

A. B. FOWLER.
 STARTING DEVICE FOR GAS ENGINES.
 APPLICATION FILED DEC. 31, 1900. RENEWED NOV. 22, 1906.

990,854.

Patented May 2, 1911.

3 SHEETS—SHEET 1.

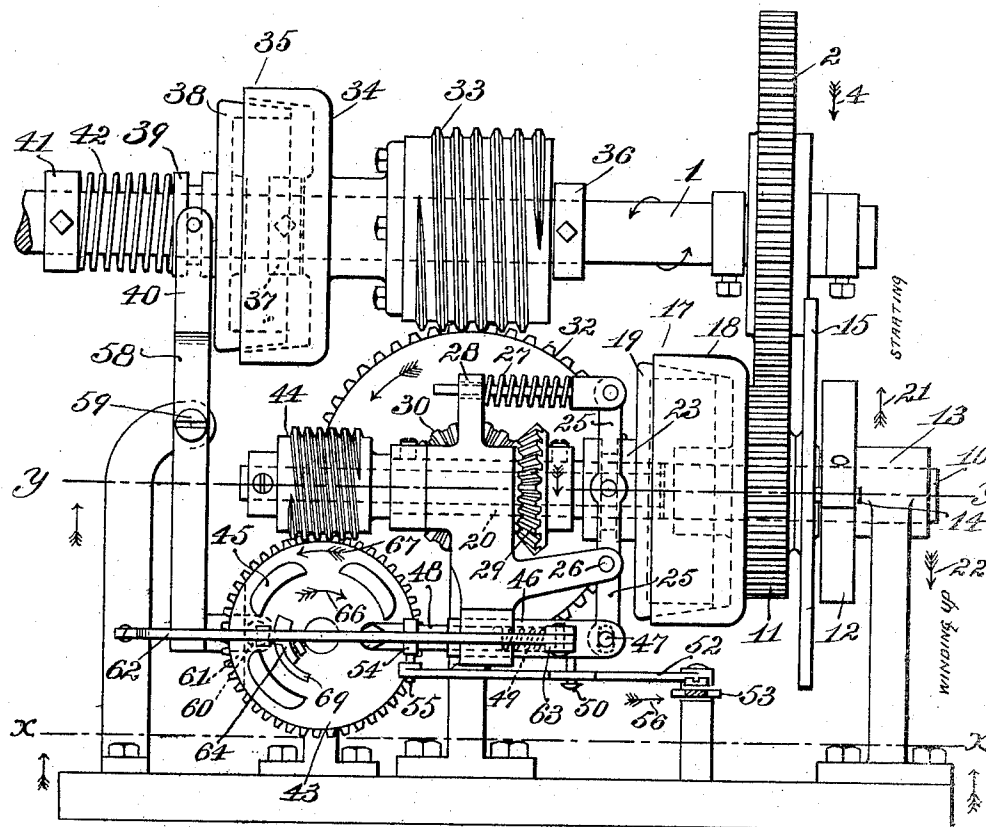
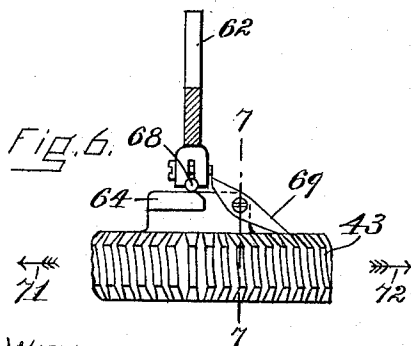


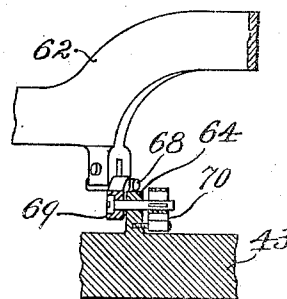
Fig. 1.



WITNESSES

Edward S. Day
 Horace Van Curen

Fig. 7.



INVENTOR

Alfred B. Fowler
 by his Attorney
 Benjamin Phillips

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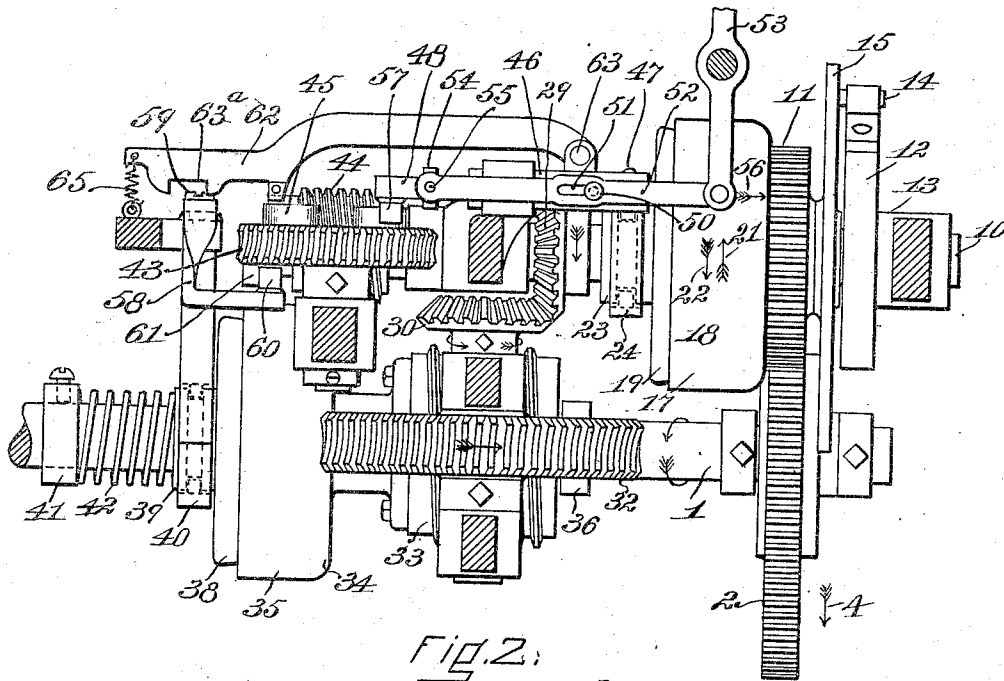


Fig. 2.

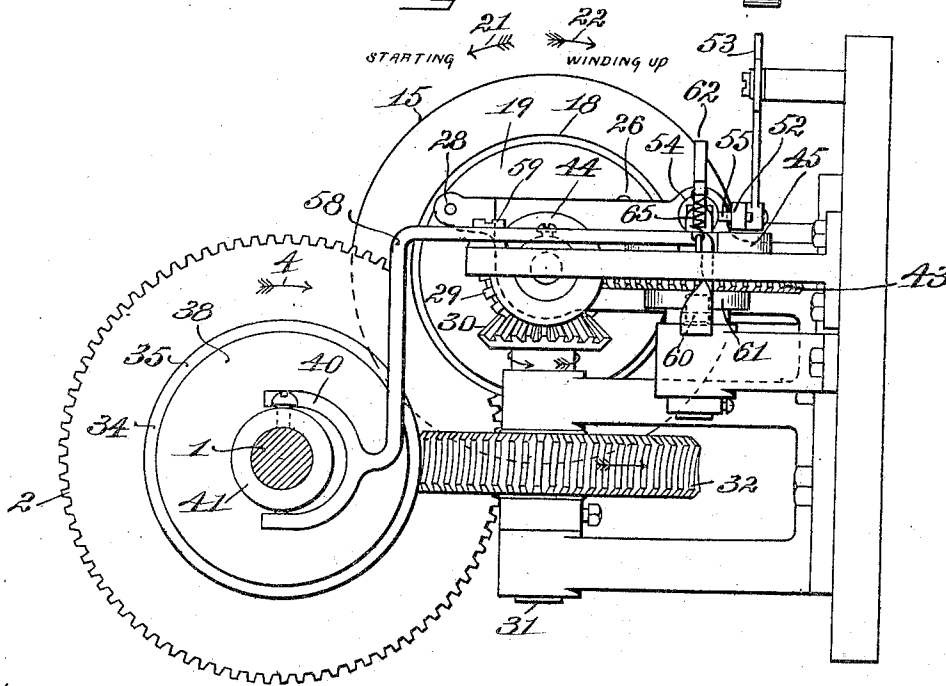


Fig. 3.

WITNESSES
 Edward S. Day
 Horace Van Dusen

INVENTOR
 Alfred B. Fowler
 by his Attorney
 Benjamin Phillips

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3 SHEETS-SHEET 3.

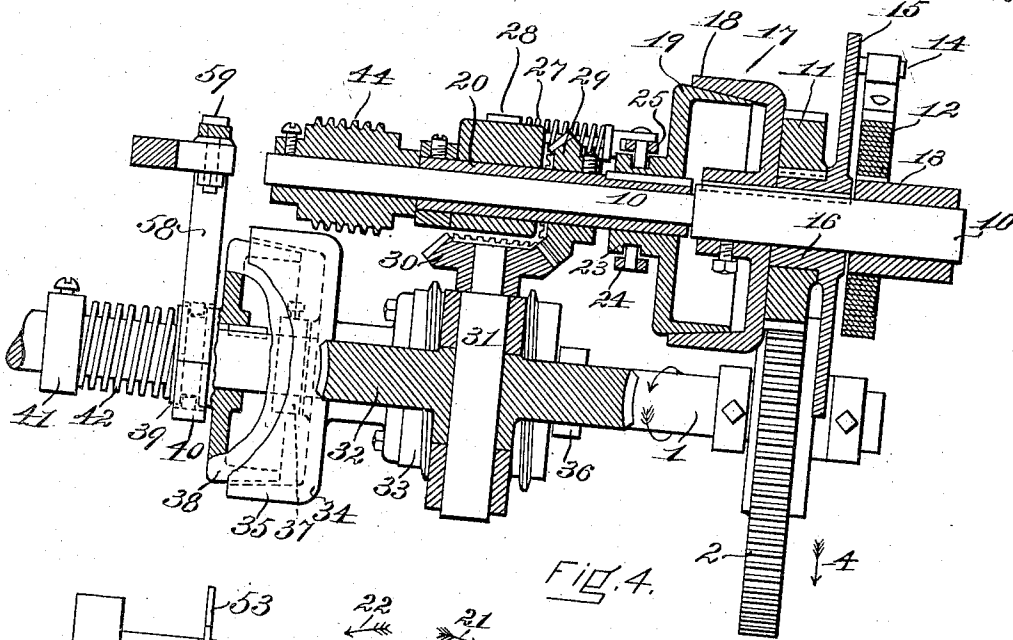


FIG. 4.

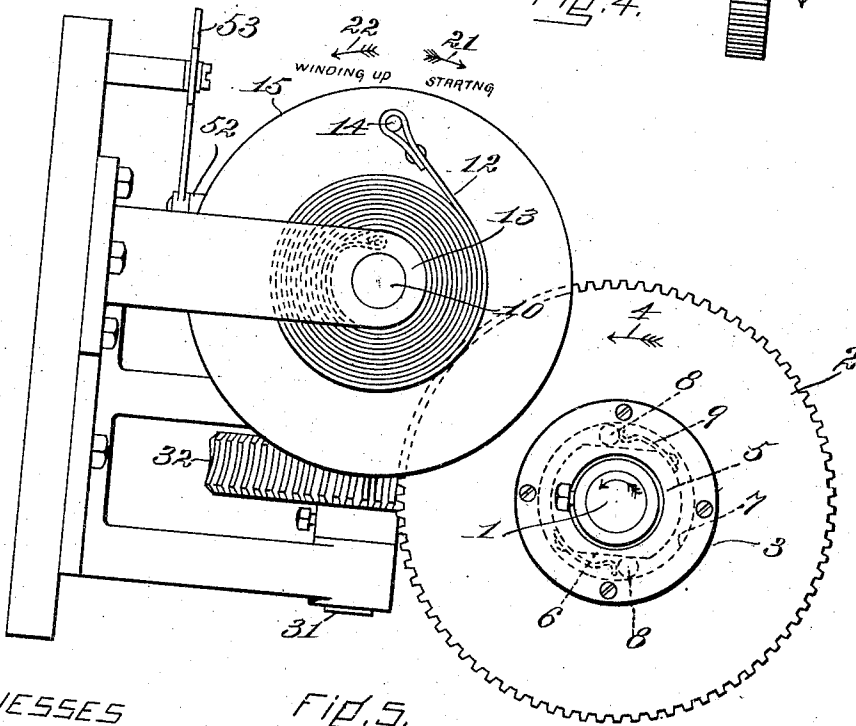


FIG. 5.

WITNESSES

Edward S. Day
Hiram Van Eeman

INVENTOR

A. B. Fowler
by his Attorney
Benjamin Phillips

UNITED STATES PATENT OFFICE.

ALFRED B. FOWLER, OF CENTRAL FALLS, RHODE ISLAND.

STARTING DEVICE FOR GAS-ENGINES.

990,854.

Specification of Letters Patent.

Patented May 2, 1911.

Application filed December 31, 1900, Serial No. 41,638. Renewed November 22, 1906. Serial No. 344,646.

To all whom it may concern:

Be it known that I, ALFRED B. FOWLER, a citizen of the United States, residing at Central Falls, in the county of Providence and State of Rhode Island, have invented certain new and useful Improvements in Starting Devices for Gas-Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The present invention relates to an improvement in devices for starting gas engines.

The object of my invention is to make a starting device for gas engines which will impart a few revolutions to the main shaft of a gas engine or to a shaft geared therewith in order to empty the cylinder, draw in and compress a charge of the explosive mixture, after which the gas engine starts running.

It sometimes occurs that upon the first revolutions of the main shaft the engine may not start and it is the object of my invention to make a starting device which, if the engine does not start on the first trial, will be arranged to start the engine again.

Another object of my invention is to provide the starting device with automatic mechanism for winding up the device and for holding it wound up ready for use when it is again desired to start the engine.

To the above end the present invention consists of the device for starting gas engines hereinafter described and claimed.

In the drawings illustrating the preferred form of my invention, Figure 1 is a plan of my improved starting device; Fig. 2 is a sectional elevation on the line $x-x$ of Fig. 1; Fig. 3 is an end elevation looking from the left-hand end of Fig. 1; Fig. 4 is a sectional detail taken on the line $y-y$, Fig. 1, looking in the direction of the arrow, Fig. 5 is an end elevation looking from the right-hand end of Fig. 1, and Figs. 6 and 7 illustrate details hereinafter described.

The shaft 1 is the main shaft of the gas engine to which my invention is attached, or it is a shaft geared with the main shaft of the engine, which, for convenience, will hereinafter be termed the engine shaft. A gear 2 is mounted on the engine shaft and adapted to be coupled to it by means of a connecting clutch 3 (see Fig. 5), which, when

the gear is rotated in the direction of the arrow 4, automatically engages itself with the shaft 1 and rotates it in the direction of said arrow. The specific form of connecting clutch illustrated is a one direction roller clutch in which a boss 5, secured upon the shaft, is provided with flattened surfaces 6 between which flattened surfaces and the cylindrical inner surface 7 of a boss on the gear 2 are interposed rollers 8 which are normally pressed by springs 9 into position to be wedged between the cylindrical surface and the flattened surfaces.

The above-described arrangement is such that when the gear 2 is rotated in the direction of the arrow 4, the rollers 8 cramp between the flattened surfaces 6 and the cylindrical surface 7 and cause the boss 5 and with it the shaft 1 to be rotated in the same direction. If the gear 2 now comes to rest, the rollers 8 free themselves and the shaft rotates without imparting any movement to the gear 2. This gear 2 is the medium through which I apply power to the engine shaft in order to give it a few revolutions in order to start the engine.

Adjacent to the engine shaft is mounted a spring shaft 10. Secured to the spring shaft is a gear 11 which meshes with the gear 2 on the engine shaft. A spiral spring 12 having one of its ends secured to the spring shaft and the other of its ends secured to a stationary support, operates when it is desired to start the engine to impart a rotary motion to the spring shaft by means of which the gear 2 and the engine shaft is rotated. Any sort of spring may be employed for this purpose, but I prefer to use a heavy, spiral, steel spring. One end of the spring is secured to the stationary support 13 and the other end of the spring is secured to a pin 14 laterally projected from a spring plate 15 mounted upon and splined to the spring shaft 10. The spring plate is provided with an elongated hub 16 and the exterior of the hub receives the gear 11 to which it is secured by a spline. The above described arrangement is such that when the shaft 10 is permitted to rotate, the spring 12 acting through the spring plate 15 will rotate the shaft 10 and the gear 11 which in turn will rotate the engine shaft and gear 2. Means are provided for holding the shaft 10 from rotation and I prefer to employ for this purpose a holding clutch 17 of which one member, as the cup

18, is keyed to the shaft 10 alongside of the gear 11, and of which the other member is the plunger 19 splined upon the sleeve 20, which in turn is rotatably mounted on the spring shaft 10 and normally held from rotation when the spring is wound up. So long as the sleeve 20 is held from rotation it will hold the clutch 17, thereby holding the spring shaft stationary. It is to be noted that the spring shaft 10 rotates in the direction of the arrow 21 when the spring is unwinding and it is starting the engine, that the spring shaft is held stationary during the time the device is idle, and that the spring shaft rotates in the direction of the arrow 22 when the spring is being wound up. As a consequence of these conditions it follows that means must be provided to hold the clutch 17 closed during the winding up of the spring and during the time the device is idle and for holding it open when it is desired to start the engine. The sleeve 20, therefore, is the means through which the power is applied to wind up the spring and to hold it wound up during the time the device is idle.

Means are provided acting normally to hold the clutch 17 closed. These means are described as follows:—A grooved collar 23 is secured to the plunger 19 of the clutch 17 and a yoke 24 provided with two pins engaging the groove of the collar is provided for moving the plunger into and out of engagement with the cup 18, thereby opening and closing the clutch 17. The yoke 24 is mounted on a lever 25 pivoted at 26 to a fixed part of the frame. The spring 27 interposed between a projection 28 on the frame and the lever 25 acts normally to close the clutch 17 by moving the lever 25 to the right into the position shown in Fig. 1. When the lever 25 is turned to the left against the pressure of the spring 27 the clutch 17 is opened and the spring 12 rotates the gear 11 and starts the engine shaft. When the lever moves to the right into the position shown in Fig. 1, the clutch 17 is closed and the gear 11 held from rotation.

Means are provided for holding the plunger 19 of the clutch 17 stationary and for rotating it when it is desired to wind up the spring. Secured to the sleeve 20 is the miter gear 29 which engages with a corresponding miter gear 30 secured to the shaft 31 mounted in stationary bearings in the frame. There is also secured to the shaft 31 a worm wheel 32 which is engaged by the worm 33 revolvably mounted on the engine shaft 1. To this worm 33 there is secured the cup 34 of the winding-up clutch 35. The worm 33 and cup 34 are supported upon the engine shaft 1 between the collars 36 and 37 which hold them from endwise motion on the shaft. The plunger 38 is splined to the engine shaft 1 and capable of longitudinal movement

thereon toward and from the cup 34. A grooved collar 39 is secured to the plunger and is adapted to be operated by the yoke 40 of a lever hereinafter referred to. A collar 41 is secured to the engine shaft 1 adjacent to the grooved collar 39 and between the collar 41 and grooved collar 39 is interposed a spring 42 which normally presses the plunger 38 in the direction to close the clutch 35. The clutch 35 constitutes means by which the worm 33 may be coupled to and released from the engine shaft. The pitch of the worm 33 is such that the tendency of the spring 12 to rotate the worm wheel 32 when the holding clutch 17 is closed will be resisted by the worm and the spring shaft 10 will by this means be held from rotation. When it is desired to wind up the spring 12, the winding up clutch 35 will be closed and the rotation of the engine shaft will, through the medium of the worm wheel 32, shaft 31, miter gears 30 and 29, impart rotary movement to the sleeve 20, the plunger 19, cup 18, spring shaft 10, and spring plate 15. After the spring has been wound up the winding-up clutch 35 will be opened and the worm 33 will come to rest, the worm through the medium of its shaft, the miter gears, the sleeve 20 and the holding-clutch 17, thereby maintaining the spring wound-up. Under these circumstances, if the engine were at rest and it was desired to start it, all that would be necessary to be done would be to open the holding clutch 17, thereby freeing the spring shaft 10 and permitting the spring 12 to rotate said shaft and with it gears 11 and 2, whereby the engine shaft would be rotated to start the engine.

The construction thus far described constitutes a complete and operative device for starting a gas engine, but in connection with this device I prefer to employ automatic mechanism for operating the several clutches in proper relation to each other to obviate the use of a multiplicity of levers to be used in starting the engine and winding-up the spring. To the above end I have provided an automatic mechanism for maintaining the holding and winding-up clutches open when it is desired to start the engine, for closing the holding clutch after the engine has been given a few revolutions, for closing the winding-up clutch after the engine has been started and for opening the winding-up clutch after the spring has been wound up.

The illustrated embodiment of the automatic mechanism for operating the clutches in the manner described is as follows:—The cam wheel 43 is mounted in suitable bearings on the frame and adapted to be rotated by a worm 44 secured to the spring shaft 10. Upon one side of the cam wheel 43 are mounted a series of cams 45 which are adapted to cooperate with devices for main-

taining the holding clutch 17 open for the few revolutions of the spring shaft 10 ordinarily necessary to start the engine. The connections between the cam wheel 43 and the holding clutch 17 consist of the sleeve 46 mounted in a bearing in the frame and articulated at 47 with the lever 25 carrying the yoke 24 which operates the plunger 19. Within the sleeve 46 is arranged a rod 48 normally held in the position shown in Fig. 1 by the spring 49 which is interposed between the end of the rod 48 and the bottom of the recess in the sleeve 46 by which it is supported. From one side of the sleeve 46 is projected the pin 50 which is adapted to be engaged by the ends of the slot 51 in the rod 52 connected with the lever 53 adapted to be operated by hand in any convenient way. The rod 48 is provided with a collar 54 from which is projected the pin 55 which is received in a hole in the rod 52.

The above described arrangement is such that when the rod 52 is moved in the direction of the arrow 56 it will first pull the rod 48 in the same direction until the collar 54 thereon comes in contact with the end of the sleeve 46, coincident with which contact the pin 50 will come in engagement with the end of the slot 51, and the further movement of the rod 52 in the same direction will move the lever 25 in the direction to compress the spring 27 and open the holding clutch 17. Upon the opening of the clutch 17 the spring shaft 10 under the influence of the spring 12 will begin to revolve and such revolutions will impart a rotary movement to the cam wheel 43, thereby bringing the cam 45 opposite a cam roll 57 mounted on the end of the rod 48 and it will thereby hold the rod 48 in the position to which it had been drawn by the rod 52, thereby holding the upper portion of the lever 25 in a position to the left of that shown in Fig. 1, and maintaining the holding clutch 17 open. The holding clutch 17 will continue to be held open by the means described (and beyond the control of the operator to close) until the cam 45 passes from in front of the cam roll 57, whereupon the spring 49 will force the rod 48 into the position shown in Fig. 1, and the spring 27 will be permitted to close the holding clutch 17 through the medium of the lever 25 and its yoke 24.

It will be noted that the lever 53 may be correctly described as a starting lever and that when it is turned by the operator it will release the spring 12 and permit it to start the engine, and that after the latter has imparted a few revolutions to the engine shaft the holding clutch 17 will be automatically closed and the spring held from imparting further revolutions to the spring shaft, thereby stopping the rotation of the spring shaft before the spring shall be en-

tirely unwound. The cam 45 will be so proportioned with relation to the number of rotations of the engine shaft that ordinarily the spring will be permitted to rotate the engine shaft two or three times after which said spring will be automatically disconnected from the engine shaft. Any desired number of cams 45 may be provided upon the cam wheel 43 and if upon the first attempt to start the engine should for some reason fail to start, then another pull on the starting lever 53 will set the engine shaft in rotation a second time, and another attempt will be made to start the engine. The number of cams 45 will be proportionate to the strength of the spring 12.

It has been observed that the winding-up clutch 35 will be opened when the spring 12 is wound up, that it will be closed when it is desired to wind up the spring and it must, of course, be opened whenever it is desired to operate the starting device to start the engine. I have therefore provided means for opening and closing the clutch 35 at the proper times in order to secure the above-suggested results. I have accomplished this result by providing the cam wheel 43 with cams and connections with the clutch 35 to open and close said clutch, and I have also provided means for holding the clutch open when the starting device is operating to start the engine shaft. The yoke 40 hereinbefore referred to is mounted upon a lever 58 pivoted at 59 to a fixed part of the frame and upon the opposite end of the lever 58 is carried a cam roll 60, adapted to be engaged by a cam 61 on the opposite side of the cam wheel 43 from the cams 45. Whenever, during the rotation of the cam wheel 43, the cam 61 comes opposite the cam roll 60, it will engage the same and oscillate the lever 58 to open the clutch 35. This will only occur when the spring 12 is wound up as the spring will not impart a sufficient number of revolutions to its shaft to rotate the cam wheel completely around to its starting point. Let it be assumed that the engine has been started, the rotation of the spring shaft will rotate the cam wheel far enough to withdraw the cam 61 from in front of the cam roll 60 and the clutch 35 will be closed by the action of the spring 42, whereupon the rotation of the worm 33 will in the manner above described operate to wind up the spring 12 and incidentally the rotation of the spring shaft will rotate the worm wheel 43 to bring the cam 61 opposite the cam roll 60 at the time that the spring will be completely wound up, whereupon the said cam will oscillate the lever 58 and open the clutch 35 and the winding up will cease. Here, therefore, are the means for opening the winding-up clutch when the spring is wound up:—In order to prevent the closing of the winding-

up clutch 35 when the starting lever is pulled to open the holding clutch 17, I have provided the latch lever 62 which is pivoted at 63 between ears projected from the side of the sleeve 46. The lever 62 is provided with a notch 63^a which is adapted to receive the lever 58 when the sleeve 46 is moved to the right of the position shown in Fig. 1. A cam 64 is provided on the side of the cam wheel 43 which when the cam 61 engages the cam roll 60 to oscillate the lever 58 operates coincidentally therewith to lift the latch lever 62 to disengage it from the lever 58. A spring 65 normally operates to pull the lever 62 into the direction to cause the notch 63^a to engage with the lever 58. The above-described arrangement is such that when the starting lever is pulled to open the holding clutch 17, the lever 62 is carried along until the notch 63^a is opposite the lever 58, now the rotation of the cam wheel 43 withdraws the cam 64 from under the lever 62 and the spring 65 pulls said lever down and causes it to engage with the lever 58, thereby holding the lever 58 in the position shown in Fig. 1, after the cam 61 has passed away from in front of the cam roll 60. After the holding clutch 17 is first closed again the lever 62 is still left in engagement with the lever 58 and the spring 27 through the medium of the lever 25 tends to force the lever 58 in the direction to close the clutch 35, this action being contributory to the more powerful spring 42 which also tends to the same result. If the engine starts, the winding-up clutch 35 being closed, the spring will be wound up again ready for another time. If, however, the engine should not start another pull on the starting lever would, through means of the lever 62, not only open the holding clutch 17 but at the same time open the winding-up clutch 35 so that the engine shaft can again be started in the same manner as before.

It is to be noted that the cam wheel 43 rotates in the direction of the arrow 66 when the device is starting the engine, and that it rotates in the opposite direction with the arrow 67 when the spring is being wound up. This fact requires the employment of a by-pass in connection with the cam 64 illustrated in detail in Figs. 6 and 7. The latch lever 62 is provided with a pin 68 which engages with the cam 64, the cam overhangs the surface cam wheel as shown, and alongside the cam 64 is mounted the by-pass lever 69 pivoted on the cam 64 and normally held in position shown in Fig. 6 by the coiled spring 70. When the spring shaft begins to rotate to start the engine shaft it moves the cam wheel 43 in the direction of the arrow 71 as shown in Fig. 6 and thereupon the pin 68 drops off of the cam 64 and passes underneath the lever 69. When the spring 12 is being wound up the cam 43 rotates in the di-

rection of the arrow 72 and the pin 68 comes in contact with the by-pass lever 69 and is raised by it to the level of the cam 64 upon which it comes to rest in the position shown in Fig. 6. This construction permits the lever 62 to be dropped quickly when the spring shaft is started to permit the notch 63^a to engage the lever 58 before the latter shall have been released by the cam 61, and, at the end of the winding-up operation the lever 62 will be raised and disengaged from the lever 58 before the cam 61 comes in contact with the cam roll 60 on the lever 58, so that the cam 61 may open the clutch 35 through the medium of the lever 58 at the proper time to stop the cam wheel with the cam roll 57 on the rod 48 in the position shown in Fig. 1.

While I have thus described a specific form of starting device for gas engines, it is to be understood that my invention is not limited to this particular embodiment of my invention, as my invention, in its broader aspects, contemplates any form of starting device embodying mechanism acting automatically to store power while the engine is running, this stored power to be used for imparting a few revolutions to the engine shaft while at rest, and mechanism acting automatically to stop such work before the stored power is exhausted so that if the engine fails to start on the first trial several subsequent trials may be made.

Having thus described my invention I claim as new and desire to secure by Letters Patent of the United States of America:—

1. A starting device for gas engines, having, in combination, an engine shaft, a spur gear, an automatically acting one-direction clutch for securing the said gear to the said shaft, a spring shaft, a spur gear secured to said spring shaft in engagement with the engine shaft gear, a spring attached at one end to a stationary support and at the other end to said spring shaft acting to drive the engine shaft through the spring shaft and gears described, and means for holding the spring shaft from rotation, substantially as described.

2. A starting device for gas engines, having, in combination, an engine shaft, a spur gear, an automatically acting one-direction clutch for securing said gear to the said shaft, a spring shaft, a gear secured to said spring shaft in engagement with the engine shaft gear, a spring secured at one end to a stationary support and at the other end to said spring shaft acting to drive the engine shaft through the spring shaft and gears described, a holding clutch for holding the spring shaft from rotation, means for opening the clutch, and means for holding the clutch open during a few revolutions of the engine shaft, substantially as described.

3. A starting device for gas engines, hav-

ing, in combination, an engine shaft, a spring shaft, gearing connecting the engine shaft and spring shaft including a clutch, a spring secured at one end to a stationary, support and at the other to the spring shaft, a holding clutch for holding the spring shaft from rotation, means for opening and closing said clutch, and a cam operatively connected with the spring shaft and with the opening and closing means for said clutch, substantially as described.

4. A starting device for gas engines, having, in combination, an engine shaft, a spring shaft, gearing connecting the engine shaft and spring shaft including a one direction clutch, gearing between the engine shaft and spring shaft for winding up the spring, said gearing including a holding clutch for connecting the parts and for holding the spring shaft from rotation after the spring is wound up, substantially as described.

5. A starting device for gas engines, having, in combination, an engine shaft, a spring shaft, a holding clutch, gearing between the engine shaft and spring shaft including a connecting clutch, gearing between the engine shaft and spring shaft for winding up the spring including a winding-up clutch, a cam and connections between the cam and spring shaft and between the cam and said winding-up clutch acting to open the said clutch when the spring is wound up, substantially as described.

6. A starting device for gas engines, having, in combination, an engine shaft, a spring shaft and spring, driving gearing between the engine shaft and spring shaft, winding-up gearing between the engine shaft and spring shaft including a winding-up clutch, and connected mechanism operating automatically to close the winding-up clutch after the spring has been partially or wholly unwound in starting the engine, substantially as described.

7. A starting device for gas engines, having, in combination, an engine shaft, a spring shaft, a spring, a holding clutch for the spring shaft, winding-up gearing between the engine shaft and spring shaft including a winding-up clutch, connected mechanism operating automatically after the holding clutch has been opened to prevent the winding-up-clutch from being closed while the holding clutch is open and for closing the holding clutch when the winding-up clutch is opened, substantially as described.

8. A starting device for gas engines, having, in combination, an engine shaft, a spring, means for connecting the spring to and disconnecting it from the shaft a plurality of times to impart a plurality of starting impulses, gearing for winding up the spring, and automatic mechanism for connecting the winding up gearing with the spring

after the spring has imparted an impulse to the shaft and has started the engine in operation, substantially as described.

9. A starting device for gas engines, having, in combination, an engine shaft, a spring, means for connecting the spring to and disconnecting it from the shaft a plurality of times to impart a plurality of starting impulses, gearing for winding up the spring, and automatic mechanism for connecting the winding up gearing with the spring after the spring has imparted an impulse to the shaft and has started the engine in operation and for disconnecting the winding up gearing after the spring has been wound up, substantially as described.

10. A starting device for gas engines, having, in combination, an engine shaft, a spring, gearing for rotating the engine shaft a few times by the spring and for winding up the spring by the engine shaft, means for holding the spring wound up, a hand lever for releasing the holding means, and means, such as a cam, beyond the control of the operator for maintaining the holding means released during a few revolutions of the engine shaft, substantially as described.

11. A starting device for gas engines, having, in combination, an engine shaft, a spring and gearing for rotating the engine shaft a few times, gearing between the engine shaft and spring for winding up the spring including a winding-up clutch and a holding clutch, mechanism acting automatically to close the holding clutch after the spring has imparted a few revolutions to the engine shaft and to close the winding-up clutch for winding up the spring and to open said clutch after the spring is wound up, substantially as described.

12. A starting device for gas engines, having, in combination, an engine shaft, a spring and gearing for rotating the engine shaft a few times, a holding clutch for holding the spring wound up, a hand lever for opening the holding clutch, automatic mechanism for maintaining the holding clutch open while the spring imparts a few revolutions to the engine shaft and for closing said holding clutch before the spring is run down, substantially as described.

13. A starting device for gas engines, having, in combination, an engine shaft, a spring and connections between the spring and the engine shaft for winding up the spring from the engine shaft, and for imparting a few revolutions to the engine shaft from the spring, a holding clutch for holding the spring wound up, means for opening and maintaining open the holding clutch for a few revolutions of the engine shaft and for automatically closing said clutch before the spring is run down, and when the means for opening the holding clutch is again operated, for again maintaining the holding

clutch open during a few revolutions of the engine shaft, and for again automatically closing said holding clutch, substantially as described.

- 5 14. A starting device for gas engines, having, in combination, an engine shaft, a spring and connections between the spring and the engine shaft for winding up the spring from the engine shaft and for imparting a few
10 revolutions to the engine shaft from the spring, a holding clutch for holding the spring wound up, means for opening and maintaining open the holding clutch for a few revolutions of the engine shaft and then
15 acting automatically to close the same, said means being constructed and arranged to permit the repeated opening, holding open, and closing of the said holding clutch, substantially as described.
- 20 15. A starting device for gas engines, having, in combination, an engine shaft, a spring and gearing for imparting a few revolutions to the engine shaft, a holding clutch for holding the spring wound up, winding-up
25 gearing between the engine shaft and spring including a winding-up clutch, means under control of the operator for opening the holding clutch, automatic mechanism operating to maintain the holding and winding-up
30 clutches open and to close them when a few revolutions have been imparted to the engine shaft, substantially as described.
- 35 16. A starting device for gas engines, having, in combination, an engine shaft, a spring and gearing for imparting a few revolutions to the engine shaft, a holding clutch for holding the spring wound up, winding-up gearing between the engine shaft
40 and spring including a winding-up clutch, a cam wheel having a series of cams for maintaining the holding clutch open, for opening the winding-up clutch and for disconnecting the mechanism for operating the holding
45 and winding-up clutches, substantially as described.
- 50 17. A starting device for gas engines, having, in combination, an engine shaft, a spring and gearing for imparting a few revolutions to the engine shaft, a holding clutch for holding the spring wound up, a lever for opening and closing the holding
55 clutch, a spring normally tending to hold the holding clutch closed, and means, such as a cam, beyond the control of the operator, for maintaining the holding clutch open for a few revolutions of the engine shaft, substantially as described.
- 60 18. A starting device for gas engines, having, in combination, an engine shaft, a spring and gearing for imparting a few revolutions to the engine shaft, gearing for winding up the spring including a holding clutch and winding-up clutch, means normally operating to maintain the holding clutch
65 closed, means normally operating to main-

tain the winding-up clutch closed, means for opening the holding clutch, means for opening the winding-up clutch, and connections between said means for maintaining the winding-up clutch open when the holding
70 clutch is opened to start the engine shaft, substantially as described.

19. A starting device for gas engines, having, in combination, an engine shaft, a spring and gearing for imparting a few
75 revolutions to the engine shaft, gearing for winding up the spring including a holding clutch and a winding-up clutch, means tending normally to maintain the holding clutch closed, means tending normally to maintain
80 the winding-up clutch closed, a hand lever for opening the holding clutch, and means for maintaining the holding clutch open for a few revolutions of the engine shaft, connections between the means for opening the
85 holding clutch and the means for opening the winding-up clutch acting to hold the winding-up clutch open when the holding clutch is opened to start the engine, and a cam for disconnecting said means, substantially
90 as described.

20. A starting device for gas engines, having, in combination, an engine shaft, a spring for imparting a few revolutions to the engine shaft, gearing for winding up the
95 spring including locking means for holding the spring wound up, and automatic mechanism for maintaining the locking means open while the spring is imparting a few revolutions to the engine shaft, for permitting
100 the locking means again to hold the spring from tending to impart motion to the engine shaft, for starting the winding-up gearing, and for stopping the winding up gearing after the spring is wound up, substantially
105 as described.

21. A starting device for gas engines, having, in combination, an engine shaft, a spring for imparting a few revolutions to the engine shaft, gearing for winding up the
110 spring including locking means for holding the spring wound up and automatic mechanism for throwing the locking means into operation after the spring has imparted a few revolutions to the engine shaft and before
115 it has entirely unwound and for starting the winding-up gearing, substantially as described.

22. A starting device for gas engines, having, in combination, an engine shaft, a
120 spring and connections for winding up the spring by the engine shaft and for imparting a few revolutions to the engine shaft and automatically stopping such work before the power stored in the spring is exhausted, substantially
125 as described.

23. A starting device for gas engines, having, in combination, an engine shaft, a spring and connections for imparting a few
130 revolutions to the engine shaft, gearing be-

tween the engine shaft and the spring for storing power in said spring, and automatic mechanism for connecting the engine shaft with the spring after the power stored in said spring has been partially exhausted, substantially as described.

24. A starting device for gas engines, having, in combination, an engine shaft, a spring and spring shaft, and connections for imparting a few revolutions to the engine shaft from the spring shaft, gearing for storing power in the spring including automatically acting locking means for holding the spring shaft from rotation, and means for automatically starting the gearing to store power in the spring after said spring and its connections have imparted a few revolutions to the engine shaft, substantially as described.

25. A starting device for gas engines, having, in combination, an engine shaft, a spring, a spring shaft, connections between said shafts including an automatically acting one-direction clutch, a clutch for holding the spring shaft from rotation, means for opening said clutch, and automatically acting means for holding said clutch open during a few revolutions of the engine shaft, substantially as described.

26. A starting device for gas engines, having, in combination, means acting automatically to store power while the engine is running, and means for applying said power to the engine shaft to impart thereto a starting impulse and for automatically cutting off said power before it is exhausted, substantially as described.

27. A starting device for gas engines, having, in combination, means for storing power while the engine is running, means for applying said stored power when the engine is at rest to start the engine, and automatic mechanism for disconnecting said power before it is exhausted, substantially as described.

28. A starting device for gas engines, having, in combination, a spring, means for storing power in the spring while the engine is running, and means for connecting the spring to the engine to apply the stored power to the engine to impart thereto a starting impulse, and means for disconnecting the spring from the engine before the stored power is exhausted, substantially as described.

29. A starting device for gas engines, having, in combination, means for storing power while the engine is running, means for applying said stored power when the engine is at rest to start the engine, automatic mechanism for disconnecting said power before it is exhausted, and automatic mechanism for setting the power storing means in operation when the engine has been started, substantially as described.

30. An engine starter comprising an energy-storing device adapted to impart rotative impulses to the engine, means for automatically stopping the operation of said energy-storing device at predetermined intervals, and means controlling said mechanism designed to bring the same into and out of operation.

31. The combination with an engine having a crank shaft, of an energy-storing device connected to said shaft and adapted to impart rotative impulses thereto, means for automatically stopping the energy-storing device at predetermined intervals, and means controlling said mechanism designed to bring the same into and out of operation.

32. The combination with an engine having a crank shaft, of an energy-storing device connected to said shaft and adapted to impart rotative impulses thereto, means for automatically arresting the energy-storing device previous to the exhaustion of its energy, and means controlling said mechanism designed to bring the same into and out of operation.

33. A starting device for gas engines, having, in combination, an engine shaft, a spring, gearing for rotating the engine shaft a few times by the spring and for winding up the spring by the engine shaft, means for holding the spring wound up, a lever for releasing the holding means, and means such as a cam, beyond the control of the operator for maintaining the holding means released during a few revolutions of the engine shaft.

34. A starting device for gas engines, having, in combination, an engine shaft, a spring and gearing for rotating the engine shaft a few times, a holding member for holding the spring wound up, a lever for releasing the holding member, automatic mechanism for maintaining the holding member released while the spring imparts a few revolutions to the engine shaft and for returning said holding member before the spring is run down.

35. A starting device for gas engines, having, in combination, an engine shaft, a spring and connections between the spring and the engine shaft for winding up the spring from the engine shaft, and for imparting a few revolutions to the engine shaft from the spring, a holding member for holding the spring wound up, means for releasing and maintaining released the holding member for a few revolutions of the engine shaft and for automatically returning said member before the spring is run down, and when the means for releasing the holding member is again operated, for again maintaining the holding member released during a few revolutions of the engine shaft, and for again automatically returning said holding member.

36. A starting device for gas engines, having, in combination, an engine shaft, a spring and connections between the spring and the engine shaft for winding up the spring from the engine shaft and for imparting a few revolutions to the engine shaft from the spring, a holding member for holding the spring wound up, means for releasing and maintaining released the holding member for a few revolutions of the engine shaft and then acting automatically to return the same, said means being constructed and arranged to permit the repeated releasing, holding released, and returning of the said holding member.

37. A starting device for gas engines, having, in combination, an engine shaft, a spring and gearing for imparting a few

revolutions to the engine shaft, a holding member for holding the spring wound up, winding-up gearing between the engine shaft and spring including a winding-up clutch, means under control of the operator for releasing the holding member, automatic mechanism operating to maintain the holding member released and the winding-up clutch open and to return the holding member and close the winding-up clutch when a few revolutions have been imparted to the engine shaft.

In testimony whereof I affix my signature, in presence of two witnesses.

ALFRED B. FOWLER.

Witnesses:

HENRY B. METCALF,
EUGENE A. TINGLEY.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."