No. 867,795. PATENTED OCT. 8, 1907.

C. J. COLEMAN.

AUTOMATIC ENGINE STARTER.

APPLICATION FILED FEB. 26, 1906.

5 SHEETS—SHEET 1.

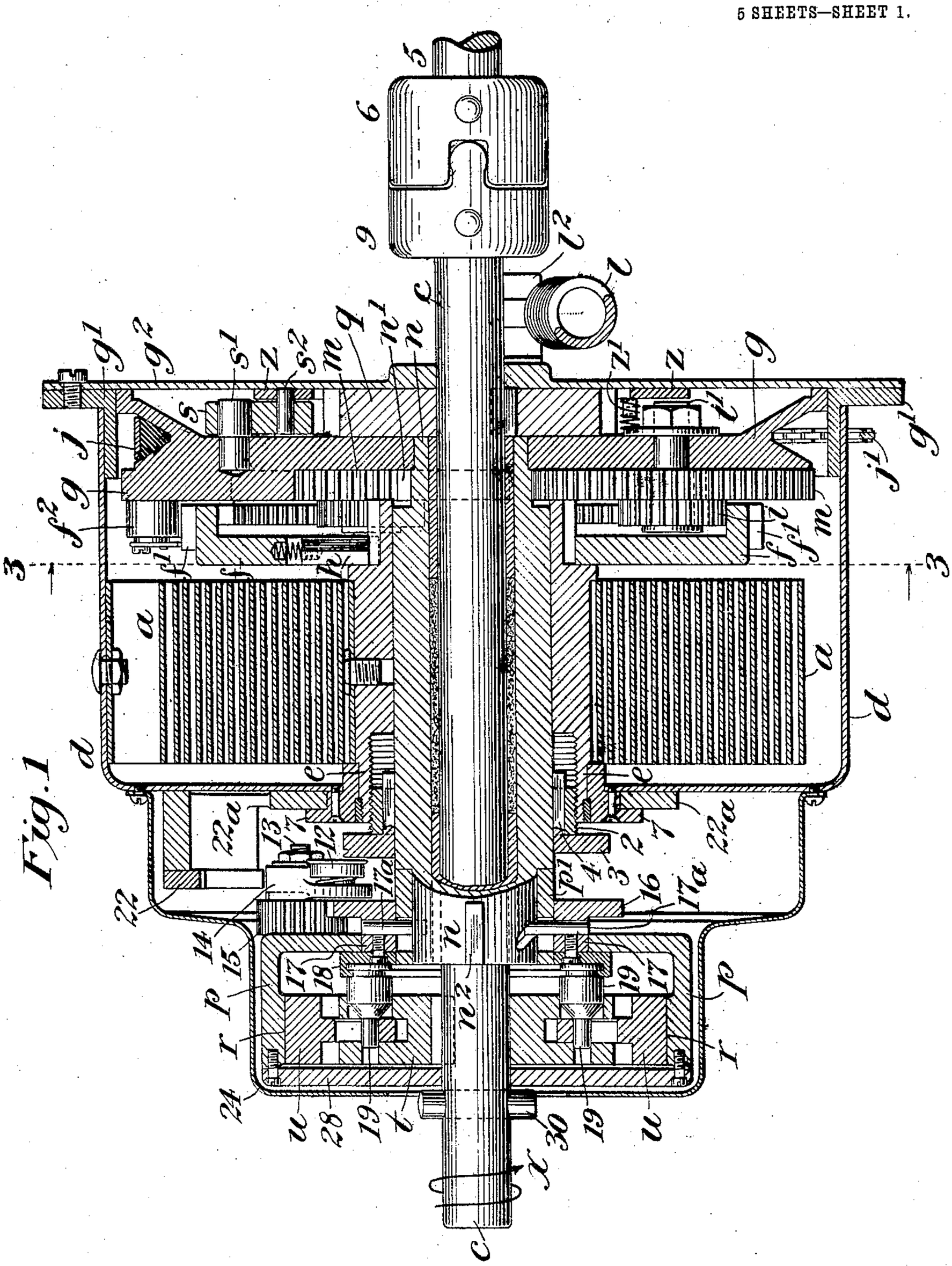

Fig. 1

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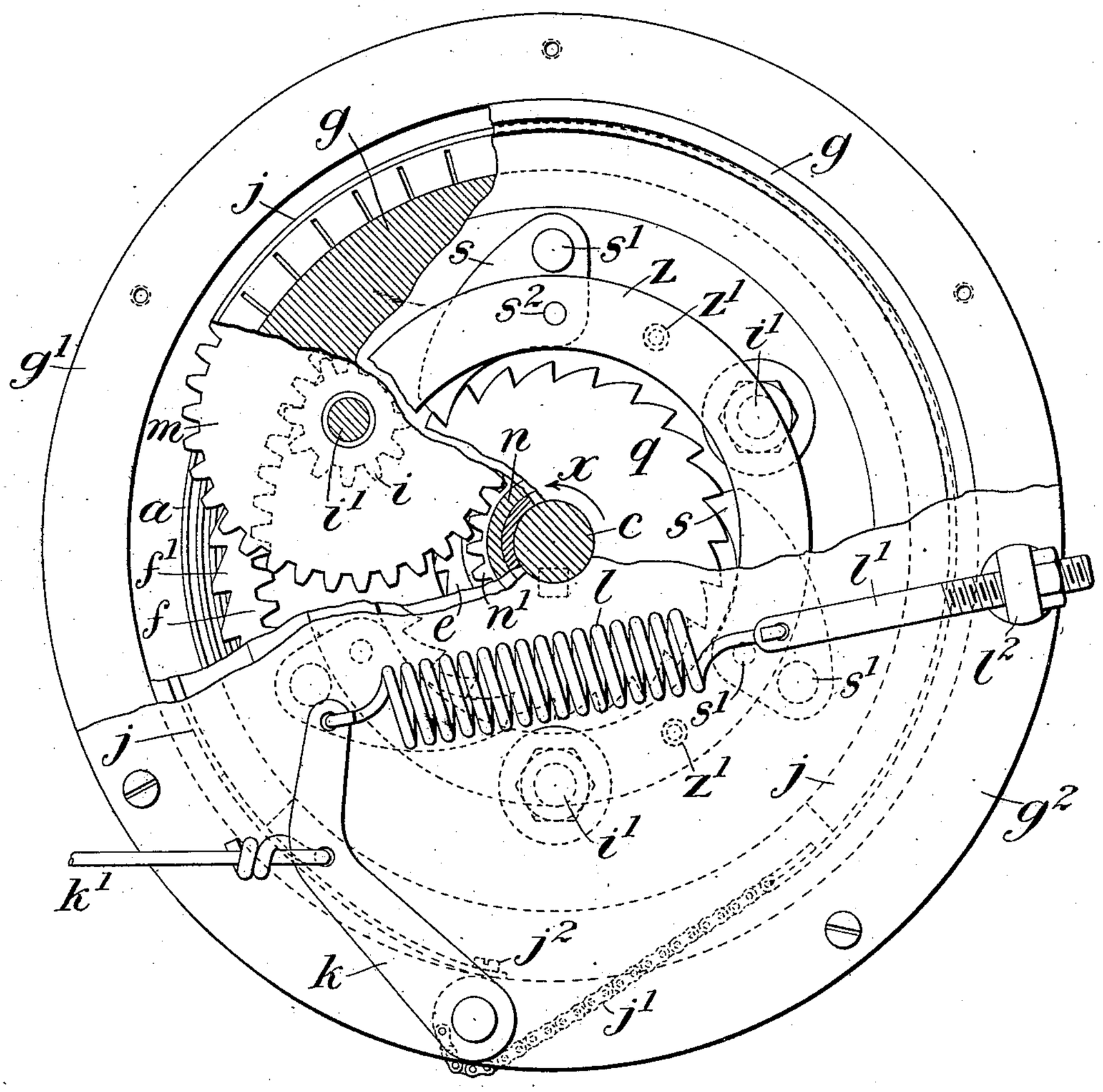
5 SHEETS—SHEET 2.

Fig. 2



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5 SHEETS—SHEET 3.

Fig. 3

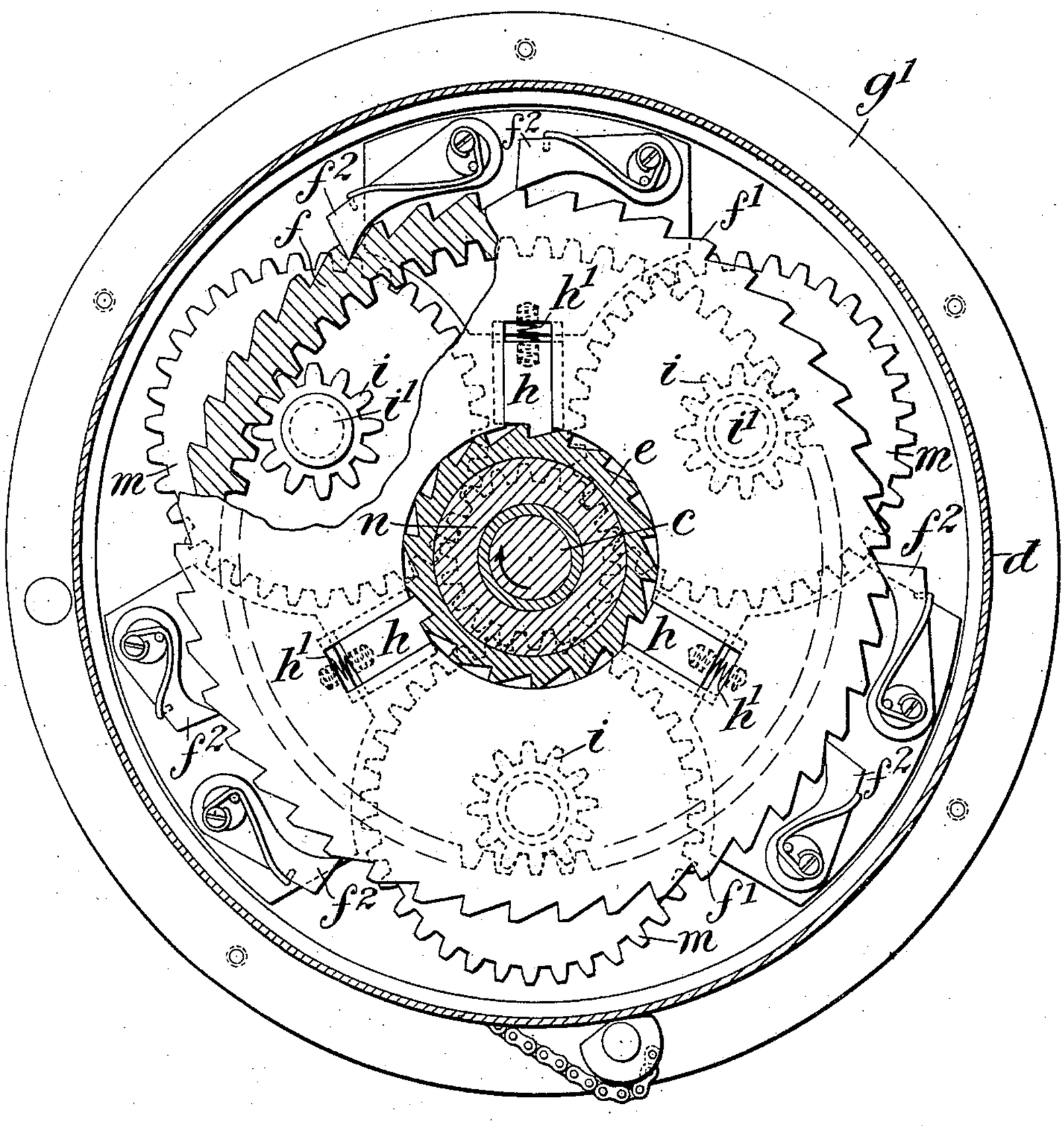

Fig. 3a

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5 SHEETS—SHEET 4.

Fig. 4

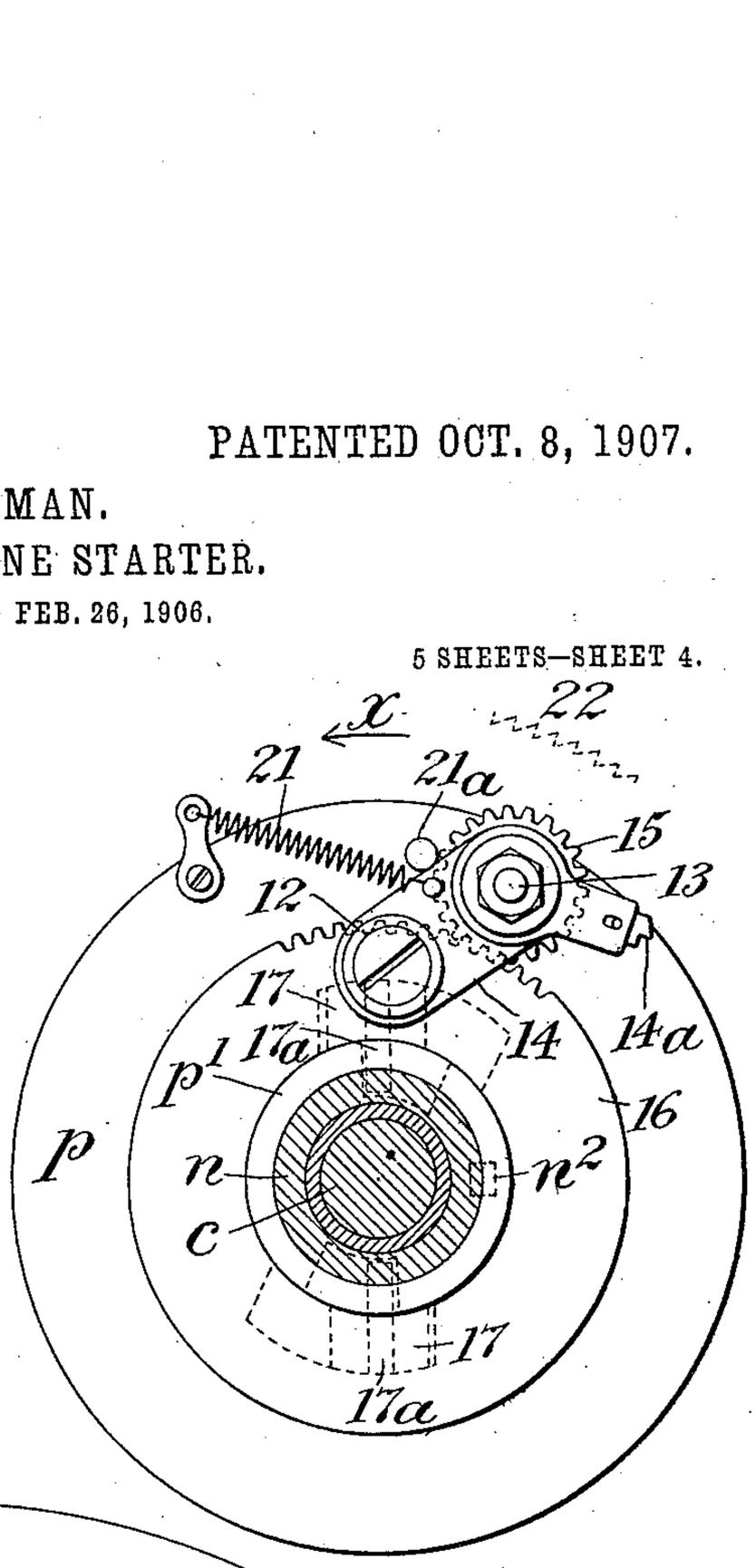
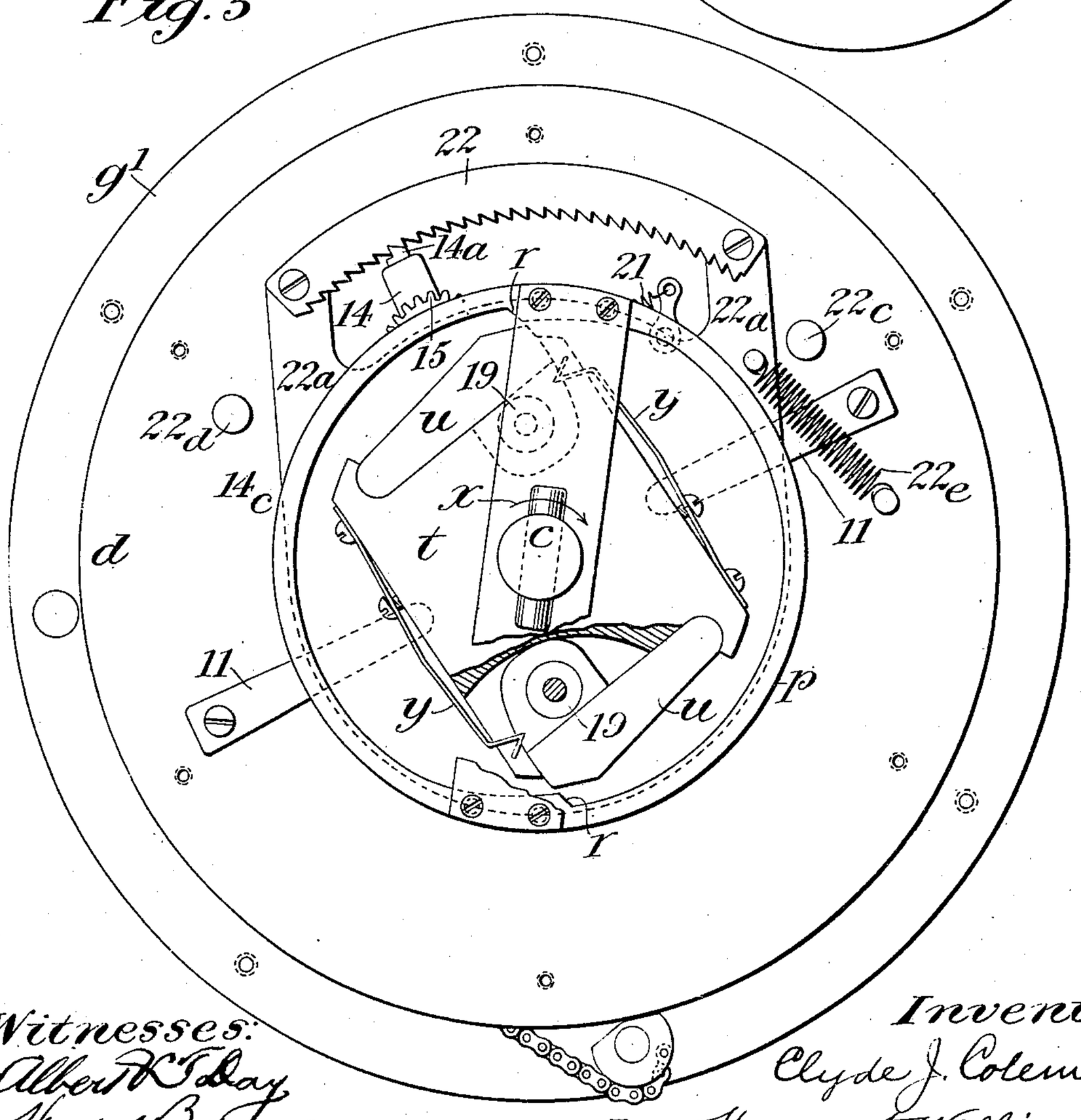


Fig. 5



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5 SHEETS—SHEET 5.

Fig. 6

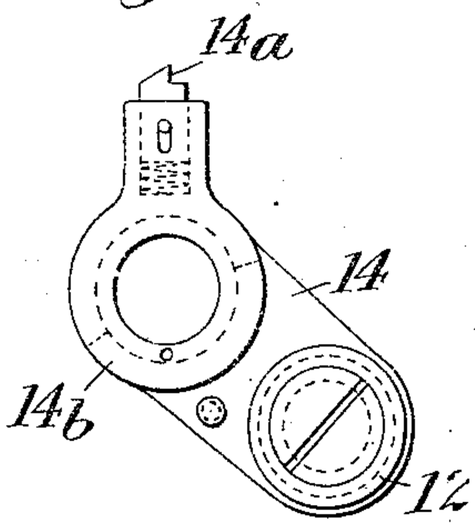


Fig. 7

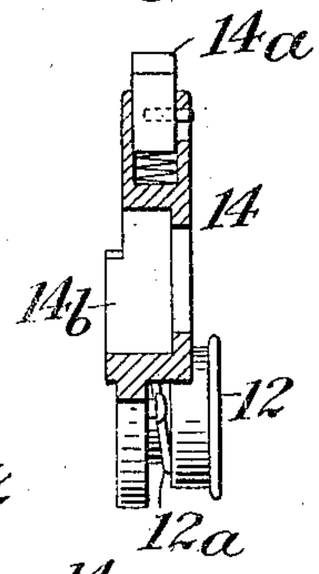


Fig. 8

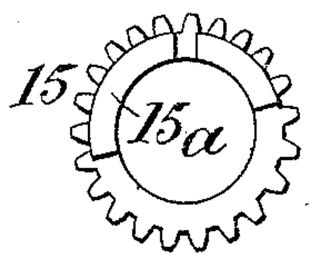


Fig. 9

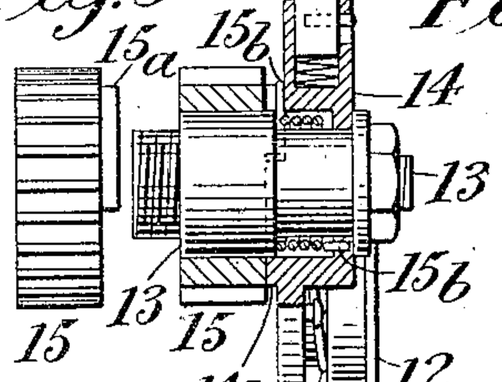


Fig. 11

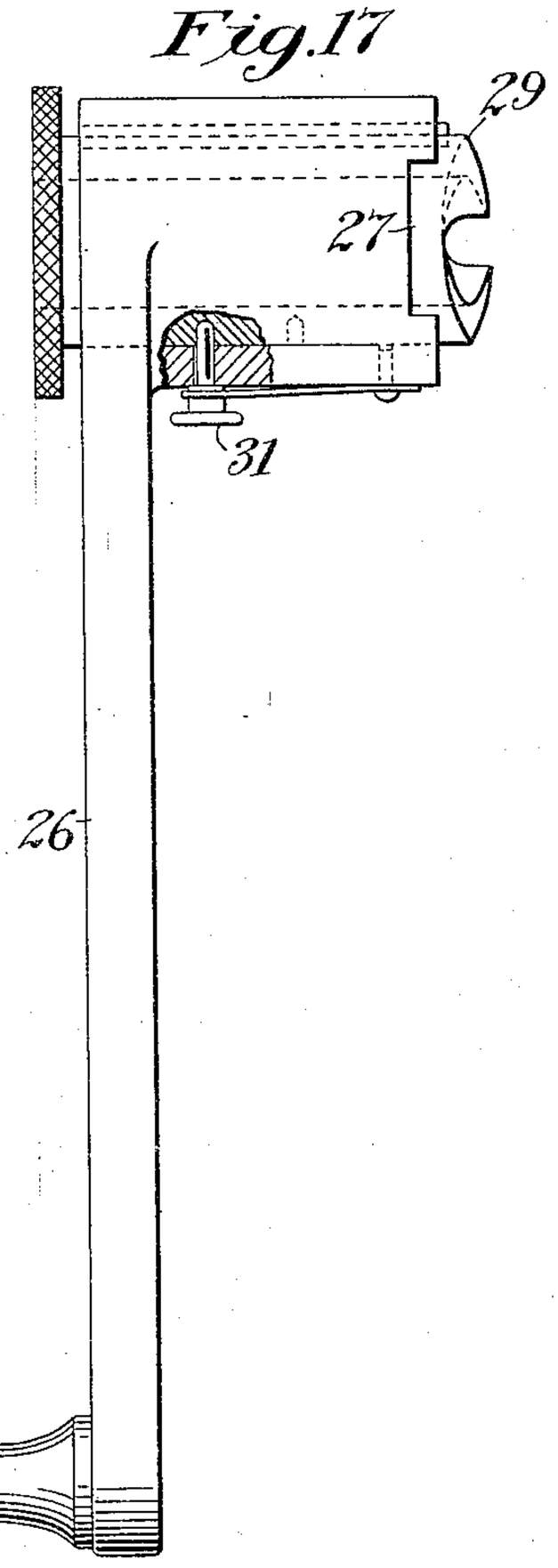


Fig. 10

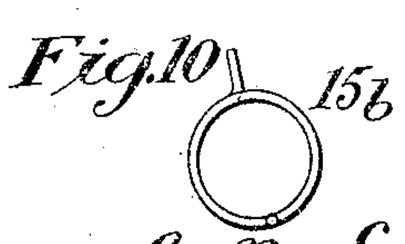


Fig. 16

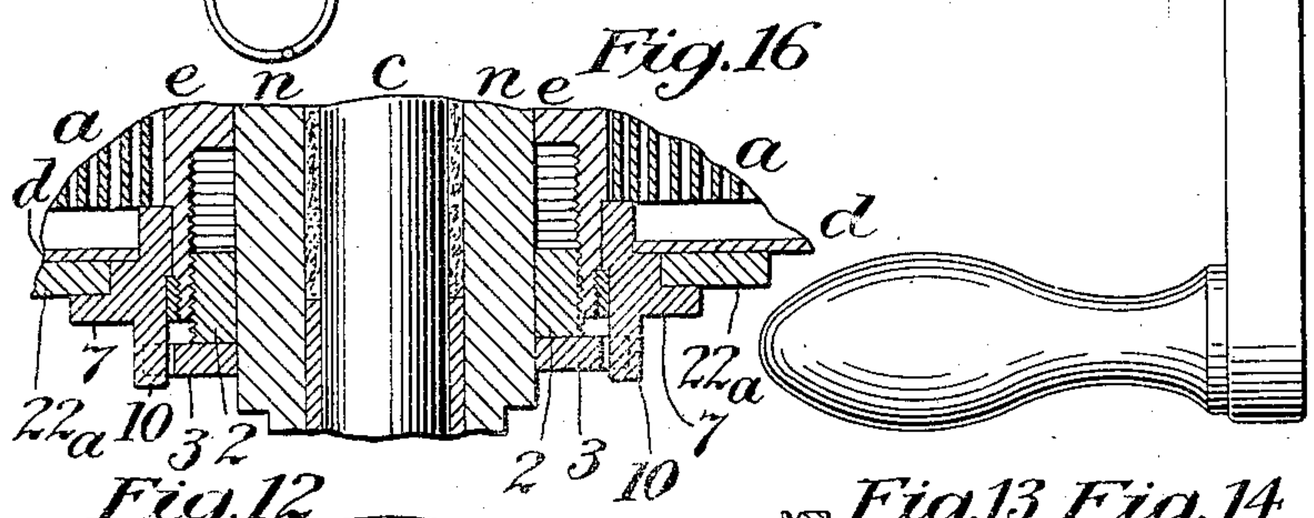


Fig. 12

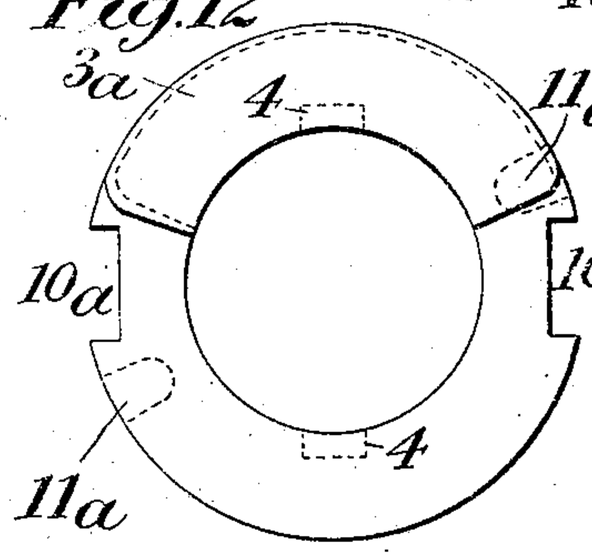


Fig. 13

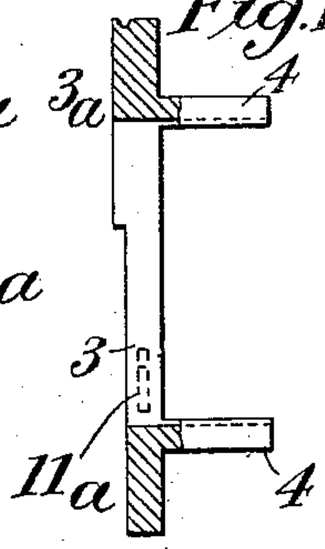


Fig. 14

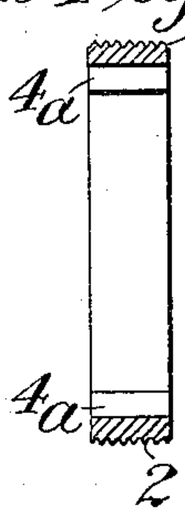
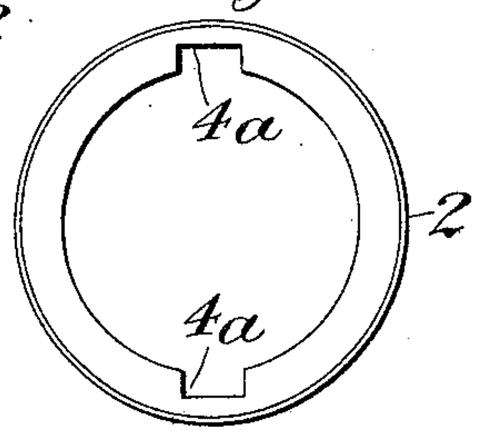


Fig. 15



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Inventor:
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UNITED STATES PATENT OFFICE.

CLYDE J. COLEMAN, OF NEW YORK, N. Y., ASSIGNOR TO CONRAD HUBERT, OF NEW YORK, N. Y.

AUTOMATIC ENGINE-STARTER.

No. 867,795. Specification of Letters Patent. Patented Oct. 8, 1907.

Application filed February 26, 1906. Serial No. 303,130.

To all whom it may concern:

Be it known that I, CLYDE J. COLEMAN, a citizen of the United States, residing at the borough of Manhattan, city of New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Automatic Engine-Starters, of which the following is a specification, reference being had therein to the accompanying drawings, forming a part thereof.

My invention relates to starting means for engines not self-starting, such as explosion engines, and means embodying my invention are particularly adapted for use on engines of automobiles by reason of the frequent necessity in the use of automobiles for the performance of the starting operation.

My invention has for its objects simplicity of construction, durability, reliability in operation, and the realization of other advantages which will appear from the following specification.

My invention relates to starting means whereby a power-storing device is connected with the engine to perform the operation of starting the engine, also to releasing means whereby the centrifugal engaging device is disengaged or released from the condition whereby it effects the connection of the engine and the power-storing device for the performance of the winding or power-storing operation.

My invention also relates to the general construction and arrangement of parts and to means for manually storing power in the power-storing device and for turning the engine independently of the power-storing device.

I will now describe the construction embodying my invention illustrated in the accompanying drawings and will thereafter point out my invention in claims.

Figure 1 is a vertical longitudinal central section of the starter. Fig. 2 is a rear elevation of the same, partly broken away to show the interior construction. Fig. 3 is a transverse vertical section taken on a plane indicated by the line 3—3, in Fig. 1, and partly broken away. Fig. 3ª is a detail end of one of the pawls engaging the ratchet on the spring-carrying sleeve. Fig. 4 is a detail rear elevation of the cup of the releasing means and connected parts. Fig. 5 is a front elevation of the starter, with the cap or end part of the casing removed and other parts broken away. Fig. 6 is a rear elevation of the releasing lever. Fig. 7 is a vertical axial section of the same. Fig. 8 is a rear elevation of the pinion connected to the releasing lever. Fig. 9 is an end elevation of the same. Fig. 10 is a rear elevation of the spring connecting the lever and pinion. Fig. 11 is a transverse axial section of the lever and pinion, assembled. Fig. 12 is a front elevation of the non-rotative disk for actuating the releasing lever. Fig. 13 is a part axial section and part elevation of the same. Figs. 14 and 15 are respectively an axial section and a front elevation of the screw-threaded sleeve which actuates the releasing disk. Fig. 16 is a horizontal central section of the non-rotative disk, screw-threaded sleeve and adjacent parts. Fig. 17 is an elevation partly in section of the combined starting and winding crank.

The engine in connection with which the starter is to be used is not shown in the drawings otherwise than by the illustration in Fig. 1 of the end of its shaft 5, this shaft being coupled to the starter-shaft *c* by a coupling or clutch device shown as a collar 6 on the engine-shaft recessed to receive projections from the end collar 9 on the starter-shaft *c*.

The direction of rotation of the engine is indicated by the arrows *x*. The rotative force to start the engine originates at the coil spring *a*, which is secured at its outer end to a stationary casing or drum *d* and at its inner end to the spring-carrying or outer sleeve *e*, this outer sleeve being fitted to rotate upon an inner sleeve *n* which, with an intermediate bushing, is fitted to rotate upon the starter shaft *c*. The outer sleeve *e* has ratchet-teeth formed at its inner end, and a rotative part or internal gear and external ratchet *f* is fitted to rotate on the outer peripheries of the ratchet-teeth and is connected to the outer sleeve by a plurality of spring pawls *h* (see Figs. 3 and 3ª), of which three are shown, each pawl being fitted to slide radially in V-shaped grooves formed in the rotative part *f* and being yieldingly thrust inward by a spring *h'* and engaging the ratchet-teeth on the outer sleeve *e* so as to impart movement from the spring-carrying outer sleeve *e* to the rotative part *f* in the direction of rotation of the power-spring in its starting or power-applying operation and to impart movement from the rotative part *f* to the spring-carrying sleeve *e* in the reverse direction during the spring-winding or power-storing operation. The function of this pawl and ratchet connection is to prevent the momentum of the parts from carrying the spring beyond its unwound condition at the conclusion of the starting or power-applying operation in the event of the complete unwinding of the spring.

Planet pinions *i* and planet gear-wheels *m*, each wheel and pinion being suitably secured together, are fitted to rotate on studs *i'* projecting from a brake-disk *g*, this brake-disk having a rear outer flange, the outer periphery of which is fitted to rotate in a bearing formed by a stationary flanged ring *g'* of the casing and the end of which bears against the rear end plate g^2 of the casing, and this brake-disk providing a bearing at its inner periphery for the rear end of the inner sleeve *n*. A brake-band *j* enters a V-shaped peripheral groove in the brake-disk *g* and very nearly encircles the brake-disk (see Fig. 2) and is secured at one end by a screw j^2 to the stationary ring *g'* and is connected at its other end by a chain *j'* to the boss of a pivoted lever *k*, this

lever being actuated to normally apply the brake by means of a helical extension spring l, which is connected at one end to the lever k and at the other end to a rod l' adjustably held in a stationary stud l^2 projecting from the casing. A brake-releasing wire k' is connected with an operating pedal or other suitable operating means (not shown) so that, at the will of the operator, the brake may be released and the brake-disk permitted to rotate under the actuation of the power-spring. Normally the brake-disk is locked or held from rotation and the brake construction is a convenient and effective form of locking device, and the brake-disk is properly describable as a lock-wheel.

When the brake-disk is released, the thrust of the power-spring is applied to the starter-shaft through directional engaging means consisting of pawls and ratchets, but independently of the gearing provided for the winding or power-storing operation. The connecting means include the pawl and ratchet connection above described between the outer or spring-carrying sleeve e and the rotative part f, and also include ratchet-teeth f' on the outer periphery of the rotative part f, co-acting with spring-actuated stop-pawls f^2 carried by the brake-disk g. Six of these pawls f^2 are shown, arranged so as to engage ratchet-teeth f' of the rotative part f in different positions of the rotative part, thereby producing the effect of small ratchet-teeth without the consequent reduction of the size of the teeth, and thereby preventing material backward movement at the conclusion of the power-storing or winding operation. The means just described carry the thrust of the wound power-spring to the brake-disk g and securely hold the spring in wound position so long as the brake-band j is applied to the brake-disk g. For the purpose of imparting to the starter-shaft the spring-actuated movement of the brake-disk, when the brake-disk is released, a friction-controlled ratchet connection is provided from the brake-disk to the starter-shaft, comprising a plurality of starting pawls s pivotally mounted upon pins s' projecting from the brake-disk and also pivotally connected by pins s^2 to a drag-ring z and engaging the teeth of a starting ratchet-wheel q suitably secured upon and shown as keyed to the starter-shaft c. The drag-ring z is pressed rearward against the inside face of the rear end-plate g^2 of the casing, by means of helical springs z', arranged between the drag-plate and the brake-disk, and this drag-plate swings the starting pawls s quickly inward into engagement with the teeth of the starting ratchet q on the spring-actuated movement of the brake-disk immediately following the release of the brake-disk, and holds the pawls in engaged position so long as the torque of the spring is applied in the starting effort. As soon as the operation of the engine, under its own power, rotates the starter-shaft c and the starting ratchet q more rapidly than the torque of the spring rotates these parts, the starting pawls s are pushed outward by the ratchet-teeth. This condition will usually be attained before the exhaustion of the power stored in the power-spring, and will become evident to the operator, who will release the pedal or other controlling means, thus permitting the brake-disk to be gripped and locked by its brake-band. Should, however, the controlling means or pedal be held in released condition for a sufficient time for the exhaustion of the power stored in the spring, the operation will be the same, since the starting ratchet will push its pawls outward and the brake-disk will come to rest. The drag-ring z will hold the starting pawls s in the outer positions to which they have been pushed by the starting ratchet q and they will be held in this disengaged position so long as the engine continues to run and when it stops and until the power-spring is again put into operation to start the engine.

The planet pinions i mesh with the internal gear formed upon the rotative part f, while the planet gear-wheels m, which as aforesaid are secured to the planet pinions i, mesh with gear-teeth n' formed upon the inner sleeve n, and these pinions and gears transmit motion from the inner sleeve n to the rotative part f with the desired reduction of speed for the winding or power-storing operation of the spring. This transmission of motion will occur while the brake-disk g is held from rotation, the pinions and gears rotating freely on their studs which project from this brake-disk, and which are stationarily held and act as fulcrums when the brake-disk is locked.

The actuation and control of the inner sleeve n for the performance of the winding or power-storing operation is effected by means located between the power-spring and the front end of the starter, these means including a cup p, the hub p' of which is secured upon the reduced front end of the inner sleeve n, as by the key n^2, and is shown as provided with two inwardly extending projections or internal ratchet-teeth r which co-act with centrifugal pawls u, of which two also are shown. These centrifugal pawls u are carried by a block t suitably secured upon the starter-shaft c and shown as keyed thereon, the centrifugal pawls being fitted at their rear ends in half round sockets in the block t so that they may swing outward at their front ends to engage the ratchet-teeth r. They are normally held in inner positions by spring detents y which engage in depressions in the centrifugal pawls and act to restrain the centrifugal pawls until a sufficcint centrifugal force has been developed to throw them quickly outward into engaging positions. When the engine has attained the sufficient speed selected for the winding operation, these centrifugal pawls are thrown outward by centrifugal force into engagement with the ratchet-teeth r and thereby the cup p and the inner sleeve n upon which it is secured are caused to rotate with the starter-shaft and the spring is wound through the speed-reducing gearing above described.

The winding or power-storing operation is discontinued automatically by the power-spring or retractive device at a predetermined point of winding or power-storing, usually just before the spring has been fully wound, and this discontinuance of the winding operation is effected by the forcible disengagement or release of the centrifugal pawls u.

The controlling means whereby the pawl-releasing operation is effected include an externally threaded sleeve 2 engaging with an internal thread on the front end of the outer or spring-carrying sleeve e, and a non-rotative plate 3, having projecting fingers or keys 4, entering grooves or ways 4^a of the threaded sleeve 2 (see Figs. 13—15) to prevent rotation of the threaded sleeve. The plate 3 is itself held from rotation by stationary arms 10 entering notches 10^a in its outer pe-

riphery (see Fig. 12), the stationary arms 10 projecting from a front bearing-block 7 secured to the casing drum *d* (see Fig. 16). By reason of the fact that the threaded sleeve 2 is non-rotative, it is caused to traverse longitudinally as the power-spring unwinds or is wound, and during the winding movement it is moved forward and pushes the plate 3 forward toward the cup *p*, the plate 3 being at all times yieldingly pressed rearward by spring fingers 11, secured to the casing drum *d* (see Fig. 5) and entering pockets 11^a in the plate 3 (see Fig. 12). As shown in Fig. 1, the sleeve and plate have nearly reached the outer limit of their movement and the winding operation is about to be discontinued. An oscillating lever 14 is carried by the cup *p*, being fitted to oscillate upon a pin 13 projecting therefrom, and this oscillating lever 14 carries a cam-roller 12 on one arm thereof, this cam-roller normally projecting in the path of the non-rotative plate 3. The oscillating lever 14 is yieldingly held in such position by a helical extension spring 21, secured at one end to a lug projecting from the cup *p* and secured at the other end to the lever 14 and holding the lever against a stop-pin 21^a projecting from the cup *p* (see Fig. 4). The movement of the non-rotative plate 3 outward or toward the cup *p* and the rotation of the cup *p* and consequent orbital movement of the oscillating lever 14, brings the cam-roller 12 on the oscillating lever in contact with a cam-projection 3^a on the approaching face of the non-rotative plate 3. Initially the face of the cam-roller will usually come in contact with the face of this cam-projection, and as the roller is yieldingly held axially by a spring 12^a located between the roller and the lever 14, the roller will be pressed toward the lever until its orbital movement has carried it beyond the cam-projection 3^a and will then spring toward the plate so that when it next approaches the cam-projection it will be advanced in such position as to effectively engage therewith. To further assure an effective engagement of the cam-roller 12 and the cam-projection 3^a, a flange is formed upon the roller and a counterpart groove is formed on the advance radial edge and on the peripheral edge of the non-rotative plate, and when the roller next encounters the cam-projection, this flange and groove will engage so as to effectively prevent the roller from slipping off the cam-projection. The movement of the lever 14 resulting from contact of its cam-roller 12 with the end of the cam-projection 3^a will be first a backward and inward swinging movement and then a backward and outward swinging movement until the roller 12 has been moved outward sufficiently to mount and roll in contact with the peripheral edge of the cam-projection and thereafter the rotation of the cup *p* will not cause the further movement of the oscillating lever 14 relatively to the cup *p*. As the lever 14 is thus oscillated, a spring-pawl 14^a, which is carried on an obliquely arranged short arm of the lever, will engage with an arc-shaped internal ratchet-bar 22, which is carried by a ring 22^a, this ring being fitted to oscillate on the front bearing-block 7 between stops 22^c and 22^d on the casing and yieldingly held against the front stop 22^c by a spring 22^e. This engagement will introduce a frictional resistance such as will be effective in overcoming the momentum of the parts after the centrifugal pawls have been released.

The oscillating movement of the lever 14 relatively to the cup *p* causes a partial rotation of a pinion 15 which is mounted concentrically with the axis of the lever 14 on the pin 13 and has a slightly yielding connection therewith, this yielding connection being effected by a helical torsion spring 15^b (see Fig. 10) which is located between the stud 13 and the hub of the lever 14 and engages at one end with the pinion 15 and at the other end with the lever 14 (see Fig. 11). The extent of this yielding movement is controlled by a projection 15^a on the pinion engaging a projection 14^b on the lever with a slight freedom of movement for the action of the spring. This spring yields when the lever is actuated by the cam-projection 3^a on the non-rotative plate 3 and remains under torsion so long as the lever is actuated by the cam to perform the releasing operation, but exerts its resilient force at the conclusion of such forcible operation to effectively complete the withdrawal of the centrifugal pawls clear of engaging positions.

The pinion 15 meshes with gear-teeth formed upon a portion of the periphery of a disk 16 of a thrust-part including this disk 16 and an annular releasing plate 18 located inside the cup, the disk 16 and plate 18 being connected by projections 17 extending forward from the disk 16 through arc-shaped slots formed in the web of the cup *p* and of sufficient length to accommodate the part rotative movement of the thrust-part relatively to the cup *p*, and the plate 18 is secured to the projections 17 at the front ends thereof, as by the screws shown. Cam-pins 17^a are also carried by the thrust-part, their outer ends being shown as secured in the projections 17 by the same screws that secure the disk 16 thereto, and these cam-pins extend inward freely through wide slots in the hub p' of the cup *p* and enter helically arranged cam-grooves formed in the reduced front end of the inner sleeve *n*. As the cup *p* is secured upon the inner sleeve *n*, the partly rotative movement of the disk 16, resulting from its actuation by the pinion 15, causes the cam-pins 17^a to move in the cam-grooves in the inner sleeve *n*, and thereby the thrust-part is projected forward or toward the block *t* which carries the centrifugal pawls *u*. This movement is imparted to releasing pins 19, which are annularly grooved so as to be engaged in an inner annular groove in the releasing plate 18, and which are fitted to slide in bearings formed in the block *t*, and pass through perforations in the centrifugal pawls *u*. The releasing pins 19 contain cylindrical portions of different diameters united by frusto-conical portions and as they are thrust forward these frusto-conical portions are thrust forward into contact with the walls of the perforations in the centrifugal pawls and force the centrifugal pawls inward out of engaging positions. The annularly grooved engagement of the releasing pins 19 and the releasing plate 18 permits the pins 19 to revolve orbitally with the starter-shaft *c* and also to rotate on their own axes when not restrained by frictional contact with their respective centrifugal pawls, so as to present different portions of their peripheries at different operations of wedging the centrifugal pawls inward, and this annularly grooved engagement also permits the releasing plate 18 to rotate freely with the cup *p* and inner sleeve *n*, but nevertheless assures

positive actuation of the releasing pins by the releasing plate both in the engaging and releasing movements of the releasing pins. The result of this release or disengagement of the centrifugal pawls *u* is that the starter-shaft ceases to impart rotative movement to the cup *p*. The retractive action of the power-spring will then be exerted during the brief interval which will elapse before the engagement of one of the stop-pawls f^2 with a tooth on the rotative part *f*, but any backward rotation of the cup *p* resulting therefrom will merely cause the arc-shaped internal ratchet-bar 22 to be moved backward by engagement therewith of the pawl 14^a on the lever 14, and such movement will be within the limit of the movement of such bar between the stops 22^c and 22^d. The resulting position of parts is shown in Fig. 5, the centrifugal pawls *u* being inward out of engaging position and the pawl 14^a on the releasing lever 14 in engagement with the ratchet-bar 22. The power-spring *a* is now fully wound and the starter ready to perform a starting operation. So long as the brake-disk *g* is locked by its brake-band *j* the power-spring *a* will remain fully wound, and the starter will be ready to perform its starting operation at the will of the operator. When the brake-band is released and a starting operation performed, as heretofore described, the spring, as it unwinds, will rotate the rotative part *f* and the brake-disk *g* and the inner sleeve *n*, the rotative movement of the part *f* being imparted through the planet-pinions *i* and planet-wheels *m* to the inner sleeve *n* without rotation of the planet-pinions and planet-wheels on their own axes. Thus the inner sleeve *n* and the cup *p* carried thereby will be rotated in the same direction in which they were rotated when winding the spring, and the pawl 14^a and the spring 22^e will carry the ratchet-bar 22 into contact with its front-stop 22^c and the pawl 14^a will thereafter click over the teeth of the ratchet-bar until it moves clear thereof and the cam-roller 12 on the releasing lever 14 will be carried forward in its track on the periphery of the non-rotative plate 3 until it has moved clear of the cam-projection 3^a and will then be swung by its spring 21 back to the disengaged position shown in Figs. 4 and 1, it being remembered that the unwinding of the power-spring is at the same time causing the threaded non-rotative sleeve 2 to be withdrawn and that the non-rotative plate 3 is being caused to follow this movement by its spring-fingers 11.

The return of the lever 14 to disengaged position will cause a reverse partial rotation of the pinion 15 and of the disk 16 engaged therewith and, in consequence of this movement, the thrust-part comprising the disk 16 and the annular releasing plate 18 will be withdrawn and will withdraw the releasing pins 19, all of these parts being returned to the position shown in Fig. 1, and thereby the centrifugal pawls *u* will be released. With the centrifugal pawls thus released, these pawls are in condition to be moved into engagement by centrifugal force and to cause the rewinding of the power-spring *a* as soon as the engine attains the predetermined speed selected as suitable for the winding operation. It will be noted that a comparatively small unwinding movement of the power-spring will release the centrifugal pawls and thus put the starter in condition to be rewound and therefore rewinding will occur after every material unwinding movement of the spring, so that the spring will be restored to fully wound condition whether or not its full force has been exerted in the starting operation.

For the purpose of initially winding the power-spring and of rewinding it in the unusual event of an operation of the engine through such a short interval of time that the spring has not been wound by the engine, or of a failure to start the engine by the spring, such as may result from a lack of proper adjustment or failure of operation of other parts, as, for example, of the sparking device, I provide a combined winding and shaft-operating crank 26, the end of the hub of which has diametrically opposite recesses 27 for engaging with a cross-bar 28 secured on the outer end of the cup *p*, for the purpose of winding the spring. The crank also has a sliding shaft-operating sleeve 29 shaped at its inner end so as to engage the cross-pin 30 at the front end of the starter-shaft to directly operate the starter-shaft and engine-shafts, and this sliding sleeve is controlled by a spring-pin 31 so that it can be pushed forward into operative position, as shown in Fig. 17, or withdrawn from such operative position, and will be held in either position by the spring-pin 31. If, for example, it is desired to turn the engine-shaft, as for inspection, adjustment or lubrication of parts, the crank is used in the position shown, with the shaft-operating sleeve 29 in forward position. If, however, an engine-starting operation under power is desired, the shaft-operating sleeve may be withdrawn and then the crank will engage the cross-bar of the cup and will wind the spring, this winding of the spring being accomplished through the reducing gearing and requiring comparatively little effort, and effecting the automatic operation of the releasing mechanism when the spring is fully wound, it being noted that the only pawls connecting the starter-shaft, which is stationary during this hand-operated winding movement, and the cup *p* and other parts which are rotated during this winding movement, are the centrifugal pawls *u*, which do not oppose this winding movement, although free to swing until restrained by the thrust-pins 19 at the completion of the winding operation.

The framing is such as to house and protect the parts. The rear end plate g^2, the flanged ring *g'*, and the casing drum *d* have been already described. A smaller drum or cap 24 is secured to the casing drum *d* at the front face thereof and covers and incases the releasing mechanism. This cap 24 has a sufficiently large opening about the protruding end of the starter-shaft *c* to permit the hub of the combined winding and shaft-operating crank to enter into engagement with the cross-bar 28 of the cup *p*.

It is obvious that various modifications may be made in the construction shown and above particularly described within the principle and scope of my invention.

What I claim and desire to secure by Letters Patent is:—

1. An engine starter comprising a power-storing device, an engine-actuating member normally connected to rotate with the engine, means for rotatably connecting the power-storing device and the engine-actuating member to start the engine, said means being constructed and operating to operatively engage the engine-actuating member only when the power-starting device tends to rotate faster than the

engine and being movable out of engagement by the relative rotation of the engine-actuating member during the normal operation of the engine, and frictional means for holding said connecting means out of engagement until the starter is again thrown into operation to start the engine.

2. An engine starter comprising a power-storing device, an engine-actuating member normally connected to rotate with the engine, means for rotatably connecting the power-storing device with the engine-actuating member to start the engine, said means being constructed and operating to operatively engage the engine-actuating member only when the power-storing device tends to rotate faster than the engine and being movable out of engagement by the relative rotation of the engine-actuating member during the normal operation of the engine, and frictional means operating to hold said connecting means out of engagement during such normal operation and to throw the connecting means into operation when the starter is again thrown into operation to start the engine.

3. An engine-starter comprising a power-storing device, means for connecting the power-storing device and an engine to start the engine, such means including a pawl operated by the power-storing device and a ratchet normally connected with and operated by the engine, the pawl being movable out of engagement under the forward impulse of the engine, and means for frictionally holding the pawl out of engagement during the continued running of the engine.

4. An engine-starter comprising a power-storing device, means for connecting the power-storing device and an engine to start the engine, such means including a pawl operated by the power-storing device and a ratchet normally connected with and operated by the engine, and means for frictionally controlling the pawl so as to move it into engagement with the ratchet under the forward impulse of the power-storing device and to hold it out of engagement when it is pushed out of engagement by the forward impulse of the engine.

5. An engine-starter comprising a power-storing device, means for connecting the power-storing device and an engine to start the engine, such means including a pawl operated by the power-storing device and a ratchet normally connected with and operated by the engine, and a drag-plate frictionally controlling the pawl so as to move it into engagement with the ratchet under the forward impulse of the power-storing device and to hold it out of engagement when it is pushed out of engagement by the forward impulse of the engine.

6. An engine-starter comprising a power-storing device, means for connecting the power-storing device and an engine to start the engine, such means including a plurality of pawls connected to the power-storing device and a ratchet-wheel connected to the engine, and an annular drag-plate connected to all of the pawls and frictionally controlling the same so as to move them into engagement with the ratchet-wheel under the forward impulse of the power-storing device and to hold them out of engagement when they are pushed out of engagement by the forward impulse of the engine.

7. An engine-starter comprising a power-spring, a rotating part operatively connected therewith, a sleeve concentric with the spring-connected part, gearing connecting the spring-connected part and sleeve at one side of the spring, a part operatively connected with the engine, means for connecting the sleeve with the engine-connected part at the other side of the spring, to wind the spring and starting means for connecting the spring-connected part and the engine-connected part independently of the gearing.

8. An engine-starter comprising a power-spring, a rotating part operatively connected therewith, a lock-wheel and locking means controlling the same, the lock-wheel being connected with the spring-connected parts so as to be engageable therewith in only one direction of movement, a sleeve concentric with the spring-connected part, gearing fulcrumed on the lock-wheel and connecting the spring-connected part and sleeve, a part operatively connected with the engine, means for connecting the sleeve with the engine-connected part to wind the spring, and starting means for connecting the lock-wheel and the engine-connected part independently of the gearing.

9. An engine-starter comprising a power-spring, a rotating part operatively connected therewith and having internal gear teeth, a lock-wheel and locking means controlling the same, the lock-wheel being connected with the spring-connected part so as to be engageable therewith in only one direction of movement, a sleeve concentric with the spring-connected part and having gear-teeth thereon, planetary gearing carried by the lock-wheel and meshing with the teeth upon the spring-connected part and sleeve, a part operatively connected with the engine means for connecting the sleeve with the engine-connected part, to wind the spring and means for connecting the lock-wheel and the engine-connected part to start the engine, comprising a ratchet-wheel on the engine-connected part and a pawl on the lock-wheel.

10. An engine-starter comprising a power-storing device, a part operatively connected therewith, a rotating part operatively connected with the engine, a centrifugal engaging device movable by centrifugal force into engaging position to connect the engine-connected part and power-storing device, a thrust-part having an inclined engagement with the power-storing-device-connected part, a non-rotative part movable by the power-storing device into operative position, an oscillating arm carried by the power-storing-device-connected part and coöperative with the non-rotative part and controlling the thrust-part, releasing means for the centrifugal engaging device controlled by the thrust-part, and a yielding resilient connection between the arm and the centrifugal engaging device and operative to complete the releasing movement.

11. An engine-starter comprising a power-storing device, a part operatively connected therewith, a rotating part operatively connected with the engine, a centrifugal engaging device movable by centrifugal force into engaging position to connect the engine-connected part and power-storing device, a thrust-part having an inclined engagement with the power-storing-device-connected part, a non-rotative part movable by the power-storing device into operative position, an oscillating arm and pinion carried by the power-storing-device-connected part, the arm being coöperative with the non-rotative part and the pinion actuating the thrust-part, releasing means for the centrifugal engaging device controlled by the thrust-part, and a yielding resilient connection between the arm and pinion and operative to complete the releasing movement.

12. An engine-starter comprising a power-storing device, a part operatively connected therewith, a rotating part operatively connected with the engine, a centrifugal engaging device movable by centrifugal force into engaging position to connect the engine-connected part and power-storing device, a thrust-part having an inclined engagement with the power-storing-device-connected part, a non-rotative part movable by the power-storing device into operative position, an oscillating arm and pinion carried by the power-storing-device-connected part, a spring between the arm and pinion and stops permitting a limited relative movement of the arm and pinion, the arm being coöperative with the non-rotative part and the pinion actuating the thrust-part, and releasing means for the centrifugal engaging device controlled by the thrust-part.

13. An engine-starter comprising a power-storing device, a part operatively connected therewith, a rotating part operatively connected with the engine, a centrifugal engaging device movable by centrifugal force into engaging position to connect the engine-connected part and power-storing device, a thrust-part having an inclined engagement with the power-storing-device-connected part, a non-rotative cam-plate movable by the power-storing device into operative position, an oscillating arm carried by the power-storing-device-connected part, a cam-roller carried by the oscillating arm and coöperative with the cam-plate, yielding resilient means controlling the cam-roller in the direction of the axis of the cam-roller, and releasing means for the centrifugal engaging device controlled by the thrust-part.

14. An engine-starter comprising a power-storing device, a part operatively connected therewith, a rotating part operatively connected with the engine, a centrifugal engaging device movable by centrifugal force into engaging position to connect the engine-connected part and power-storing device, a thrust-part having an inclined engage-

ment with the power-storing-device-connected part, a non-rotative cam-plate movable by the power-storing device into operative position, an oscillating arm carried by the power-storing-device-connected part, a cam-roller carried by the oscillating arm and coöperative with the cam-plate, a spring controlling the cam-roller in the direction of the axis of the cam-roller, the cam-plate and cam-roller having a flange and groove engagement, and releasing means for the centrifugal engaging device controlled by the thrust-part.

15. An engine-starter comprising a power-storing device, a part operatively connected therewith, a rotating part operatively connected with the engine, a centrifugal engaging device movable by centrifugal force into engaging position to connect the engine-connected part and power-storing device, a thrust-part carried by the power-storing-device-connected part, means controlled by the power-storing device for actuating the thrust-part, and a releasing pin carried by the engine-connected part; the thrust-part and releasing pin having an annularly grooved engagement so that the releasing pin is orbitally movable relatively to the thrust-part but is controlled thereby in its engaging and releasing movements.

16. An engine-starter comprising a power-storing device, a part operatively connected therewith, a rotating part operatively connected with the engine, a centrifugal pawl carried by the engine-connected part, a projection on the power-storing-device-connected part engageable by the centrifugal pawl, a thrust-part carried by the power-storing-device-connected part, means controlled by the power-storing device for actuating the thrust-part, and a releasing pin carried by the engine-connected part and having an inclined face coöperative with the centrifugal pawl, the thrust-part and releasing pin having an annularly grooved engagement so that the releasing pin is orbitally movable relatively to the thrust-part but is controlled thereby in its engaging and releasing movements.

17. An engine-starter comprising a shaft rotatively connected with the engine, an inner sleeve thereon, an outer sleeve on the inner sleeve, a power-spring carried by the outer sleeve, gearing connecting the outer sleeve and inner sleeve at one side of the spring, and a combined shaft-operating and winding crank engageable either with the inner sleeve to wind the power-spring or with the shaft to turn the engine, and engageable therewith from the side of the spring opposite to that at which the gearing is located.

18. An engine-starter comprising a power-storing device, a part operatively connected therewith, a shaft rotatively connected with the engine, and a combined shaft-operating and winding crank having a hub engageable with the power-storing-device-connected part to store power in the power-storing device and having an inner sleeve movable relatively to the hub and engageable with the engine-connected shaft to turn the engine, and means for holding either the hub or sleeve in position for engagement.

In testimony whereof I have affixed my signature in presence of two witnesses.

CLYDE J. COLEMAN.

Witnesses:
HENRY D. WILLIAMS,
M. M. ALCORN.