon pivotal movement of said housing; spaced apart starter motor switches mounted on said engine, one of said switches in a closed position electrically connected to said starter motor to cause said starter motor to operate in one direction and said other switch in a closed position electrically connected to said starter motor to cause said starter motor to operate in the opposite direction; actuating means carried by said housing adapted upon pivotal movement of said housing to selectively close one of said starter motor switches and start the motor whereby one of said pinion gears is axially moved on said shaft into engagement with said starter gear to crank same in a clockwise or counterclockwise direction.

14. An internal-combustion engine ignition and starting mechanism for engine operation in a clockwise or counterclockwise direction comprising: a reversible starter motor mounted on said engine and having a shaft; spaced apart pinion gears carried by said shaft and axially movable thereon upon rotation of said shaft; a starter gear carried by said engine transverse to said shaft and positioned intermediate said pinion gears; an ignition housing carried by said engine and pivotal about an axis with respect thereto; ignition means comprising a pair of breaker points and first cam means adapted to open same mounted in part in said housing for providing a spark for said engine, said spark being advanced or retarded upon pivotal movement of said housing; an ignition switch mounted on said engine; a pair of laterally spaced starter motor switches mounted on said engine, one of said switches in a closed position electrically connected to said starter motor to cause said starter motor to operate in one direction and said other switch in a closed position electrically connected to said starter motor to cause said starter motor to operate in the opposite direction; actuating means carried by said housing adapted upon pivotal movement of said housing about said axis to actuate the ignition switch to effect current flow through said ignition means and to selectively close one of said starter motor switches whereby one of said pinion gears is axially moved into engagement with said starter gear to crank same in a clockwise or counterclockwise direction, said starter motor switches being spaced apart a distance such that said actuating means when pivotally moved from a

position where one of said switches is closed to a position where said other switch is closed describes an angle

$$\alpha \text{ equal to } \frac{360}{\text{No. of engine cylinders}}$$

(No. of degrees points open)

where number of degrees points open refers to the number of degrees said first cam means must be rotated from a position where said cam means begins to open one of said points to a position where said cam means closes said one of said points, whereby said spark when either of said switches is closed to crank said starter gear occurs when the engine piston is in the same position with respect to top dead center position.

15. An internal-combustion engine ignition and starting mechanism for engine operation in a clockwise or counterclockwise direction comprising: a reversible starter motor mounted on said engine and having a shaft; spaced apart pinion gears carried by said shaft and axially movable thereon upon rotation of said shaft; a starter gear carried by said engine transverse to said shaft and positioned intermediate said pinion gears; an ignition housing carried by said engine and pivotal about an axis with respect thereto; ignition means comprising a pair of breaker points and first cam means adapted to open same mounted in part in said housing for providing a spark for said engine, said spark being advanced or retarded upon pivotal movement of said housing; a double-pole, double-throw ignition switch mounted on said engine; a pair of laterally spaced starter motor switches mounted on said engine, one of said switches in a closed position electrically connected to said starter motor to cause said starter motor to operate in one direction and said other switch in a closed position electrically connected to said starter motor to cause said starter motor to operate in the opposite direction; actuating means carried by said housing and adapted upon pivotal movement of said housing selectively in a clockwise or counterclockwise direction to actuate the ignition switch to effect current flow through said ignition means and to close the starter motor switch corresponding to the direction of pivot of said housing and thereby start the motor whereby the corresponding pinion gear is axially moved on said shaft into engagement with said starter gear to crank same in the desired direction, said starter motor switches being spaced apart a distance such that said actuating means when pivotally moved from a position where one of said switches is closed to a position where said other switch is closed describes an angle

$$\alpha \text{ equal to } \frac{360}{\text{No. of engine cylinders}}$$

(No. of degrees points open)

where number of degrees points open refers to the number of degrees said first cam means must be rotated from a position where said cam means begins to open one of said points to a position where said cam means closes said one of said points, whereby said spark when either of said switches is closed to crank said starter gear occurs when the engine piston is in the same position with respect to top dead center position.

16. An internal-combustion engine ignition and starting mechanism for engine operation in a clockwise or counterclockwise direction comprising: a reversible starter motor mounted on said engine and having a shaft; spaced apart pinion gears carried by said shaft and axially movable thereon upon rotation of said shaft; a starter gear carried by said engine transverse to said shaft and positioned intermediate said pinion gears; an ignition housing carried by said engine and pivotal about an axis with respect thereto; ignition means comprising a pair of breaker points and first cam means adapted to open same mounted in part in said housing for providing a spark for said engine, said spark being advanced or retarded

11

upon pivotal movement of said housing; a double-pole, double-throw ignition switch mounted on said engine and having an "off" position; a pair of laterally spaced starter motor switches mounted on said engine, one of said switches in a closed position electrically connected to said starter motor to cause said starter motor to operate in one direction and said other switch in a closed position electrically connected to said starter motor to cause said starter motor to operate in the opposite direction; actuating means carried by said housing for actuating said ignition switch and including an arcuate portion having a recess; and detent means mounted on said engine and being adapted to frictionally engage said recess to hold the ignition switch in said "off" position; said actuating means being disengageable from said detent means upon pivotal movement of said housing and adapted to actuate the ignition switch from said "off" position to effect current flow through said ignition means and to selectively close one of said starter motor switches and start the motor whereby one of said pinion gears is axially moved on said shaft into engagement with said starter gear to crank same in a clockwise or counterclockwise direction, said starter motor switches being spaced apart a distance such that said actuating means when pivotally moved from a position where one of said switches is closed to a position where said other switch is closed describes an angle

$$\alpha \text{ equal to } \frac{360}{\text{No. of engine cylinders}}$$

(No. of degrees points open)

where number of degrees points open refers to the number of degrees said first cam means must be rotated from a position where said cam means begins to open one of said points to a position where said cam means closes said one of said points, whereby said spark when either of said switches is closed to crank said starter gear occurs when the engine piston is in the same position with respect to top dead center position.

17. An internal-combustion engine ignition and starting mechanism for engine operation in a clockwise or counterclockwise direction comprising: a reversible starter motor mounted on said engine and having a shaft; spaced apart pinion gears carried by said shaft and axially movable thereon upon rotation of said shaft; a starter gear carried by said engine transverse to said shaft and positioned intermediate said pinion gears; an ignition housing carried by said engine and pivotal about an axis with respect thereto; ignition means comprising a pair of breaker points and first cam means adapted to open same mounted in part in said housing for providing a

12

spark for said engine, said spark being advanced or retarded upon pivotal movement of said housing; a carburetor mounted on said engine and having throttle means for regulating the speed of the engine; cam means mounted on said ignition housing for controlling said throttle means upon pivotal movement of said housing; a double-pole, double-throw ignition switch mounted on said engine and having an "off" position; a pair of laterally spaced starter motor switches mounted on said engine, one of said switches in a closed position electrically connected to said starter motor to cause said starter motor to operate in one direction and said other switch in a closed position electrically connected to said starter motor to cause said starter motor to operate in the opposite direction; actuating means carried by said housing for actuating said ignition switch and including an arcuate portion having a recess; and detent means mounted on said engine and being adapted to frictionally engage said recess to hold the ignition switch in said "off" position; said actuating means being disengageable from said detent means upon pivotal movement of said housing and adapted to actuate the ignition switch from said "off" position to effect current flow through said ignition means and to selectively close one of said starter motor switches and start the motor whereby one of said pinion gears is axially moved on said shaft into engagement with said starter gear to crank same in a clockwise or counterclockwise direction, said starter motor switches being spaced apart a distance such that said actuating means when pivotally moved from a position where one of said switches is closed to a position where said other switch is closed describes an angle

$$\alpha \text{ equal to } \frac{360}{\text{No. of engine cylinders}}$$

(No. of degrees points open)

where number of degrees points open refers to the number of degrees said first cam means must be rotated from a position where said cam means begins to open one of said points to a position where said cam means closes said one of said points, whereby said spark when either of said switches is closed to crank said starter gear occurs when the engine piston is in the same position with respect to top dead center position.

References Cited in the file of this patent

UNITED STATES PATENTS

1,369,220	Chryst	Feb. 22, 1921
1,844,543	Codrington	Feb. 9, 1932
2,764,028	Kincannon	Sept. 25, 1956