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J. R. THONGER ET AL

1,951,637

STARTING MECHANISM FOR INTERNAL COMBUSTION MOTORS

Filed May 9, 1931

2 Sheets-Sheet 1

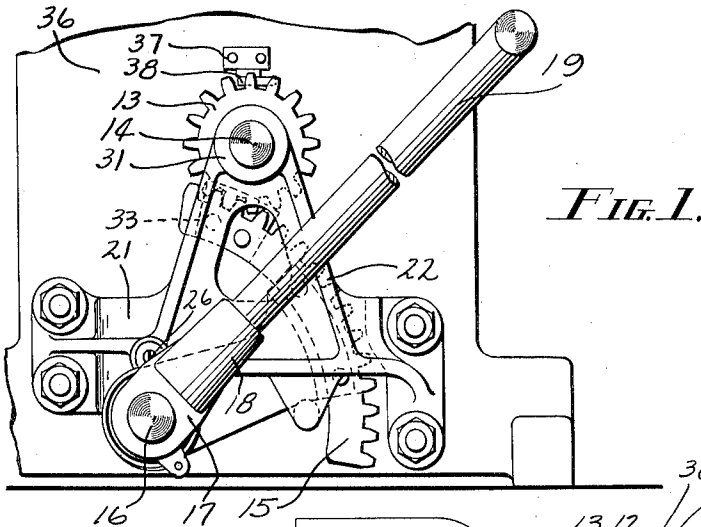


FIG. 1.

FIG. 2.

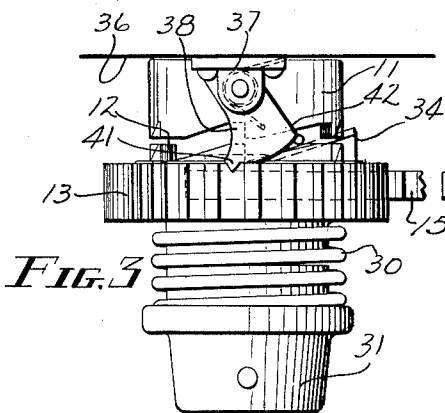
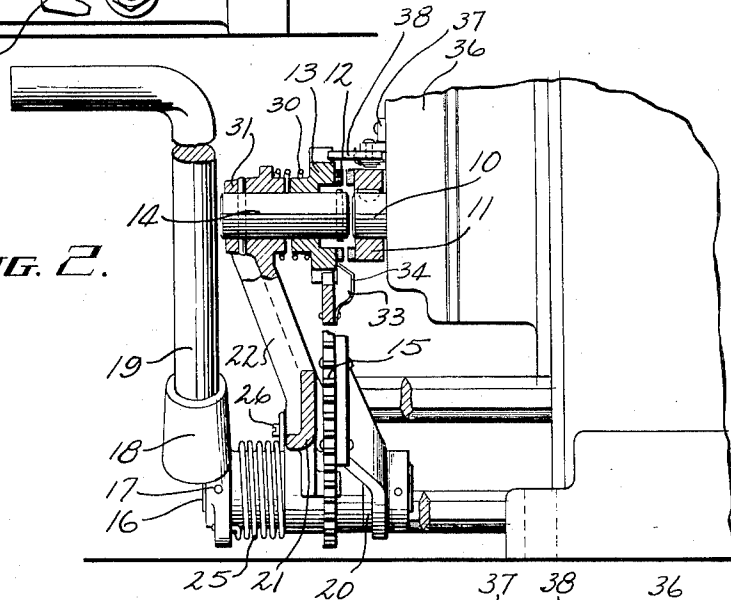


FIG. 3.

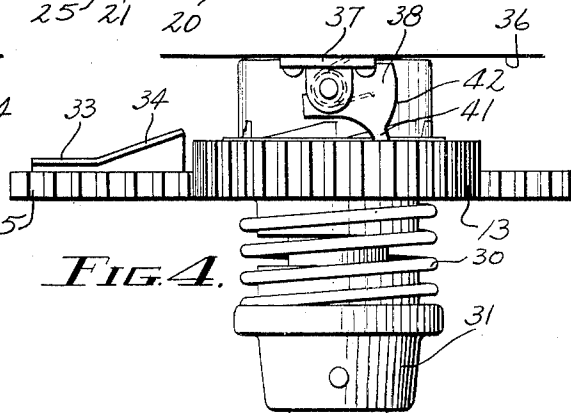


FIG. 4.

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FIG. 5.

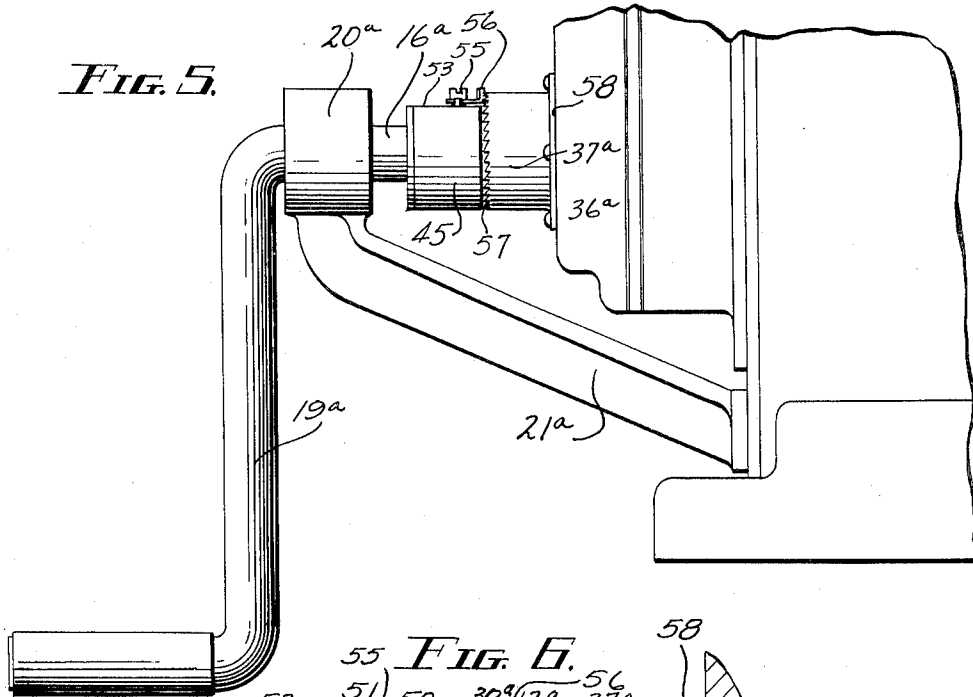


FIG. 6.

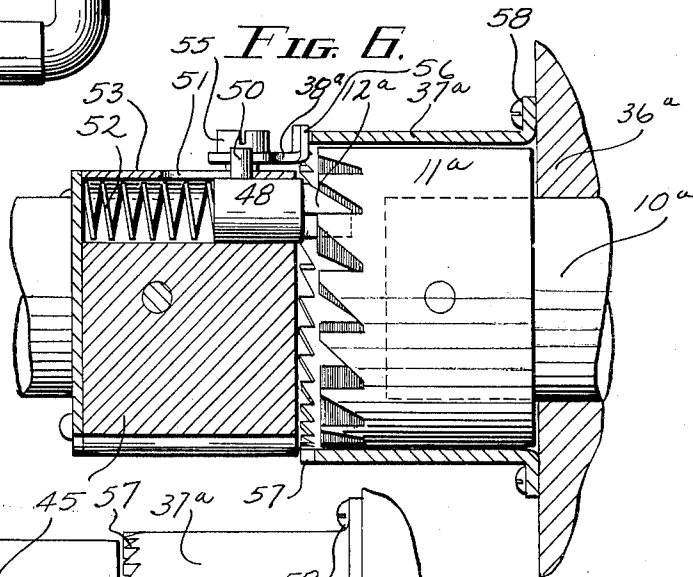
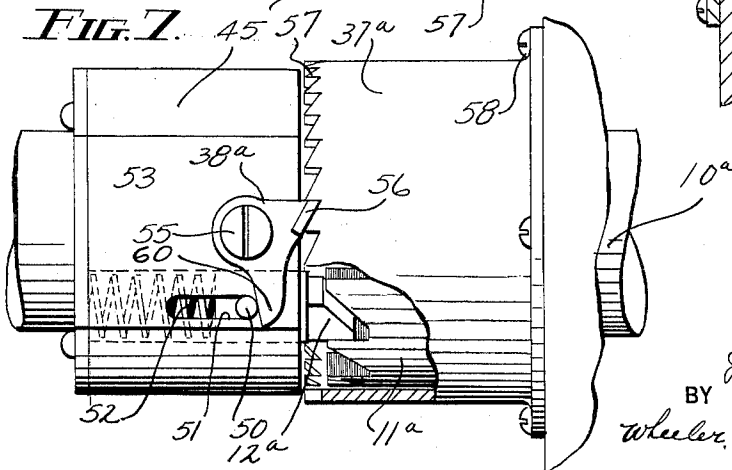


FIG. 7.



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STARTING MECHANISM FOR INTERNAL COMBUSTION MOTORS

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Application May 9, 1931, Serial No. 536,215

11 Claims. (Cl. 127—185)

Our invention relates to improvements in starting mechanism for internal combustion motors.

Our objects are to provide an improved starting mechanism promoting convenience and safety in motor starting operations.

More specifically stated, our objects are,—to provide efficient and safe means for rotating the crank shaft of the motor with the aid of reduction gear mechanism, the driven member of which is normally disengaged from the engine shaft but automatically becomes engaged therewith during operation of the starting lever; to provide starting mechanism having reduction gears in constant mesh and associated clutch mechanism in which a driving connection will be automatically made with the engine shaft only during a portion of the movement of the lever in one direction; to provide means whereby the starting lever will be automatically returned to its normal position if manually released when in any other position; to provide reliable, positively acting, throw-out mechanism for automatically disengaging the driven member of the starting gear from the motor shaft if the motor backfires, i. e., if the motor starts in the wrong direction; and in general, to so organize a starting mechanism that a motor may be easily and safely started by mere reciprocation of a starting lever after proper adjustment of its ignition switch and throttle valve, no manual adjustments or other attention being required to effect the coupling of the starting mechanism to the motor shaft at the proper time.

In the drawings:

Figure 1 is a front elevation of our invention, showing the same applied to a motor casing.

Figure 2 is a side elevation of the same, with parts broken away and other parts illustrated in vertical section.

Figure 3 is a plan view of the driven member and associated parts, a fragment of the sector gear being also illustrated, and the throw-out cam dog being shown in clutch disengaging position.

Figure 4 is a view showing the cam dog in normal position and the sector gear in position allowing the associated pinion to engage the motor shaft.

Figure 5 is a side elevation showing a modification, wherein the throw-out cam dog is associated with a starting crank adapted to be directly coupled to the motor shaft.

Figure 6 is an enlarged fragmentary view of the clutch, cam dog, and associated parts, with portions shown in vertical section.

Figure 7 is a plan view of the parts shown in Figure 6, with a portion of the clutch housing partially broken away.

Like parts are identified by the same reference characters throughout the several views.

In the structure shown in Figures 1 to 4, inclusive, the crank shaft 10 of the motor is provided with a clutch member 11 engageable by clutch jaws 12 projecting from the side face of a pinion 13, slidably mounted on a supporting stud shaft 14, whereby the jaws 12 may be carried into and out of engagement with the teeth of clutch member 11 by movement of the pinion on its stud shaft. The pinion may be rotated by a toothed sector 15 carried by an oscillatory starting shaft 16 to which the sector is fixedly secured. The shaft 16 has an arm 17 provided with a socketed end portion 18 adapted to receive a rod 19 which serves as a lever to manually oscillate the shaft.

The extent of the sector 15 is such that it remains in continuous mesh with the pinion while the lever is being oscillated, and the pinion is of sufficient width to allow it to shift on its stud shaft into and out of clutch engagement with the motor shaft while remaining in mesh with the teeth of the sector. Therefore, during the movement of the sector and its actuating lever in one direction the pinion may be in clutch engagement with the motor crank shaft for at least a portion of such stroke, and during the return stroke the pinion may be shifted on its stud shaft to release the motor shaft.

In the construction illustrated, means are provided for holding the pinion out of engagement with the motor shaft during the initial portion of the actuating stroke of the lever and for retracting the pinion from engagement with the motor shaft during the final portion of the retractive stroke, this being incident to the operation of the pinion actuating mechanism herein-after described.

The shaft 16 is mounted in suitable bearings 20 carried by the frame bracket 21. This bracket has an upwardly projecting arm 22 to which the stud shaft 14 is secured. A tension spring 25 is coiled about the starting shaft 16, with one end anchored to the shaft or its arm 17 and the other end attached to the frame bracket at 26 (Figure 2). This spring tends to swing the starting lever to normal position, whereby if the lever is manually released when out of such position it will be immediately returned to the normal position by the spring 25.

To automatically shift the pinion 13 into engagement with the motor shaft, a compression spring 30 is interposed between the pinion 13 and a hub 31 of the frame bracket arm 22, the pinion being provided with a suitable hub to receive the other end of said spring whereby the pinion 13 will be urged by the spring in the direction of the motor shaft clutch member 11. The pinion teeth and those of the clutch member 11 are of ratchet type, with oblique faces at one side permitting independent rotation of the

motor shaft in clockwise direction by pushing the pinion outwardly to allow the points of the teeth to clear.

Normally, however, the pinion is held in the retracted position by a shoe 33, secured to the inner side of the sector gear 15 and provided with an upwardly projecting flange-like portion in a position to bear against the inner side face of the pinion 13 when in registry therewith. The shoe has an extension 34 of its pinion engaging flange, which diverges from the sector in the direction of the end opposite that which normally engages the pinion, whereby, after the starting lever has been swung to the left, (counter-clockwise), in a motor starting stroke, the shoe 33 will first be moved to the left as viewed in Fig. 4 far enough to release the pinion and allow the spring 30 to automatically move it inwardly to engage its clutch teeth with those on the motor shaft clutch member. The oblique portion 34 of the shoe is so disposed that upon the return stroke it will engage the inner side of the pinion and force it outwardly as the sector approaches normal position, thereby disengaging the pinion from the motor shaft.

Back fire throw-out mechanism is also provided. The crank case 36 has a supporting projection 37 to which an oscillatory spring-actuated cam dog 38 is pivoted. This dog is provided with an arm 41 which bears obliquely against the ends of the pinion teeth and slides across the ends of the teeth when the pinion is being rotated in a motor starting direction. The arm is urged by the spring between the teeth, but owing to its oblique position, it is pushed out from between them during such rotation. But whenever the pinion is rotated in the opposite direction, the teeth engage this arm 41 and rotate the dog until its cam surface 42 engages the pinion and pushes the pinion outwardly to disengage it from the motor shaft.

In the construction illustrated in Figures 5, 6, and 7, the starting crank 19a is formed for direct clutch engagement with the motor shaft. Its shaft portion 16a is supported by an arm 21a, provided with a bearing member 20a, and the inner end of this shaft portion 16a is provided with a cylindrical head 45 in which a plunger 48 is socketed, this plunger having a projecting ratchet tooth 12a adapted to engage between the teeth of the motor shaft clutch member 11a. The plunger 48 is provided with a laterally projecting pin 50 extending through a slot 51 in the wall of the plunger socket, this pin preventing the plunger from rotating in its socket.

A compression spring 52 is seated between the plunger and the base of the socket and tends to urge the tooth 12a in the direction of the motor clutch member 11a while allowing the tooth to yield and pass over the ends of the clutch teeth during retractive movements of the crank. The portion of the head 45 through which the slot 51 extends has a flat surface 53 to which a cam dog 38a is pivoted at 55. This dog has a ratchet tooth 56 in position for engagement with ratchet teeth 57 formed at the outer end of a sleeve-like projection 37a which encircles the clutch member 11a and is attached to the wall of the motor crank case, as indicated at 58. The cam dog 38a also has an arm 60 which normally bears against the pin 50 which guides the plunger 48.

It will be observed that the ratchet teeth 57 are pitched in the opposite direction from those of the clutch member 11a and the arm or tooth 56 of the cam dog is reversely pitched, whereby if

the motor back-fires, thereby tending to rotate the motor shaft and associated clutch member 11a in a counter-clockwise direction, the arm 56 of the cam dog will engage one of the teeth 57 and the cam will be oscillated in a clockwise direction, thereby causing its arm 60 to push against the pin 50 and retract the clutch dog 12a by pushing the plunger 48 into its socket against the resistance of the spring 52. As soon as the clutch dog 12a is released from the teeth of the clutch member 11a the crank will, of course, be released from connection with the motor shaft.

It will be observed that in the construction shown in Figures 1 to 4, inclusive, the back-fire throw-out cam is supported from the crank case of the motor, whereas in Figures 5, 6, and 7 it is supported from the starting crank shaft and the associated ratchet is supported from the crank casing. The principle of operation is substantially the same, and in a broad aspect, one is to be regarded as the mechanical converse of the other. In either case, the cam dog operates to force a retraction of the starting crank, clutch teeth, or clutch tooth, from the motor shaft ratchet clutch whenever the motor shaft revolves in a counter-clockwise direction, such as occurs when the motor back fires.

We are aware that attempts have heretofore been made to provide throw-out cam dogs in a somewhat similar organization to that illustrated in Figures 5, 6, and 7, but we believe we are the first to provide a cam dog which can be relied upon to positively retract or separate the clutch members without injury to the operator. In both forms of construction as illustrated herein the engagement of the cam dog arm between the teeth from which the cam action is derived is positive and certain in operation, although the arm freely slides across the ends of the teeth when the motor shaft is being revolved in the proper direction. Also, in both forms of construction, the oscillation of the cam by the positively engaged arm is certain to effect an instant and complete release of the starting crank.

An important feature of our improved throw-out mechanism includes the provision of means for automatically and yieldingly urging the starter clutch member in the direction of the motor shaft clutch member.

We claim:

1. The combination with a motor crank shaft and associated motor clutch member, of a starter shaft aligned with the motor shaft, a manually rotatable one-way acting starter member movable along the starter shaft into and out of engagement with the motor clutch member, means for yieldingly urging the starter member in the direction of the motor clutch member, a cam responsive to reverse rotation of the motor shaft for retracting the starter member from the motor clutch member, said cam having an actuating finger adapted to normally bear obliquely against the side of the starter member in a position to be positively engaged thereby during reverse rotation of the starter member.

2. The combination with a motor crank shaft and associated motor clutch member, of a starter shaft aligned with the motor shaft, a manually rotatable one-way acting starter member movable along the starter shaft into and out of engagement with the motor clutch member, means for yieldingly urging the starter member in the direction of the motor clutch member, a cam responsive to reverse rotation of the motor shaft for retracting the starter member from the motor clutch mem-

ber, and a manually operable toothed sector provided with a laterally offset shoe having a radially extending flange adapted to move with a wedging action upon the starter member to retract the latter during final movement of the sector to normal position, said starter member having peripheral teeth in continuous mesh with the manually operable toothed sector.

3. The combination with a motor shaft provided with a one-way acting clutch member, of a pinion having its axis aligned with that of the motor shaft and provided with a counter-part clutch member, said pinion being axially movable along said axis to bring the clutch members into and out of engagement, a compression spring arranged to urge said pinion into clutch engaging position, and a manually operable gear member in continuous mesh with said pinion and provided with a laterally offset shoe having a flange provided with an oblique portion movable along the side of the pinion occupied by the clutch to progressively retract the pinion during final movement of the gear member to normal position and hold the pinion with the clutch members out of engagement when the gear is in normal position, said shoe being formed to release the pinion for spring actuation after an initial motor starting operation of said gear member.

4. The combination with a motor shaft provided with a one-way acting clutch member, of a pinion having its axis aligned with that of the motor shaft and provided with a counter-part clutch member, said pinion being axially movable along said axis to bring the clutch members into and out of engagement, a compression spring arranged to urge said pinion into clutch engaging position, a manually operable gear member in continuous mesh with said pinion and provided with a shoe adapted to engage and retract the pinion when the gear is in normal position, said shoe having a radially extending flange movable along the side of the pinion occupied by the clutch member during an initial movement of the gear member from normal position and having an oblique portion adapted to progressively retract the pinion during the final portion of the return stroke of the gear member, and a throw-out cam responsive to reverse rotation of the motor shaft for retracting the pinion against the tension of its actuating spring.

5. In a motor starting mechanism, the combination with a starting pinion provided with a one-way acting clutch on its inner side face, a sector gear having teeth in continuous mesh with said pinion and provided with an offset shoe having a radially extending flange oblique to the side face of the pinion at one end and adapted to engage and shift the pinion axially to clutch retracting position when the gear is approaching normal position, and means for automatically shifting the pinion in the other direction when released by said shoe, together with an oscillatory cam provided with a clutch releasing face and having an arm in position for oblique engagement between the ends of the pinion teeth, whereby the arm may slide across the ends of the teeth when the pinion is rotating in one direction and be engaged between the teeth during relative rotation in the other direction to swing the cam to clutch releasing position.

6. In a motor starting mechanism, the combination with a starting pinion provided with a one-way acting clutch on its inner side face, a sector

gear having teeth in continuous mesh with said pinion and provided with an offset shoe having a radially extending flange oblique to the side face of the pinion at one end and adapted to engage and shift the pinion axially to clutch retracting position when the gear is approaching normal position, and means for automatically shifting the pinion in the other direction when released by said shoe, together with a cam provided with a pinion retracting face and having a tooth in position for oblique engagement between the ends of the pinion teeth, to swing the cam to clutch releasing position when the teeth act upon said arm in one direction, said cam being provided with a spring adapted to urge the cam arm in the direction of the pinion teeth.

7. In a motor starter, the combination with an axially movable clutch pinion, of a pivoted knock out cam having a cam actuating finger engageable between projections on said pinion relatively movable and normally oblique with respect to said cam, said cam having a curved body portion adapted to be brought by said finger into pinion shifting position when the normal direction of pinion rotation is reversed.

8. In a motor starter, the combination with a shiftable clutch pinion, of a knock out cam pivoted to a relatively stationary support at one side of the pinion and having a cam actuating finger adapted to slide over the ends of the pinion teeth when the pinion is actuated in one direction, a cam actuating spring for urging the finger in the direction of the pinion teeth, said cam having a curved body portion adapted to be brought by the finger into engagement with the side of the pinion to shift the latter into a clutch releasing position when the rotation of the pinion is reversed.

9. A motor starter having an axially shiftable pinion provided with an associated clutch member engageable with a motor shaft, in combination with a sector gear for rotating the pinion, a laterally offset pinion shifting member at one end of the sector engageable with the pinion when the sector is at and near its normal position and a knock out cam provided with a one-way acting cam actuating member adapted to swing the cam into position for shifting the pinion to a clutch retracting position when the rotary motion of the pinion is reversed.

10. In a motor starter having a clutch member provided with a clutch rotating pinion shiftable to engage and retract the clutch member, a knock out cam for shifting the pinion to clutch retracting position when the rotation of the pinion is reversed from normal direction and a one-way acting cam actuating member integral with said knock out cam responsive to reverse rotation of the pinion.

11. In a motor starter having a clutch member provided with a clutch rotating pinion shiftable to engage and retract the clutch member, a knock out cam for shifting the pinion to clutch retracting position when the rotation of the pinion is reversed from normal direction and a one-way acting cam actuating member integral with said knock out cam and responsive to reverse rotation of the pinion, said cam actuating member comprising a finger positioned for normal sliding engagement between the ends of the pinion teeth.

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