

F. S. BACON.
STARTER FOR INTERNAL COMBUSTION ENGINES.
APPLICATION FILED JAN. 5, 1911.

1,174,010.

Patented Feb. 29, 1916.

2 SHEETS—SHEET 1.

Fig. 1.

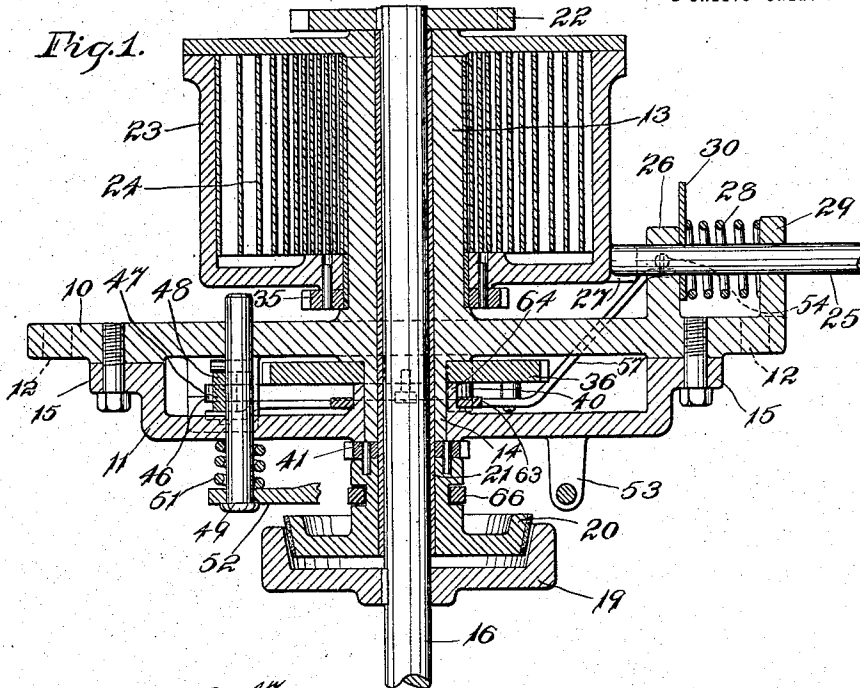
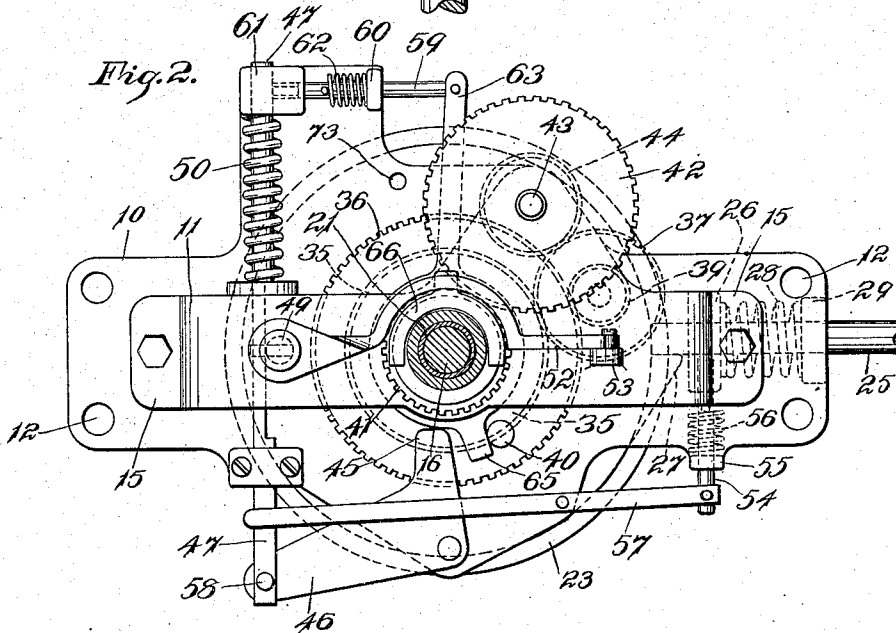


Fig. 2.



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2 SHEETS—SHEET 2.

Fig. 3.

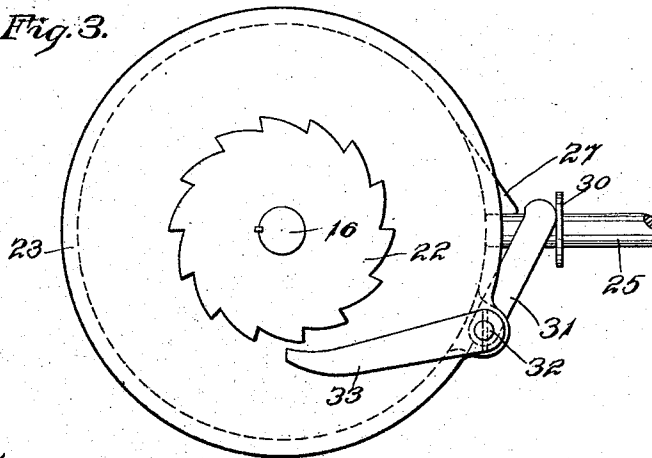


Fig. 5.

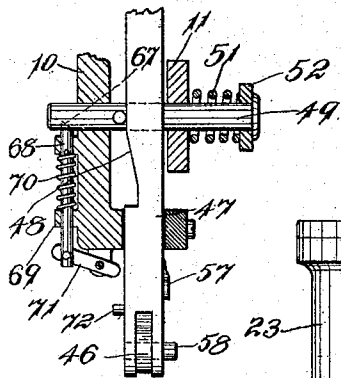
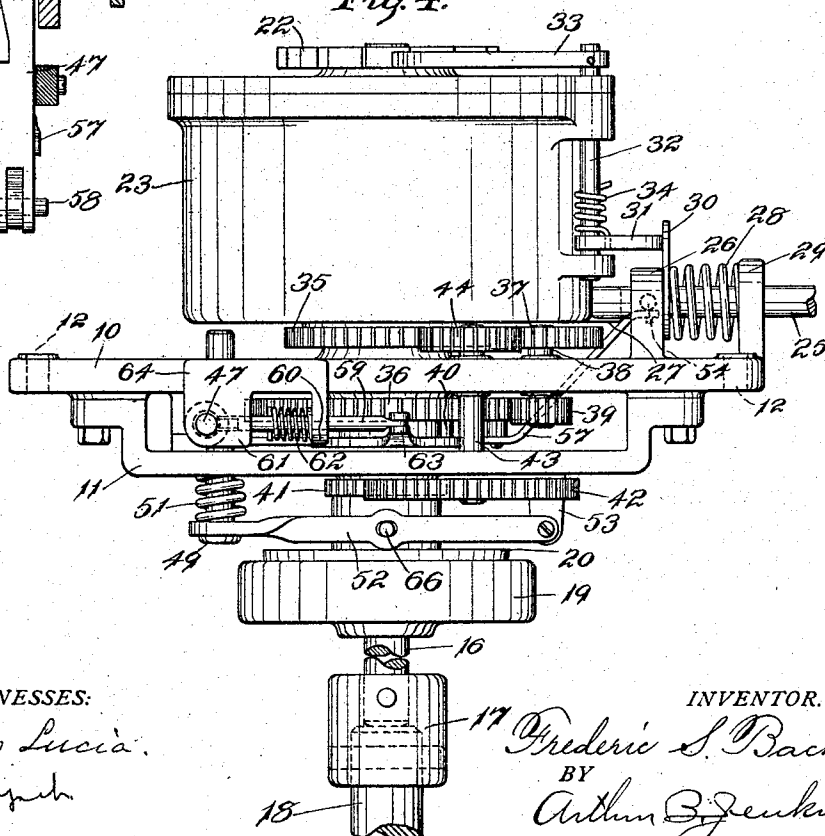


Fig. 4.



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STARTER FOR INTERNAL-COMBUSTION ENGINES.

1,174,010.

Specification of Letters Patent.

Patented Feb. 29, 1916.

Application filed January 5, 1911. Serial No. 600,901.

To all whom it may concern:

Be it known that I, FREDERIC S. BACON, a citizen of the United States, and a resident of Middletown, in the county of Middlesex and State of Connecticut, have invented a new and Improved Starter for Internal-Combustion Engines, of which the following is a specification.

My invention relates to the class of devices employed for mechanically starting or "cranking" internal combustion engines, and the object of my invention, among others, is to provide a strong, durable device of this class, simple and compact in form, and which will effectually perform the operations required of it.

Various other objects will appear from the following description.

One form of device in the use of which the objects herein sought to be attained may be accomplished is illustrated in the accompanying drawings, in which—

Figure 1 is a view in central section through my improved starter, on plane passing through the axis of the main shaft. Fig. 2 is a view in cross section through the same, on plane located near the clutch. Fig. 3 is a view in end elevation. Fig. 4 is a top view. Fig. 5 is a detail view showing the arrangement and operation of a portion of the clutch operating mechanism.

The device embodying my invention and illustrated in the accompanying drawings includes a frame which consists of a base 10 and a supporting plate 11. The base is constructed of any suitable material and is provided with means for attachment as to the frame of a vehicle, holes 12 for the reception of screws being shown herein. A tubular drum support 13 extends from one side of the base and a shorter extension 14 projects from the opposite side of the base. The supporting plate 11 is formed to provide a space between it and the base plate, this supporting plate having feet 15 through which bolts may extend to secure it to the base plate.

A shaft 16 is mounted in the frame, extending completely through it, being provided with any suitable means, as a coupling 17, for securing it to the engine shaft 18 of an engine. A clutch composed of a driving clutch member 19 keyed to the shaft and a driven clutch member 20, mounted to

rotate freely upon a bushing 21 extending through the frame is employed to connect the engine to operate the mechanism as will be hereinafter described. A ratchet wheel 22 is secured to the outer end of the shaft 16.

A drum 23 is mounted to rotate freely upon the drum support 13 and a main spring 24 is located within the drum, the inner end of the spring being secured to the support 13 and the outer end to the drum. The drum is held from rotating at certain times as will appear from the following description by means of a starting rod 25 mounted to slide in a lug 26 extending from the base plate. This starting rod will have any suitable means for manually disengaging it from the drum 23, as for instance, a connection with a lever mounted in convenient position on the frame of the vehicle, the showing of this connection and lever being omitted as not essential to a thorough understanding of the invention. The starting rod is adapted to be interposed in front of a nose 27 on the drum, to hold it against rotation, a starting rod spring 28 thrusting against a lug 29 from the frame being shown herein as a means for normally holding the rod in the path of movement of said nose. A starting plate 30 is secured to the starting rod 25 in position to underlie a starting lever 31 secured to the starting shaft 32, bearing a pawl 33, adapted to engage the ratchet wheel 22 and normally held from engagement therewith by means of the starting shaft spring 34. The parts just described are so positioned one with respect to another that when the starting rod is moved to disengage it from the nose 27 the pawl 33 will be permitted to engage with the ratchet wheel 22 under the force of the spring 34 before the starting rod and nose are disengaged, the ratchet wheel being in such position at this time that the pawl will readily engage it before the parts have assumed position to cause the ratchet wheel and pawl to bear one against the other.

A setting train of gears forms an operative connection between the drum and other parts of the mechanism to place such other parts in proper position to perform their function. There is also a winding train of gears for transmitting the force of the engine to the drum 23 for the purpose of winding the main spring. It will be noted that

certain gears perform a function in both trains, and such gears serving a double purpose will therefore be considered herein as a part of either train and as though separate gears were supplied to perform the double purpose.

The setting train includes a drum gear 35 secured to rotate with the drum 23, and connected with a setting gear 36 by reducing means consisting of a reducing pinion 37, meshing with the gear 35 and secured to a setting shaft 38 to which shaft is also secured another reducing pinion 39 which meshes with the setting gear 36. This reducing mechanism is for the purpose of enabling the drum 23 to make a sufficient number of turns to cause the engine to start before the setting mechanism is operated to connect the drum with the engine shaft and also to place the other parts in proper position. The setting gear 36 bears a setting pin 40 arranged to operate certain parts to place them in proper position to perform their function as will be hereinafter described.

The driving train includes a driving pinion 41 secured to rotate with the driven clutch member 20 and connected with the drum gear 35 by means of a connecting gear 42 connecting shaft 43 and connecting pinion 44. From this point the connection with the drum gear 36 is through the reducing pinion 37 hereinbefore described as included in the setting train, this gear 37 meshing with the connecting pinion 44.

The operation of the mechanism above described is as follows:—It being assumed that the main spring 24 is under tension the starting rod 25 is moved to disengage it from the nose 27. Before such disengagement the pawl 33 easily engages with the teeth of the ratchet wheel 22, the latter being in position to permit this operation. A further movement of the starting rod disengages it from the nose and the force of the spring starts to rotate the drum in the direction of rotation of the hands of a clock. The pawl 33 is now forced tightly into engagement with the teeth of the ratchet wheel which causes the main shaft 16 to be rotated and thereby the engine shaft to start the engine, this operation of the engine mechanism to start the engine being well known. As the drum 23 rotates to "crank" the engine rotation is imparted through the drum gear 35 and reducing pinions 37 and 39 to the setting gear 36. The reducing pinions are of such size that the drum 23 and its gear 35 may have several complete rotations while the setting gear is making nearly a complete rotation.

The setting pin 40, carried by the gear 36 makes nearly a complete revolution, at the end of its movement encountering the bell crank lever of a clutch operating mechanism constructed as follows:—This bell

crank lever is pivotally mounted on the base 10 and has a short arm 45 located in the path of movement of the setting pin 40. The other long arm 46 of the lever has an elongated opening to receive a pin which connects a sliding clutch bar 47 with said lever, the end of the bar being preferably forked to receive the arm 46. This bar has a cam 48 arranged to operate a sliding clutch rod 49, and a shifting spring 50 is mounted on the bar to hold it at one limit of its play and with the clutch rod 49 in position to hold the clutch members disengaged. A clutch engaging spring 51 is employed to force the clutch members into engagement, as herein shown, this spring being mounted on the clutch rod 49. A clutch lever 52 is pivotally supported at one end by a lug 53 on the supporting plate 11, the opposite end of the lever being attached to the clutch rod 49, and the lever between its ends being connected by a slot and pin construction and a shoe 66 of well known form with the driven clutch member 20, so that the driven clutch member may rotate freely and independently of said lever.

From the above construction it will be seen that as the setting pin 40 strikes the short arm of the bell crank lever the clutch bar 47 will be thrown against the tension of its shifting spring 50 and the cam 48 will be moved to position to permit the clutch engaging spring 51 to throw the clutch members into engagement.

The starting rod 25 is held disengaged from the nose 27 on the drum 23 by a pin 54 mounted to slide in a lug 55 and the lug 26, and normally held with its end in a recess in the starting rod by a spring 56. This pin is connected by a slot and pin construction with a starting rod releasing lever 57 pivotally mounted on the base 10. The free end of this lever is located in the path of movement of the starting rod releasing pin 58 borne by the long arm 46 of the bell crank lever, and which may be the pin hereinbefore described connecting such long arm with the clutch bar.

It will thus be seen that as the bell crank lever is thrown as hereinbefore described to operate the clutch bar 47 the starting rod releasing lever will be operated at the same time that the clutch parts are thrown into engagement. The starting rod being thus released is moved by the starting rod spring into the path of movement of the nose 27. At this time the drum will have completed its "cranking" movement, having been stopped by the mechanism as hereinbefore described, and during its movement in the reverse direction to wind the spring the nose 27 will force the starting rod away from the drum by means of the inclined face at the back of the nose, the starting spring immediately snapping the rod back into the

path of movement of the nose. As the starting rod 25 is moved to its normal position in the path of the nose 27 the starting plate 30 encounters the starting lever 31, this however after the "cranking" movement of the drum has ceased. In this position the teeth of the ratchet wheel are disengaged or freed from pressure upon the pawl 33, and as the starting rod continues its movement the pawl is disengaged from the teeth of the ratchet wheel so that there is no clicking movement between the pawl and ratchet as the latter is constantly rotated while the engine is running.

The shifting spring 50 forms an important part of the mechanism having a three-fold function, to wit, to take the shock incident to stopping the rotation of the drum under the force of the main spring, to store power sufficient to throw the clutch parts from engagement against the force of the clutch engaging spring 51 and to return the clutch bar 47 and the bell crank lever to their normal positions. When the setting pin 40 encounters the short arm 45 of the bell crank lever during the "cranking" movement it will be observed that the drum has considerable momentum gained from the operation of the main spring 24 and which is transmitted through the gears and pinions to the pin 40. As the pin 40 comes in contact with the short arm of the bell crank lever its movement is resisted by the shifting spring 50, which is of sufficient strength to resist this movement and gradually through the pin 40 to stop the movement of the drum. This forms a cushion to stop the rotation of the drum without severe shock. This compression of the spring 50 and its retention in a compressed state, as hereinafter described, enables the force required to stop the rotation of the drum to be transposed into power that is stored in the spring, this power being afterward utilized to disengage the clutch parts against the tension of the spring 51 which is somewhat weaker than the spring 50.

The engagement of the clutch members 19 and 20, as hereinbefore described, brings the winding train into operation, the driving pinion 41 rotating with the driven clutch member 20 imparting movement to the drum gear 35 through the connecting gear 42, connecting shaft 43, connecting pinion 44 and reducing pinion 37, the latter meshing with the drum gear 35. The drum is thus rotated to wind the spring 24, the nose 27 passing the starting lever 25 as hereinbefore described. When the drum is at rest the teeth of the ratchet wheel 22 are in such position that the pawl 33 may be readily engaged and disengaged therefrom. As the winding train including the reducing pinion 37 is thus operated, the reducing shaft to which said pinion is secured is also rotated, driv-

ing the reducing pinion 39 and the setting gear 36. These gears and pinions are so constructed and timed that when the drum 23 has been rotated the required number of times to wind the spring the setting gear will have been rotated backwardly nearly a complete rotation.

The clutch parts are held in engagement only during the winding of the main spring 24, their release being effected by a clutch bar holding pin 59 mounted in lugs 60 and 61 projecting from the base, said pin entering a recess in the clutch bar 47. The lug 61 may also afford a bearing for one end of the clutch bar 47. A spring 62 forces the pin 59 toward the clutch bar 47 and causes it to engage the recess therein whenever said recess and pin register one with the other. A clutch releasing lever 63 pivotally connected with the clutch bar holding pin 59 is pivotally supported upon a projection 64 from the inner face of the supporting plate 11. This lever has a clutch bar releasing lug 65 projecting from one side into the path of movement of the setting pin 40, and it will thus be seen that as the setting pin is returned to its normal position, as hereinbefore described, just before it finishes this movement it encounters the lug 65, thus withdrawing the pin 59 from engagement with the clutch bar 47, allowing the latter to be forced by the shifting spring 50 to its normal position of rest, this movement causing the cam 48 to force the clutch lever 52 against the tension of its spring 51 to disengage the clutch members 19 and 20 and thus stop the winding operation. All of the parts are now in their normal position of rest ready to repeat the operation of "cranking" the engine, winding the spring and resetting the different mechanisms simply by disengaging the starting rod 25 from the nose 27 as hereinbefore described.

The gear and pinion connection between the setting pin 40 and the drum 23 accurately times the movement of one with respect to the other, so that the number of rotations to be made by the drum in either direction before such rotation is stopped by the action of the setting pin is certainly determined. In the construction of parts shown herein the drum makes substantially three rotations (a trifle less) in its "cranking" movement, and the same number to rewind the spring. As the setting pin controls the amount of movement of the drum in both directions and also the time of operation of the clutch parts, the latter will be operated to disconnect the winding mechanism at such times as to bring no undue force upon the main spring 24.

It is important that the clutch members shall not engage until the spring 50 is fully compressed, as otherwise a premature connecting of the drum 23 through the winding

train with the shaft 16 may cause the rotation of the said drum to be suddenly stopped, thus counteracting the force of the spring 50, preventing it from exerting its full function, and consequently creating a shock on different parts of the mechanism to their detriment. In order therefore to avoid such a result and enable the rotation of the drum, caused by the expansion of the main spring, to be stopped without shock and by the interposition of a yielding element (the spring 50) I form a recess 67 in the clutch rod 49, in which recess the end of a clutch rod holding pin 68 engages. This holding pin is mounted to slide in lugs 69 projecting from the front of the plate 10, (see Fig. 5 of the drawing), and a spring 70 forces the pin toward the clutch rod so that it will enter said recess whenever the latter is located opposite the end of the pin. A clutch rod holding pin operating lever 71 is pivotally mounted on the plate 10, one end of this lever pivotally engaging the holding pin and the other end of the lever being located in the path of movement of a trip pin 72 on the clutch bar 47. This pin is so located that it encounters the lever 71 just at the time the bar is completing its movement, so that the spring 50 is fully compressed, and the parts are also in proper position to permit the clutch bar holding pin 59 to perform its function before the clutch parts are engaged. The pivotal connection between the lever 71 and the pin 68 will be such as to permit the movement of the outer end of the lever on the arc of a circle without binding the parts.

It will be noted from the above description and the accompanying drawings that the device may readily be attached to an automobile by simply securing the base to a frame part of the vehicle and connecting the engine shaft with the main shaft of the starter. The latter may be provided if desired with the usual crank for initially starting the device, but this has been omitted from the showing herein as its construction and operation will be readily understood, the initial operation of the device being accomplished in the same way that an engine is ordinarily "cranked". Other means however for effecting this result may be employed, such as a winding arbor which may be inserted in the recess 73 in the plate 10, this winding arbor bearing a pinion arranged to mesh with the connecting gear 42 and by means of which with comparatively little power the main spring may be wound, the force required to thus wind the main spring will be much lessened if the clutch bar holding pin is tripped before the winding operation begins, thus allowing the shifting spring 50 to expand.

While I have shown and described herein in a satisfactory form of construction em-

bodifying my invention this may be changed to a greater or less extent without departing from the spirit and intent of the invention, and I do not therefore confine my invention to a construction in exact accordance with the showing herein.

I claim:—

1. A base having means to removably secure it in place, a rotary shaft mounted in the base and having means for connecting it with an engine shaft, a spring motor mounted on the base, means for connecting said motor with its shaft when the latter is stationary whereby the energy from the motor is imparted to the shaft to drive it, means for connecting said shaft with said motor when the shaft is active whereby energy is stored in the motor, means for disconnecting both of said connecting means and means for releasing the drum.

2. A base having means for attachment to an object and including a supporting plate secured to the base with a space between the two, a drum mounted to rotate on the base, a main spring operatively secured within the drum, a shaft mounted in the base in position for connection with the shaft of an engine, means for connecting the drum with the shaft when the latter is inactive, means including a train of gears mounted on the base and supporting plate for connecting the drum with the shaft when the latter is active, and means for releasing the drum.

3. A base having a projection from one side thereof, a drum mounted to rotate freely upon said projection, a main spring operatively secured within said drum, a main shaft operatively mounted in the base, means for connecting the drum with the shaft when the latter is inactive, a clutch having one member secured to the shaft and the other member rotatively mounted with respect thereto, means for connecting the freely mounted clutch member with said drum, means for operating the clutch and means for releasing the drum.

4. A base having a projection from one side thereof, a shaft mounted to rotate in the base, a drum mounted to rotate on said projection, a main spring operatively located within the drum, means for connecting the drum to the shaft when the latter is inactive, a clutch including a member secured to said shaft and a member mounted to rotate independently thereof, a train of gears to connect said independently rotating clutch member to the drum, means operated by movable parts of the mechanism for operating said clutch and means for releasing the drum.

5. A base, a main shaft mounted therein, a drum rotatively mounted upon the base, a spring operatively mounted within the drum, means for connecting the drum with

the shaft when the latter is inactive, a clutch member secured to said shaft, a cooperative clutch member mounted to rotate independently of said shaft, a clutch operating mechanism, a setting train of gears including a member of the winding train operatively connected with the drum and with the clutch operating mechanism to operate the latter, a winding train of gears connecting the independently rotatable clutch member and said drum and means for releasing the drum.

6. A main shaft, a spring motor including a drum mounted to rotate independently of said shaft, ratchet teeth secured to one of said parts, a pawl secured to the other part arranged to engage said teeth, means for engaging and disengaging the pawl from said teeth, means for holding the pawl and the teeth so that the pawl may be freely operated and without pressure between the teeth and pawl, and means for tensioning the spring in said motor.

7. A base, a main shaft mounted on the base, a ratchet wheel secured to the shaft, a spring motor including a drum mounted to rotate independently of said shaft, a pawl mounted on the drum to engage said ratchet wheel, means for engaging and disengaging the pawl from the ratchet wheel, means for holding the pawl and the ratchet wheel so that the pawl may be freely operated and without pressure between the teeth and pawl, and means for imparting active movement of the shaft to said drum.

8. A base, a main shaft mounted on the base, a ratchet wheel secured to the shaft, a spring motor including a drum mounted to rotate independently of said shaft, a pawl mounted on the drum to engage said ratchet wheel, means for holding the drum against rotation with the pawl in position to freely engage said teeth, means for operating the pawl, and means for tensioning the spring within the drum.

9. A shaft, a spring motor including a drum mounted to rotate independently of the shaft, a ratchet wheel secured to the shaft, a pawl mounted on the drum to engage said ratchet wheel, movably mounted means to hold the drum against rotation, means movable with said holding means to operate the pawl and to hold it from engagement with the teeth of the ratchet wheel, means for tensioning the spring and means connected with said shaft to be driven thereby.

10. A shaft, a spring motor including a drum mounted to rotate independently of the shaft, a ratchet wheel secured to the shaft, a pawl mounted on the drum, movably mounted means to hold the drum against rotation, means positioned on said holding means to operate the pawl to permit engagement of the ratchet teeth before the release of said holding means, means for

tensioning the spring within said drum, and means connected with said shaft to be driven thereby.

11. A shaft, a spring motor including a drum mounted to rotate independently of the shaft, a ratchet wheel secured to the shaft, a pawl mounted upon said drum to engage the ratchet wheel, movably mounted means to hold the drum against rotation, means mounted upon said holder to operate the pawl before release of the holder and the drum, a clutch including a member secured to the shaft and a member mounted to rotate independently thereof, means for connecting the last mentioned clutch member to the drum to wind the spring, and means for operating the clutch.

12. A shaft, a spring motor including a drum mounted to rotate independently of the shaft, a ratchet wheel secured to the shaft, a pawl mounted on the drum to engage said ratchet wheel, movably mounted holding means to prevent rotation of the drum, means positioned on the holding means to operate the pawl before release of the drum from the holding means, a clutch including a member secured to the shaft and a member mounted to rotate independently thereof, connecting means between the last mentioned clutch member and the drum to wind the spring, and clutch operating means actuated by movable parts of the mechanism to operate the clutch members.

13. A shaft, a spring motor including a drum mounted to rotate independently of the shaft, a ratchet wheel secured to the shaft, a pawl mounted upon the drum, movably mounted means for holding the drum against rotation, means movable with said holding means to actuate the pawl and to hold it normally disengaged from the teeth of the ratchet wheel and to permit engagement in the movement of the holding means to release the drum, a clutch including one member secured to the shaft and a driven member loosely mounted with respect to the shaft, connecting means between said driven member and the drum to wind the spring, and means for operating the clutch.

14. A shaft, a spring motor including a drum mounted to rotate independently of the shaft, a ratchet wheel secured to the shaft, a pawl mounted on the drum, movably mounted holding means to prevent rotation of the drum, means for operating the pawl, mechanically operated means for temporarily restraining the movement of the holding means, means for releasing said restraining means, a clutch including one member secured to the shaft and a driven member movable independently thereof, connecting means between the driven member and the drum to wind the spring, and means for operating the clutch.

15. A shaft, a spring motor including a

drum mounted to rotate independently of the shaft, a ratchet wheel secured to the shaft, a pawl mounted on the drum to engage the ratchet wheel, mechanically actuated means for operating the pawl, movably mounted means holding the drum against rotation, means for temporarily restraining the movement of said holding means, means actuated by the movement of parts of the mechanism to release said restraining means, a clutch including one member secured to the shaft and a driven member movable independently thereof, an operative connection between said driven member and the drum to wind the spring, and means operated by movable parts of the mechanism for operating the clutch.

16. A shaft, a spring motor including a drum mounted to rotate independently of the shaft, a ratchet wheel secured to the shaft, a pawl adapted to engage the ratchet wheel, movably mounted means to hold the drum against rotation, means for operating the pawl, means for temporarily restraining the movement of said holding means, a clutch including a member secured to said shaft and a driven member movable independently thereof, clutch actuating mechanism, a member connected with the clutch actuating mechanism and with said restraining means and arranged to operate the latter before the former, and connections between said drum and said member to operate the latter.

17. A shaft, a spring motor including a drum mounted to rotate independently of the shaft, a ratchet wheel secured to the shaft, a pawl mounted on the drum to engage the ratchet wheel but normally disengaged therefrom, means for operating the pawl, movably mounted means for holding the drum against rotation, a clutch including a member secured to the shaft and a driven member movable independently thereof, clutch operating mechanism, a member connected to actuate said clutch operating mechanism, connections between said member and drum to operate the former by the movement of the latter, means for temporarily positioning the clutch operating mechanism to permit the clutch parts to engage, and means actuated by movable parts of the mechanism for releasing said holding means.

18. A shaft, a spring motor including a drum mounted to rotate independently of the shaft, a ratchet wheel secured to the shaft, a pawl mounted on the drum, means for operating the pawl, movably mounted means for holding the drum against rotation, means for temporarily restraining movement of said holding means to engage the drum, a clutch including a member secured to the shaft and a driven member movable independently thereof, clutch ac-

tuating mechanism, a member connected with the clutch actuating mechanism and arranged to operate said restraining means before the operation of the clutch, connections between said member and drum to operate the member by movement of the drum, means for temporarily holding the clutch mechanism with the clutch parts engaged, and means operated by movable parts of the mechanism for releasing the clutch holding means after the operation of the other parts.

19. A shaft, a drum including a spring motor, means for connecting the drum to drive the shaft, a clutch including a clutch member secured to the shaft and a driven member movable independently thereof, a winding train of gears connecting the driven member with said drum, a setting train of gears connected to move with said drum, a lever operated by the setting train of gears, movably mounted means to hold the drum against rotation, means for temporarily restraining the movement of said holder, clutch actuating mechanism to be operated by said lever in its movement, means for temporarily holding the clutch actuating means in one position, and means operated by movable parts of the mechanism for releasing said clutch restraining means.

20. A shaft, a spring motor including a drum mounted to rotate independently of the shaft, means for connecting the shaft and drum to rotate together, movably mounted means for holding the drum against rotation, a clutch including a member secured to the shaft and a driven member to rotate independently thereof, a setting train of gears operated by said drum and including a setting gear having a pin, a lever mounted in the path of movement of said pin, clutch operating mechanism connected with said lever, and a winding train of gears extending from the drum to said driven clutch member.

21. A shaft, a spring motor including a drum mounted to rotate independently of the shaft, means for connecting the shaft for rotation by the drum, movably mounted means for holding the shaft against rotation, a clutch including a member secured to the shaft and a driven member movable independently of the shaft, a setting train of gears including a setting gear having a setting pin, a lever mounted in the path of movement of said pin, clutch operating mechanism secured to said lever, means for holding the clutch operating mechanism with the clutch parts in engagement, and a rocker lever located in the path of movement of said setting pin and connected with the clutch holding mechanism.

22. A shaft, a spring motor including a drum mounted to rotate independently of

the shaft, a ratchet wheel secured to the shaft, a pawl mounted on the drum to engage the ratchet wheel, movably mounted means for holding the drum against rotation, means for temporarily restraining said holding means, a lever mounted to operate said temporary restraining means, a clutch including a member secured to the shaft and a driven member mounted to rotate independently thereof, clutch operating mechanism for operating said lever, a train of clutch winding gears extending from the drum to said driven clutch member, a train of setting gears extending from said drum and including a gear having a pin traveling in a path to strike said lever, means for holding the clutch mechanism with the clutch parts in engagement, and a rocker lever included in said holding means and located in the path of movement of said setting pin.

23. A shaft, a spring motor including a drum mounted to rotate independently of the shaft, means for connecting the shaft for rotation by said drum, movably mounted means for holding the drum against rotation, means for temporarily restraining said holding means, clutch mechanism including a member secured to said shaft and a member movable independently thereof, clutch operating mechanism, means for temporarily holding said clutch operating mechanism with the clutch parts in engagement, a connection between said movable clutch member and the drum for winding the latter, a setting train of gears connected with the drum, mechanism arranged to be operated by said setting train, first to release the drum restraining means, then to operate the clutch mechanism and then to release the clutch parts.

24. A shaft, a spring motor including a drum mounted to rotate independently of said shaft, means for connecting the shaft and drum for operation one by the other, a member arranged to stop the rotation of the drum under the influence of its main spring, means for storing the energy derived from said stopping action, and a member connected to be operated from the force derived from said energy.

25. A shaft, a spring motor including a drum mounted to rotate independently of said shaft, means for connecting the shaft and drum for operation one by the other, a spring arranged to receive the force of the drum and to stop its rotation under the influence of its main spring, means for storing the energy derived from said stopping action, and a member connected to be operated by the energy derived from said force.

26. A shaft, a spring motor including a drum mounted to rotate independently of the shaft, means for connecting the shaft

and drum to rotate together, a winding train connecting the drum and shaft, a clutch connecting the winding train and shaft, a member to stop the rotation of the drum under the influence of its main spring, means for storing in said member the energy derived from said stopping action, and a clutch operating means connected with said member to receive force derived from said energy to operate the clutch parts.

27. A shaft, a spring motor including a drum mounted to rotate independently of the shaft, means for connecting the shaft and drum to rotate together, a winding train connected with the drum, a clutch connecting the winding train and shaft, a member movably connected with the drum, a bell crank lever located in the path of movement of said member to receive the force imparted in stopping the movement of the drum and a spring acting against the movement of the bell crank lever.

28. A shaft, a spring motor including a drum mounted to rotate independently of the shaft, means for connecting the shaft and drum to rotate together, a winding train connected with the drum, a clutch connecting the winding train and shaft, a member movably connected with the drum, a bell crank lever located in the path of movement of said member to resist the force imparted in stopping the movement of the drum, a spring acting against the movement of the bell crank lever, a clutch operating mechanism including a spring for forcing the clutch parts into engagement, and connections between the clutch operating mechanism and the spring that acts against the movement of the bell crank lever whereby the clutch parts are operated.

29. A shaft, a main spring connected with said shaft, a drum connected with said spring, a ratchet wheel secured to said shaft, a pawl mounted on the drum to engage the teeth of said ratchet wheel, means for engaging said ratchet wheel to rotate the shaft, means for holding said pawl disengaged from said teeth during rotation of the shaft, and means for holding the drum against rotation.

30. A shaft, a spring motor including a drum mounted to rotate independently of the shaft, means for connecting the drum and shaft for rotation of the latter, a clutch to connect the shaft and drum to wind the spring of the motor, a clutch operating member, connections between the clutch parts and said operating member, connectors between said operating member and the drum to operate the former by means of movement of the latter, and means for yieldingly resisting the movement of said operating member and thereby stopping the movement of said drum.

31. A shaft, a spring motor including a

drum mounted to rotate independently of the shaft, means for connecting the drum and shaft for rotation of the latter, a clutch connecting the shaft and drum to wind the spring of the motor, connections between the clutch parts and drum, a clutch operating member, connections between the clutch parts and said operating member, means for holding said clutch operating member against movement, connections between said operating member and the drum to operate the former by means of movement of the latter, and means for releasing said clutch holding means by movement of the clutch operating member, and means for yieldingly resisting the movement of said operating member and thereby to stop the movement of said drum.

32. A shaft, a spring motor including a drum mounted to rotate independently of the shaft, means for connecting the drum and shaft for rotation of the latter, a clutch connecting the shaft and drum to wind the spring of the motor, connections between the clutch parts and the drum, a clutch operating bar, a clutch rod connected with the bar, a clutch rod holding pin holding the rod against movement, and connections between the bar and pin to release said clutch rod by the movement of the bar when near the end of such movement to effect the actuation of other parts of the mechanism.

33. A shaft, a spring motor including a drum mounted to rotate independently of the shaft, means for connecting the shaft and drum to rotate together, means connected with the shaft to operate the drum to wind the spring, means for yieldingly resisting the movement of the drum under the influence of its main spring, and connections between the drum and said yieldingly resisting means to permit operation of the latter.

34. A shaft, a spring motor including a drum mounted to rotate independently of said shaft, means for connecting the shaft and drum for operation one by the other, said connection including a friction clutch, a member arranged to be moved by the drum under the influence of its main spring, and connections between said member and the clutch mechanism for operating the latter, and whereby said member serves as a brake to retard the unwinding movement of the drum.

35. A shaft, a spring motor including a drum mounted to rotate independently of the shaft, means for connecting the shaft and drum to rotate together, an automatically operated actuating member arranged to act, when brought into operation, as a brake to gradually retard the rotating move-

ment of the drum under the force of the spring and mechanism arranged to be engaged by said actuating member to be operated thereby and thereby to retard the movement of said operating member.

36. A shaft, a spring motor including a drum mounted to rotate independently of said shaft, means for connecting the shaft and drum for operation one by the other, another connection between the shaft and drum including a clutch, a member arranged to stop the rotation of the drum under the influence of its spring, means for storing the energy from said stopping action, and a connection between said storing means and the clutch for operating the latter.

37. A shaft, a spring motor including a drum mounted to rotate independently of the shaft, means for connecting the shaft and drum to rotate together, a braking member, means positioned for engagement by said braking member to be operated thereby and thereby to retard the movement of said braking member, and means for transmitting the force of said spring motor to actuate said braking member in the braking operation.

38. A shaft, a spring operated drum rotatably mounted on the shaft, means for connecting the drum to rotate the shaft, a winding train to tension the spring in the drum, a clutch connecting the winding train and shaft, a spring connected with the clutch parts to throw them into engagement, a clutch actuating rod, a spring to move said rod in one direction against the tension of said clutch actuating spring, and a connection between the winding mechanism and said clutch actuating rod to receive the force of the unwinding movement of the drum and to move said rod in opposition to its spring to tension the latter.

39. A shaft, a spring operated drum rotatably mounted on the shaft, means to connect the drum to operate the shaft, winding mechanism for said spring, a clutch connecting the winding mechanism and shaft, a clutch actuating rod, a spring to force said rod in one direction, means for holding the clutch with the clutch members disengaged, means carried by said rod to disengage said clutch holding means, a lever mounted to operate the clutch actuating rod against the tension of its spring, and a member carried by the winding mechanism to operate said lever.

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Witnesses:

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