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STARTING MECHANISM FOR AN INTERNAL COMBUSTION ENGINE

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Fig. 1

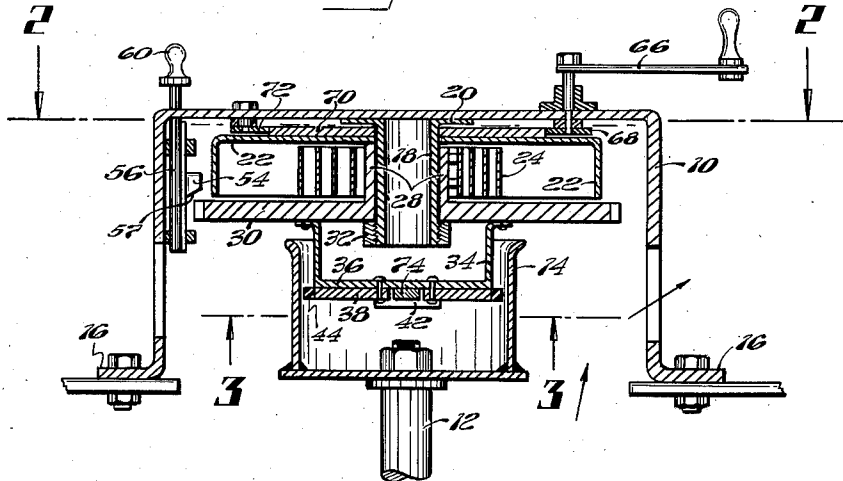


Fig. 2

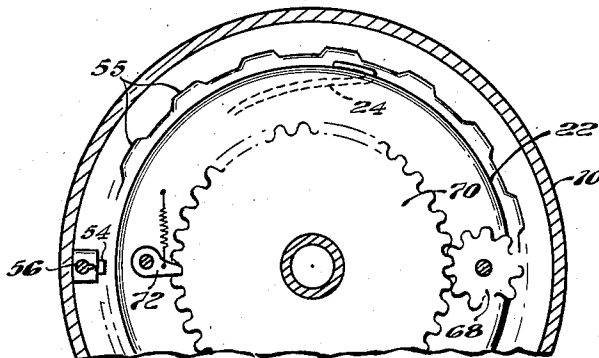
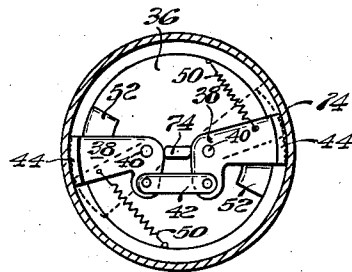


Fig. 3

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STARTING MECHANISM FOR AN INTERNAL COMBUSTION ENGINE

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1 Claim. (Cl. 123—179)

This invention relates to turning devices for imparting a rapidly accelerating movement to a rotatable body, and more particularly to manually operated spring starters.

Previous developments in the area of manually operated spring starters have been directed generally toward developing inexpensive starters of simple construction for use in conjunction with the small internal combustion engines on lawnmowers and outboard boat motors. The starters hitherto developed, however, have employed a drive mechanism in which the initial torque of the spring had to be sufficient in and of itself to start the drive shaft moving at a rapid rate despite compression and cold bearing resistances. This has necessitated large and strong springs which are expensive and hard to wind up.

Therefore it is an object of my invention to provide a manually operated spring starter for use on small internal combustion engines which gains kinetic energy before engaging the drive shaft of the motor, which kinetic energy is utilized to counteract the viscosity bonds and stiffness in the bearings, as well as the compression resistance and inertia of the cold motor.

It is a feature of my invention that the coiled spring in my starter engages the drive shaft of a motor by means of drive clutch mechanism which includes knurled brake shoe elements which swing out by means of centrifugal force and lock against the inside diameter of the rope winding drum commonly found on small gasoline engines. It is a further feature of my invention that it may be mounted on the outside shell of the motor with the drive clutch mechanism fitting into, but in no way fastened to, the inside diameter of the engine rope winding drum. It is yet a further feature of my invention that precision alignment of starter and motor drum is not essential since the various parts of the clutch mechanism accommodate minor alignment variations in the shaft or the drum. It is an additional feature of my invention that the spring starting mechanism disengages from the motor drum once the motor has been started, disengagement occurring when the drum speed exceeds that of the drive clutch element of the starter.

These and other objects and features of my invention will best be understood and appreciated from the following description of a preferred embodiment thereof, selected for purposes of illustration, and shown in the accompanying drawings, in which:

Fig. 1 is a cross sectional view in side elevation showing the starter of my invention;

Fig. 2 is a cross sectional plan view along the lines 2—2 of Fig. 1; and

Fig. 3 is a view of the drive clutch mechanism taken along the lines 3—3 of Fig. 1.

The preferred embodiment of my invention herein shown comprises a generally cylindrical outer casing 10 bolted to a motor in general axial alignment with the crankshaft 12 and covering a conventional rope winding drum 14, as it may be found on ordinary lawnmower type motors. Of course, the starter of my invention may be used

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with various other types of motors and I have simply selected the lawnmower type for convenience of illustration. Where the crankshaft 12 of the motor does not employ a conventional rope winding drum 14, an element of similar size and shape can be attached to the crankshaft to facilitate the use of my invention with such a motor.

The housing 10 is provided with flanged feet 16 which facilitate bolting the housing 10 to the motor. Internally of the housing 10 and coaxial therewith, I mount a tube 18. In Fig. 1 the tube 18 is shown connected to the housing 10 by a flanged element 20 which is welded to the top inside of the housing 10. The tube 18 generally serves the purpose of supporting and maintaining the operating elements of the starter for rotation and in proper alignment. Thus, an inverted spring drum 22 is mounted to rotate on the tube 18, and houses a coil spring 24, one end of which is connected to the side wall of the inverted spring drum 22. The other end of the spring 24 is connected to an upstanding tubular member 28 mounted on a relatively heavy horizontal drive disk 30. The drive disk 30 and its upstanding tubular member 28 fit around the tube 18 in close but free sliding relationship, and they are retained in position on the tube 18 by a retaining nut 32.

On the lower face of the drive disk 30, I mount a drive clutch mechanism which is adapted to fit into and clutch the inner face of the rope winding drum 14. The drive clutch mechanism is supported by a depending cylindrical support 34 which is bolted to the drive disk 30. The operating elements of the clutch are mounted on a horizontal disk 36 integral with the lower end of the tubular element 34. The clutch elements themselves include a pair of pivotally mounted eccentric brake elements 38 (see Fig. 3) pivotally connected to the disk 36 by bearing elements 40. The brake elements 38 are interconnected by a link 42 which ensures unity of motion between the two brake elements. Each brake element 38 is provided on its outer surface with a knurled metal or friction brake shoe 44 mounted on the eccentric surface and in position to engage the inner wall of the rope winding drum 14 in firm frictional contact when the brake elements 38 are pivoted against limit stop lugs 52. In order to accommodate gross variations in drum size or shape, wear in the brake shoes 44, and unusual shaft misalignments, the brake shoes 44 may be resiliently mounted on the brake elements 38, but normally it is sufficient to make the brake elements 38 large enough to subtend an arc slightly larger than the internal arc of the rope winding drum 14. The brake elements 38 are provided with tension springs 50 for the purpose of holding the brake elements 38 normally in the disengaged position. The force of the spring 50, however, is selected in relation to the centrifugal and acceleration forces involved when the drive disk 30 starts rotating to permit the brake elements 38 to pivot and bring the brake shoes 44 into contact with the inner face of the rope winding drum 14. Once the brake shoes 44 contact the rope winding drum 14, however, the brake elements 38 are turned abruptly backward by the crankshaft resistance against the stop lugs 52. In this position, the inner faces of the brake elements 38 abut a central buttressing lug 74 which serves to support the brake elements 38, or more specifically, the brake shoes 44 in firm contact with the drum 14.

In order to wind up the spring 24 and thereby store energy in the starter, I provide a wind-up locking mechanism for the drive disk 30. This includes a latch 54 mounted for vertical sliding motion on a keyed shaft 56 inside the housing 10. The latch 54 is positioned adjacent to the periphery of the disk 30 and when the shaft 56 is depressed, latch 54 fits between spaced teeth 55 on the rim of disk 30 preventing the disk 30 from rotating. The upper end of the shaft 56 is provided with an op-

erating knob 60 by means of which the latch may be raised or lowered to lock or release the drive disk 30. The bottom riding surface of the latch 54 is slanted at 56 to prevent its accidental entrance between teeth 55 when the disk 30 is rotating.

Once the drive disk 30 has been locked by the above-described latching mechanism, the spring 24 can be wound up by turning the spring drum 22. This is accomplished by means of a crank 66 mounted on the housing 10 and arranged to turn a small winding gear 68 near the upper corner of the housing 10. This gear 68 meshes with a gear 70 mounted on the upper surface of the spring drum 22. The spring drum 22 is restrained against counter rotation by means of a spring loaded pawl 72 which engages the teeth of the gear 70. In this way turning the crank 66 rotates the spring drum 22, and since the disk 30 is held against rotation, the spring 24 commences to store energy. When the spring 24 is fully wound, the latch 54 may be released by pulling upward on the knob 60 to disengage the latch 54 from the teeth 55 on the drive disk 30. When this has been done, the drive disk 30 commences rotating in response to the force of the spring 24 and, when it has reached a sufficient rotational velocity, the brake elements 38 pivot outwardly in response both to the acceleration and centrifugal forces bringing the brake shoe elements 44 in contact with the inner face of the rope winding drum 14. At this point the brake shoes 44 grab the rope winding drum 14, throwing the brake elements 38 back against stop lugs 52 and imparting the entire kinetic energy of the drive disk 30 to the drive shaft 12. This initial shock serves to overcome the bearing friction, compression resistance and inertia of the rotating parts of the engine, and permits me to employ a lighter, smaller and essentially weaker spring than in previous starters of this general type while at the same time providing an equally effective starter. Since the spring 24 is only unwound a relatively small amount by the time the brake elements grab the drum 14, the remaining energy in the spring 24 is then further imparted to the crankshaft to turn the motor and increase the rotational velocity. Since the forces required for this additional turning are not as great as those required for the initial turning, the crankshaft soon reaches operating speeds. As the motor itself starts up, the crankshaft 12 then starts rotating at a faster rate than the drive disk 30, and when this happens, the tension springs 50 pivot the brake elements 38 backwardly and away from the inside face of the rope winding drum 14 such that the rotating elements of the starter are completely disengaged from the motor and come to rest after there is no longer any turning force in the spring 24. In this condition, the starter remains at rest until the motor is stopped and again needs to be started.

It will be understood that during the normal life of a lawnmower, the starter is only called upon to start the motor a relatively few number of times estimated at from 2000 to 4000 times at the maximum. In the usual suburban use, 500 times is probably maximum. Under these circumstances it will be seen that carefully machined bearing surfaces are unnecessary, and considerations of

metal fatigue from the kinetic energy shock during starting are minor. Thus, with the starter of my invention, the spring 24 receives a relatively abrupt shock when the brake elements 38 grab the rope winding drum 14. Such would be undesirable under many conditions of spring usage, but in the context of this invention, it is well within fatigue limits of conventional spring steel. On the other hand, provision can be made to reduce this shock without departing from the spirit of this invention. For instance, instead of integrally connecting the sleeve 28 and the disk 30, the two can be connected by a friction sleeve adapted to slip under heavy impact but to hold the full force of the spring under more static conditions.

Similar considerations affect the construction of the brake elements 38 and the brake shoes 44. Under normal conditions, no special precautions need be taken to withstand excessive shock or wear. Thus, the brake elements 38, and stop lugs 52 may be made of conventional malleable iron. In fact, the disk 36 with the stop lugs 52 and the buttressing lug 74 may be conveniently cast out of malleable iron as a single piece. The brake shoes 44 can also be made of relatively soft metals with knurled outer faces, or they can be faced with conventional brake lining materials. More durable materials, however, can be employed if the need for them arises, without departing from the spirit of the invention.

Numerous other variations of this preferred embodiment of my invention will now be apparent to those skilled in the art, and therefore, it is not my intention to confine the invention to the precise form herein shown, but rather to limit it in terms of the appended claim.

Having thus described and disclosed a preferred embodiment of my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

A starter for internal combustion engines comprising an outer casing, flanges on said outer casing in such position that said outer casing can be bolted to the internal combustion engine to be started, central tube mounted inside said outer casing, spring drum mounted on said outer casing, spring inside said spring drum with one end of said spring connected to said spring drum, drive dish mounted to rotate about said central tube below said spring drum with the other end of said spring attached thereto, and centrifugal force clutch mounted below said drive disk co-axial with said central tube and in such position that when said drive disk achieves sufficient rotary motion, said clutch will grip the inner surface of a drum connected to the crankshaft of said internal combustion engine and will cause said crankshaft to rotate with said drive disk.

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