W. F. CLARK.

STARTING APPARATUS FOR INTERNAL COMBUSTION ENGINES.

APPLICATION FILED JULY 25, 1911. RENEWED NOV. 4, 1915.

1,210,150.

Patented Dec. 26, 1916.

4 SHEETS—SHEET 1.

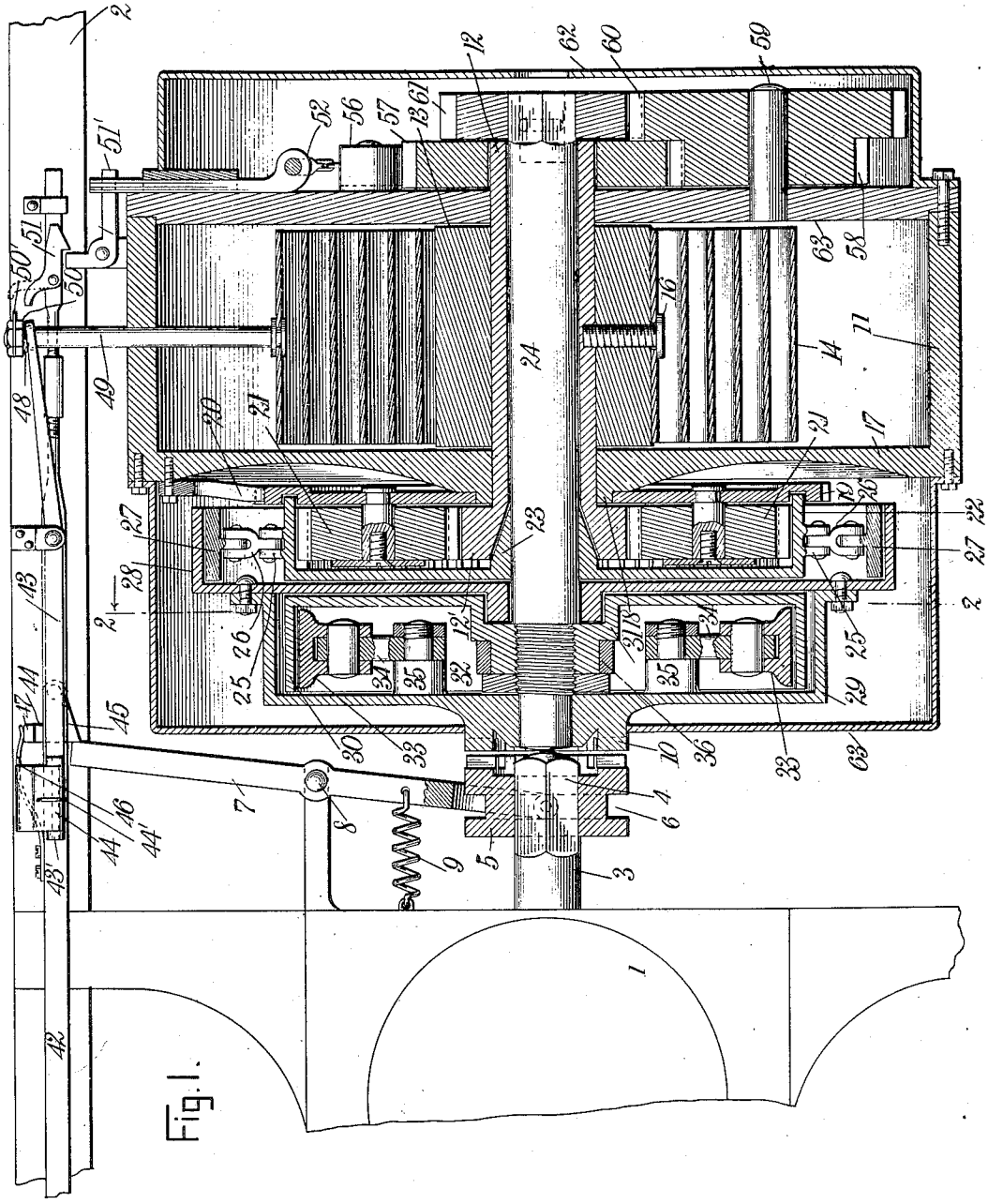


Fig. 1.

WITNESSES

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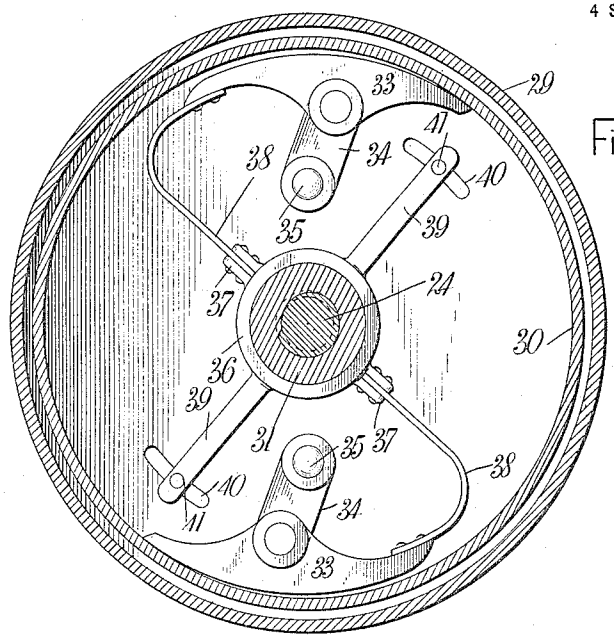


Fig. 2.

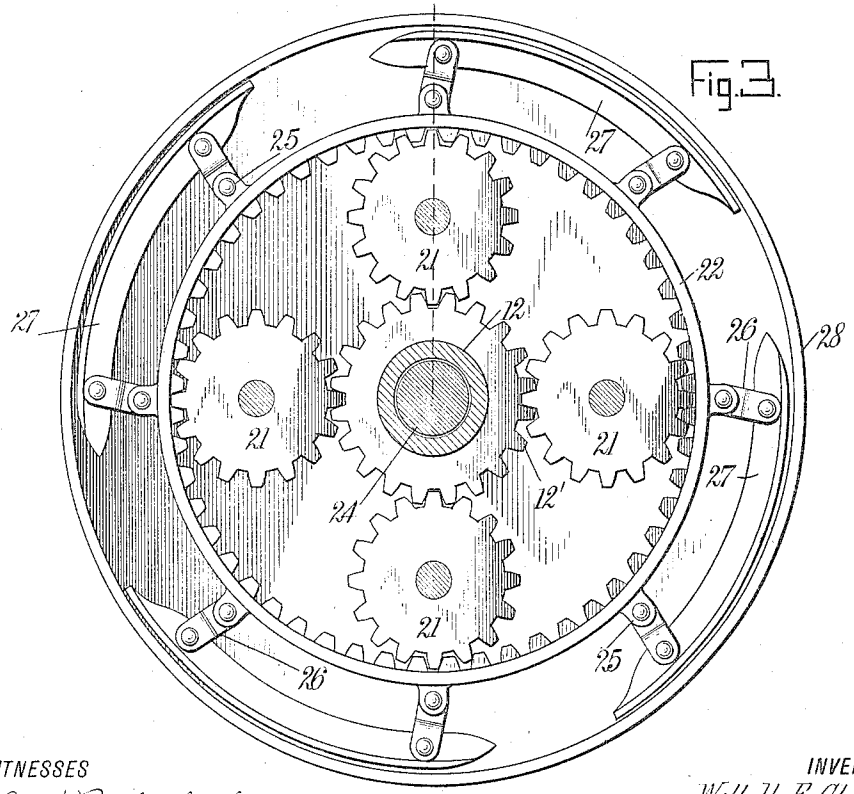


Fig. 3.

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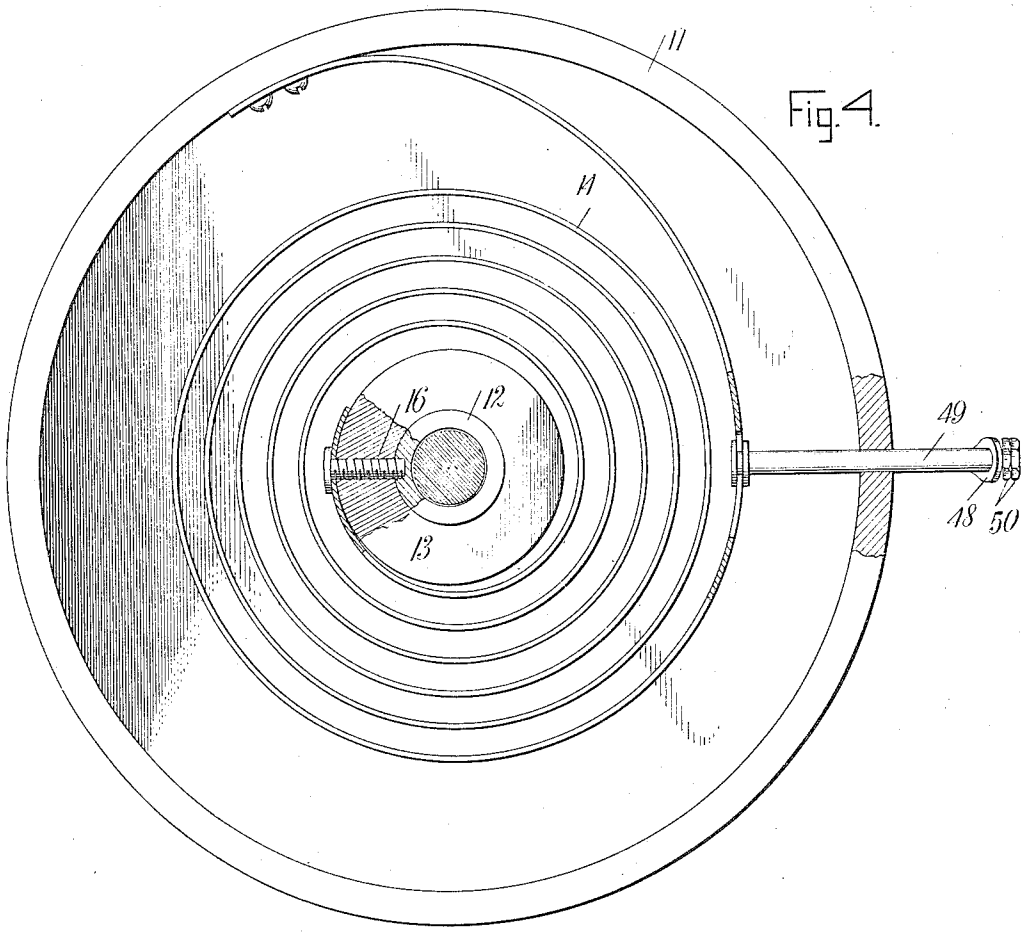


Fig. 4.

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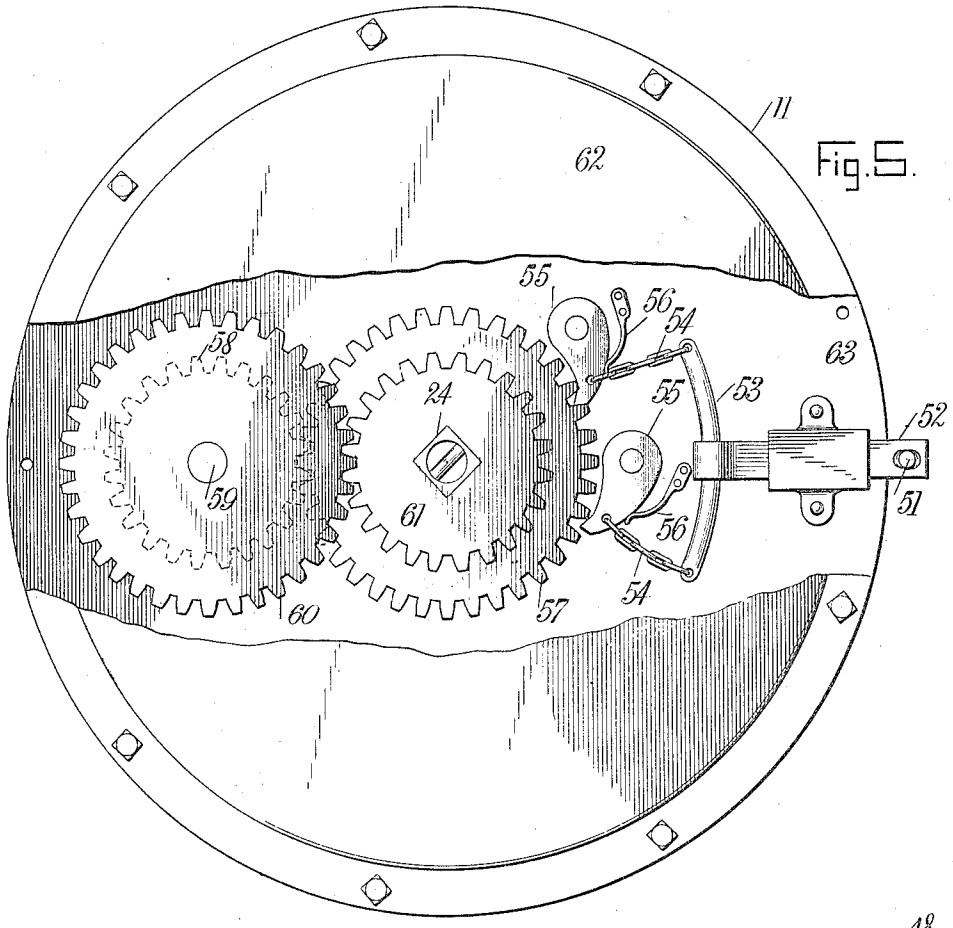


Fig. 5.

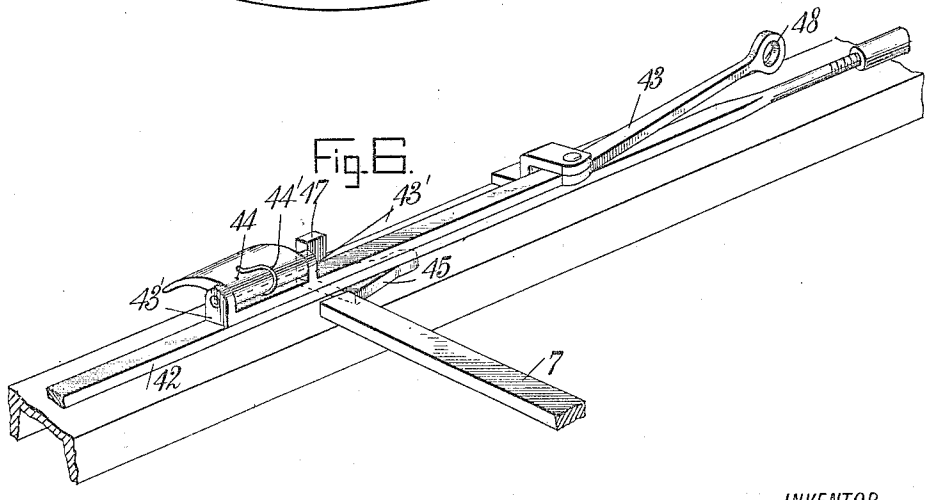


Fig. 6.

WITNESSES

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UNITED STATES PATENT OFFICE.

WILLETT FLETCHER CLARK, OF PINE BLUFF, ARKANSAS.

STARTING APPARATUS FOR INTERNAL-COMBUSTION ENGINES.

1,210,150. Specification of Letters Patent. Patented Dec. 26, 1916.

Application filed July 25, 1911, Serial No. 640,448. Renewed November 4, 1915. Serial No. 59,699.

To all whom it may concern:

Be it known that I, WILLETT F. CLARK, a citizen of the United States, and a resident of Pine Bluff, in the county of Jefferson and State of Arkansas, have invented a new and Improved Starting Apparatus for Internal-Combustion Engines, of which the following is a full, clear, and exact description.

My invention is an improved starting apparatus for internal-combustion engines, and it comprises a motor, preferably of the spring-actuated type, for giving the initial impulse to the engine crank-shaft. Suitable clutching mechanism is provided to connect the crank-shaft to the motor; and means are included for automatically winding up the motor after the engine has commenced running, to put the spring under the required degree of tension, to set the engine again in operation after the next stop is made.

Reference is to be had to the accompanying drawings forming a part of this specification, in which the same characters of reference indicate the same parts in all the views.

Figure 1 is a longitudinal horizontal sectional view of my improved starting apparatus; Fig. 2 is a sectional view on the line 2—2 of Fig. 1; Fig. 3 is a front elevation of the transmission mechanism through which the power of the motor is transmitted to the crank-shaft; Fig. 4 is a front elevation of the casing in which the motor spring is contained, the front cover being removed; Fig. 5 is a front elevation of the starting apparatus, the casing being broken away to show the mechanism for rewinding the spring; and Fig. 6 is a perspective view of the controlling levers.

On the drawings, 1 indicates the front end of an engine frame which is mounted upon suitable supports 2, which supports may be the framework of an automobile or the floor beams of a power house or boat. The engine 1 has a crank-shaft 3, provided with a squared end 4, on which is mounted a movable clutch member 5. This clutch member has an annular groove 6, which receives the forked end of an operating lever 7, pivotally mounted at 8 and engaged by a spring 9 to hold it in such a position as to keep the clutch member 5 out of engagement with a complementary clutch member which is operated by the starting motor. The clutch members 5 and 10 are of course thrown together when it is desired to set the engine in operation.

The starting apparatus comprises a main casing 11, in which is mounted to rotate a hollow sleeve 12, this sleeve being in alinement with the crank-shaft 3. On the sleeve 12 and inside of the casing 11 is rigidly mounted a cylindrical head 13, to which is connected one end of the motor spring 14, the other end of this spring being made fast to the inner wall of the casing 11. The inner end of the spring 14 and the head 13 are preferably secured in rigid relation to the sleeve 12, by means of a single bolt 16, as shown.

The rear wall 17 of the casing 11 has a central boss 18 projecting therefrom, this boss surrounding the sleeve 12 and serving as a hub, on which is mounted a disk 19. The disk 19 has ratchet teeth on its circumference, and these ratchet teeth are engaged by a pawl 20, pivoted to the rear wall of the casing 11, to engage the teeth and prevent the disk from moving in one direction. The arrangement of the ratchet teeth and the pawl 20 is such that the disk will be free to rotate clockwise, but cannot rotate in the opposite direction, for a purpose which will appear later.

The sleeve 12 terminates at its rear end without the casing 11 in a pinion 12′. This pinion 12′ meshes with a number of gear wheels 21, mounted on journals carried by the disk 19, and meshing at points opposite their engagement with the pinion 12′, with a number of internal gear teeth carried on a flange disk 22. This disk 22 has a central hub 23, which hub is preferably conical in shape and fits into a counterbore in the outer end of the sleeve 12. Both the sleeve 12 and the disk 22 are loosely mounted on a central shaft 24, which passes through the sleeve, as shown on Fig. 1.

On the outer cylindrical surface of the flange of the disk 22 is a number of ears or perforated lugs 25, arranged in pairs. Between each pair of these lugs or ears is pivotally held a link 26, and to each pair of these links 26 is connected a friction shoe 27. These friction shoes are designed to engage the inner surface of a flange on a disk 28, this disk also being loosely mounted on the shaft 24, and partly inclosing the flange disk 22. When the flange disk 22 rotates in a

clockwise direction the friction shoes 27 fly outward by centrifugal force until they engage against the inner surface of the flange of the disk 28. Preferably, the links 26 are slightly longer than the amount of free space between their points of pivotal connection with the disk 22, and the friction shoes 27, when the same engage the flange of the disk 28, so that, when the disk 28 is being turned by the disk 22, the links 27 will be turned to a slight extent forward of a radial line connecting the center of the disk 22 to the center of the pivot connecting each link to the disk 22. This relation of the parts is shown by the vertical broken line on Fig. 3, and by virtue thereof the disk 22 will be enabled to rotate the disk 28 clockwise, but not in the opposite direction; and when the disk 28 begins to rotate faster than the disk 22, the shoes 27 will not hold the disk 28 back.

The disk 28 is secured by means of bolts or other suitable fastenings to a flange disk 29, terminating in a central hub on which is formed the clutch member 10. This central hub is loosely mounted upon the end of the shaft 24 abutting the crank-shaft 3, so that when motion is transmitted by the spring to the sleeve 12, and through the gearing to the disks 22 and 28, the disk 29 will be rotated; and when the clutch member 5 is in engagement with the clutch member 10, the crank-shaft 3 will be turned to start the engine.

Between the end of the shaft 24 on which the disk 29 is loosely mounted, and that portion on which the disk 28 is loosely mounted, is a threaded section on which is screwed the hub 31 of a flange disk 30. This flange disk is inclosed between the disks 28 and 29; and 32 is a locking nut which secures the hub 31 in tight relation on the shaft 24. The flange of this disk 30 is adapted to be engaged by friction shoes 33, carried by links 34 mounted on journals 35 on the inner face of the flange disk 29. The hub 31 is reduced on its outer end; and on the reduced portion is fitted a loose ring 36 having ears 37, between which are secured springs 38. Each of the springs 38 is secured to one of the shoes 33, and by tensioning these springs the amount of centrifugal force needed to throw out the shoes 33 into engagement with the flange of the disk 30, can be regulated. To secure this regulation the ring 36 is provided with a pair of radially-projecting arms 39, the ends of which terminate adjacent arc-shaped slots 40 in the disk 29, and carry bolts 41, which pass through these slots, so that the arms can be turned to tension the springs 38, as desired. The outer ends of the bolts 41 will of course have locking nuts thereon to engage with the face of the disk 29 and hold the arms 39 in any adjusted position.

42 is a longitudinally-movable main operating lever; and 43 is a lever pivoted to the frame 2. This lever 43 has ears 43′ adjacent one end, and between these ears is pivotally mounted a curved pawl 44. The pawl 44 will engage the bent over end 47 of a catch 45, pivoted to the lever 42, to lift the same at the proper moment, this catch normally being held down by a spring 46, to engage the outer end of the lever 7, so that, when the lever 42 is moved to the right, the lever 7 will throw the clutch members 5 and 10 together. 44′ is a spring holding pawl 44 in operative position.

The outer end of the lever 43 has an eye 48, through which passes a sliding rod 49. The outer end of this rod has adjustable locking nuts 50 thereon holding between them a projection plate 50′, and the rod itself passes through the side of the casing 11, and is secured at its inner end to the spring 14.

The outer end of the lever 42 carries a pawl 51 one arm of which extends upward to be engaged by the plate 50′, and the other arm of which is to operate a bell-crank lever 51′, mounted on the outside of the casing 11, and connected at its outer end to a sliding link 52, mounted on the front face of the casing 11. At its lower end the sliding rod 52 carries a cross-piece 53, connected by chains or cords 54 to a pair of locking pawls 55. These pawls 55 are normally engaged by springs 56, to press them into engagement with the teeth of a pinion 57, which is rigidly secured to the front end of the sleeve 12. The pinion 57 meshes with a gear 58 mounted on a journal 59 in the front of the casing 11, and made integral with another gear 60, which engages a gear 61. This last-named gear is mounted on the squared front end of the shaft 24, so that, when this shaft is rotated by the engine after starting, motion will be transmitted therefrom through the gear arrangement shown, to the sleeve 12, to rewind the spring 14. A suitable cover 62 is secured to the front of the casing 11, to inclose the gears for rewinding the spring; and a suitable cover 63 is secured to the rear face to inclose the disks 19, 22, 28 and 29, this last-named cover having a central opening through which the hub of the disk 29, on which the clutch member 10 is formed, passes.

When the motor is wound up and ready for use, but not connected with the shaft 3, the parts will occupy the position shown in Fig. 1. The pawl 44 will be located to the left of the catch 45, but on account of the fact that the spring 14 is wound up the rod 49 will be withdrawn, so that the pawl 44 will project slightly beyond the bent-over end 47 of the catch 45, and the plate 50′ will be located at a point inward of the adjacent end of the pawl 51.

To start the engine the lever 42 is moved

to the left by means of a hand-lever or pedal, and the catch 45 will throw the lever 7 to put the clutch members 5 and 10 into engagement. At the same time the bent over end 47 moves into position over the pawl 44, which is normally located to the left of the catch 45. The bell-crank 51′ will be operated to throw the pawls 55 out of engagement with the gear 57, and release the spring 14. This spring will now rotate the sleeve 12 in a counter-clockwise direction, viewing the apparatus from the front, and as a result the disk 22 will be rotated in a clockwise direction through the gears 21, the disk 19 being held by the pawl 20 against movement at this stage of the operation. As soon as the disk 22 moves at a sufficient speed the friction shoes 27 will fly outward into engagement with the inner surface of the flange on the disk 28. As a result, motion will be transmitted through the disks 28, 29 and the clutch members 10 and 5, to the shaft 3, setting the engine in motion. The unwinding of the spring 14 in the course of the operation of starting moves the sliding rod 49 outward, rotating the lever 43 in a counter-clockwise direction through a slight angle, the rod engaging the lever to move the same, by any suitable means. The pawl 44 now moves over the bent end 47, the spring 44′ yielding, and the pawl when it passes the end 47, snaps back under the influence of the spring 44′, so as to be in position to engage this end. The same movement of the rod 49 causes the plate 50′ to slip past the adjacent end of the pawl 51, so as to put the parts in question in proper position to allow the rewinding of the motor. When the engine has gotton under way, the force of the spring 14 being wholly or partly expended, the disk 22 will of course tend to rotate slower, and the disks 28 and 29 faster. As soon as the speed of the engine reaches a certain point, the friction shoes 33 mounted on the disk 29 fly out and engage the flange of the disk 30. These shoes 33 first stop the disk 30, which is being rotated contrary to the direction of rotation of the flange 29, owing to the engagement of the gears at the front end of the sleeve 12. As soon as the shoes 33 come into solid engagement with the flange on the disk 30, the disk 30 of course rotates with and in the same direction as the disk 29, turning the shaft 24 with it. The gear 61 now rotates in a clockwise direction, and transmits motion through the gears 60 and 58 to the gear 57, causing the sleeve 12 to turn in a clockwise direction, or, in other words, in a direction opposite to that of the motion given to it by the spring 14. The result is that the spring 14 is re-wound. The rewinding motion of the sleeve 12 will tend to rotate the gears 21 in such a way as to reverse the direction of revolution of the brake shoes 27; but if the friction between the shoes 27 and the disk 28 be too great, the result will be simply that the gears 21 and the disk 19 will rotate bodily around the boss 18 as a hub, the pawl 20 being inoperative in this case. As soon as the spring 14 is wound up to a sufficient extent it will pull down the rod 49, moving the lever 43; and through the pawl 44 carried at the other end thereof, the bent-over end 47 will be operated to move the catch 45 outward. This will release the lever 7, whereupon the spring 9 will pull the clutch member 5 away from the clutch 10. Also the rod 49 will trip the pawl 51 by means of the plate 50′ to release the lever. The springs 56 will then throw the pawls 55 into engagement with the gear 57, and lock the spring in wound-up position for further use. The lever 42 is of course moved back to the right when the starting mechanism is again needed.

From the above description it will be apparent that the motor is adapted to be connected to the engine to start the same at any time, and the mechanical connections between the motor and the engine include transmission mechanism for automatically rewinding the motor for use when the next start is to be made. The starting apparatus is thus always kept in operative condition, as only a small part of the power of the engine is required to rewind the spring, and this power is applied immediately after the engine has commenced running, and does not interfere with the operation of the engine in the main at all.

I wish it to be understood that I may make such changes in the shape, size and arrangement of the parts, as fairly fall within the scope and spirit of my invention.

Having thus described my invention, I claim as new and desire to secure by Letters Patent:

1. Starting apparatus for internal combustion engines, comprising a motor, a rotary member operated by said motor, centrifugally-operated friction shoes connected to said rotary member, a second rotary member mounted to have movement relative to the first rotary member, and means for connecting said second rotary member to the crank-shaft of the engine, whereby, when the motor is thrown into operation, the friction shoes thereof will transmit motion from the first member to the second member to rotate the crank-shaft.

2. Starting apparatus for internal combustion engines, comprising a motor, a rotary member operated by said motor, centrifugally-actuated friction shoes mounted upon said rotary member, a second rotary member, and clutch means for connecting said second rotary member to the engine crank-shaft, whereby, when the motor is thrown into operation, the first member will

transmit motion to the second member through the friction shoes, to set the crank-shaft into operation.

3. Starting apparatus for internal combustion engines, comprising a spring motor, means for transmitting motion from said motor in one direction, to rotate the engine crank-shaft, centrifugal means actuated by the crank-shaft when the speed of the same reaches a certain value, to transmit motion from the crank-shaft to the motor to rewind the same, and means connected to the motor spring and actuated thereby when the operation of rewinding is finished, to disengage the crank-shaft and the motor.

4. Starting apparatus for internal combustion engines, comprising a spring motor, means for transmitting motion from said motor in one direction, to rotate the engine crank-shaft, centrifugal means actuated by the engine crank-shaft when the latter speeds up to transmit motion to the motor spring to rewind the same, means actuated by the motor spring when the operation of rewinding is finished, to disengage the crank-shaft from the motor spring, and means for locking the spring when the rewinding is finished.

5. Starting apparatus for internal combustion engines, comprising a spring motor, means for connecting the same to the crank-shaft, said means comprising a transmission mechanism for rotating the crank-shaft in one direction, a clutch for connecting said crank-shaft and said means together, means mounted upon said first-named means and actuated by centrifugal force when the speed of the crank-shaft increases, to rewind the motor spring, and means connected to the motor spring and actuated thereby to throw out the clutch and disengage the crank-shaft from the motor when the rewinding of the spring is finished.

6. Starting apparatus for internal combustion engines, comprising a spring motor, a clutch for connecting the same to the engine crank-shaft, a lever for actuating the clutch, a rod for actuating said lever, a second lever adjacent the said rod, a catch carried upon said rod in position to be engaged by one end of said second-named lever, said catch engaging the first lever to move the clutch into engaging position, a connection between the other end of the second-named lever and the motor spring, and means operated by the engine for rewinding the motor spring, whereby, when the rewinding is finished, the lever adjacent the rod will operate the catch to disengage the clutch lever, to allow the clutch to be moved out of position.

7. Apparatus for starting internal combustion engines, comprising a spring motor, a shaft having a gear thereon operated by the motor, a gear meshing with said first-named gear, a member on which said second-named gear is mounted, means engaging said second-named gear to transmit motion to the engine crank-shaft, and means for holding the said member against rotation when the engine is being started by the motor, said means also permitting said member to rotate when the first-named gear is being rotated in the opposite direction, to allow the motor spring to be rewound.

8. Apparatus for starting internal combustion engines, comprising a spring motor, a gear operated thereby, a second gear meshing with the first-named gear, a rotatable member on which said second-named gear is mounted, means for transmitting motion from said second-named gear to the engine crank-shaft, to rotate the same, means for holding said member against rotation when the motor is operating the engine, said means permitting the member to rotate freely when the first-named gear is rotating in the opposite direction, and means operated by the engine to rewind the motor.

9. Apparatus for starting internal combustion engines, comprising a spring motor, a hollow shaft operated thereby, transmission mechanism for transmitting motion from the said hollow shaft to the engine in one direction, said means permitting the hollow shaft to rotate freely in the opposite direction, a shaft inside the hollow shaft and gear-connected at one end to said hollow shaft, and centrifugal means actuated by the engine upon an increase in the speed thereof, to transmit motion to said second shaft, to rotate the same, to rewind the motor.

10. Starting apparatus for internal combustion engines, comprising a motor, a member operated by said motor, a second member mounted to have movement relative to said first member, means actuated by centrifugal force to connect said members together to enable the movement of the first member to be transmitted to the second member, and means for connecting said second member to the crank shaft of the engine, whereby, when the motor is thrown into operation, the crank shaft will be rotated.

11. Starting apparatus for internal combustion engines, comprising a motor, a member operated thereby, a second member mounted to have movement relative to the first member, means actuated by centrifugal force for connecting said members together to cause the motion of the first member to be transmitted to the second member, and clutch means for connecting said second member to the engine crank shaft, whereby, when the motor is operated, the crank shaft will be turned to start the engine.

12. A starting apparatus for internal combustion engines, comprising a motor pro-

vided with a motor spring, means connecting said motor to the engine crank shaft to rotate said shaft, rewinding mechanism operated by the engine shaft after the engine has been started, for the purpose of rewinding said motor, a rod radially connected with said spring and movable by tension of said spring in the general direction of the length of said rod, and mechanism connected with said rod and controllable by means thereof for disconnecting said rewinding mechanism from said crank shaft.

13. Starting apparatus for internal combustion engines, comprising a spring motor, means connecting said motor to the crank shaft of the engine to start the same, said means including a clutch, means operated by said crank shaft to rewind the spring after the engine has been started, and means connected to said clutch and actuated by the tension of the motor spring when the operation of rewinding is substantially finished; to cause the clutch to disengage the crank shaft of the engine from said motor.

14. Starting apparatus for internal combustion engines, comprising a spring motor, means for transmitting motion from said motor to the crank shaft of the engine to start the same, said means comprising a clutch, means for normally holding said clutch in inoperative position, means for moving said clutch out of inoperative position to connect the engine crank shaft to the motor, means operated by said engine crank shaft when so connected, to rewind the motor spring, and means actuated by the tension of the motor spring when the operation of rewinding is substantially finished, to release the clutch and enable the same to be moved to disconnect the motor and the engine.

15. Starting apparatus for internal combustion engines, comprising a spring motor, means for transmitting motion from said motor to rotate the crank shaft of the engine to start the same, said means comprising a clutch, means for normally holding said clutch in inoperative position, means for moving said clutch against the force of said holding means to connect the motor and the engine, said means including a lock or catch to hold the clutch in position to connect the crank shaft and the engine together, means operated by the engine after the same has been started, to rewind the motor spring, and means actuated by the tension of the spring for withdrawing the lock or catch when the operation of rewinding is substantially finished, to enable the clutch to be withdrawn to inoperative position to disconnect the motor and the engine.

16. A starting apparatus for internal combustion engines, comprising a motor provided with a spring, means for connecting said motor to an engine shaft for the purposes of rotating said engine shaft, and mechanism including a rod slidable in the general direction of its own length and connected with said spring for disconnecting said motor from the crank shaft after said crank shaft has been started to rotating and the spring is rewound to a predetermined position.

17. A starting apparatus for internal combustion engines comprising a motor provided with a motor spring, mechanism for connecting said motor to the engine crank shaft in order to rotate the latter, rewinding mechanism operated by the engine crank shaft after the engine has been started for the purpose of rewinding the motor, a rod slidably mounted in the general direction of its own length and connected with said rewinding mechanism, for the purpose of throwing the same into and out of action, said rod being connected with said spring and movable by tension of said spring as said spring is rewound, and mechanism connecting said rod with said rewinding mechanism.

18. A starting apparatus for internal combustion engines, comprising a motor provided with a motor spring, means for connecting said motor to the engine crank shaft in order to rotate the latter, a sliding rod connected with said spring, said sliding rod being movable in the general direction of its own length under tension of said spring, a lever connected with said rod, means controllable at the will of the operator for adjusting said lever relative to said rod, and mechanism connected with said lever for the purpose of disconnecting said motor from said crank shaft after said crank shaft is set in motion, and said spring is rewound to a predetermined position.

19. A starting apparatus for internal combustion engines, comprising a motor provided with a motor spring, means for connecting said motor to the engine crank shaft in order to rotate the latter, a sliding rod connected with said spring and movable under tension of said spring in the general direction of the length of said sliding rod, mechanism controllable by said sliding rod for disconnecting said motor from said crank shaft after said crank shaft is in motion and the spring is rewound to a predetermined position, and means controllable at the will of the operator for adjusting the sensitiveness of said last mentioned mechanism relative to the tension of said spring.

20. Starting apparatus for internal combustion engines, comprising a spring motor, a starting shaft operated by said motor, clutch means for connecting the said shaft to the crank shaft to rotate the same, a spring-held lever for controlling the clutch

means, means operated by the engine crank shaft after the engine has been started to rewind the motor, and means actuated by the tension of the motor spring to release the lever when the operation of rewinding is finished, and cause the clutch means to be disengaged so as to disconnect the crank shaft from the motor.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

WILLETT FLETCHER CLARK.

Witnesses:
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V. J. WEBB.