March 7, 1950 A. A. HONEYMAN 2,500,076

RATCHET STARTER FOR MOTORS

Filed Sept. 21, 1948 2 Sheets-Sheet 1

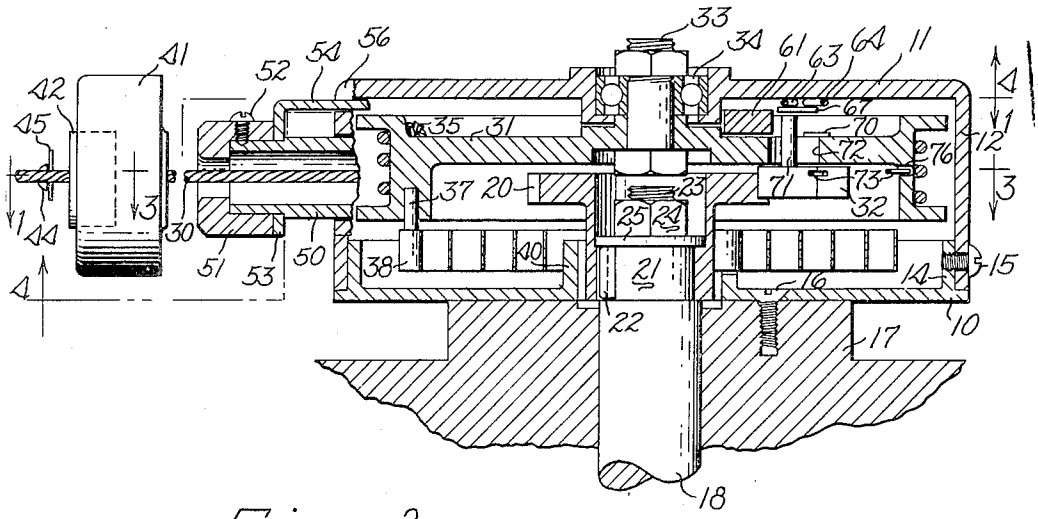
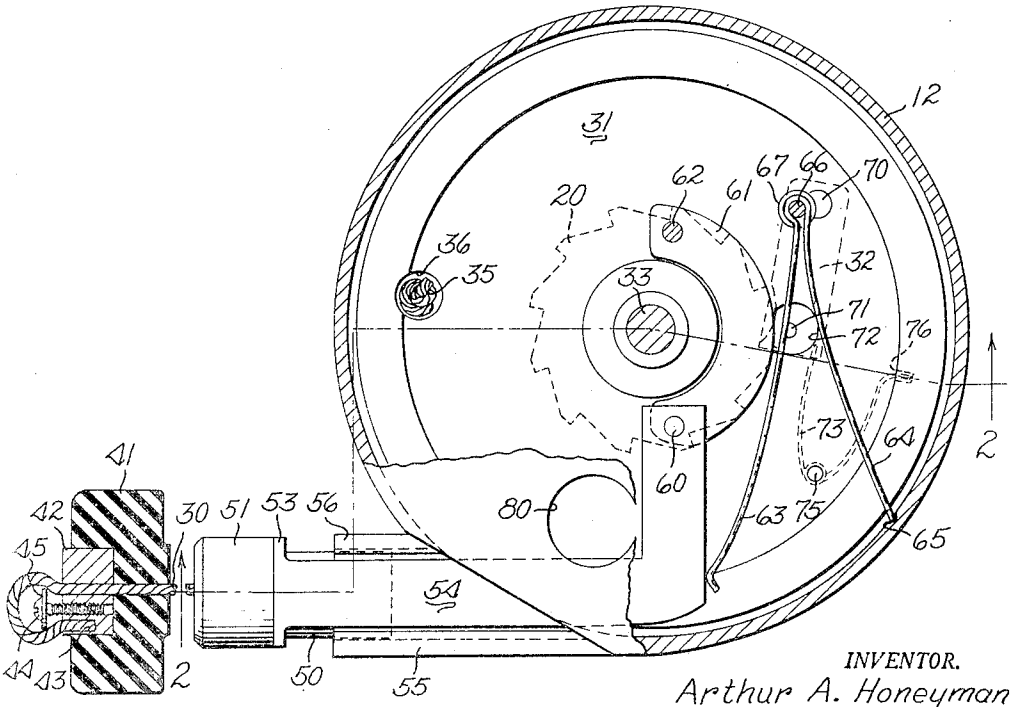


Fig. 2.

Fig. 1.



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Fig. 3.

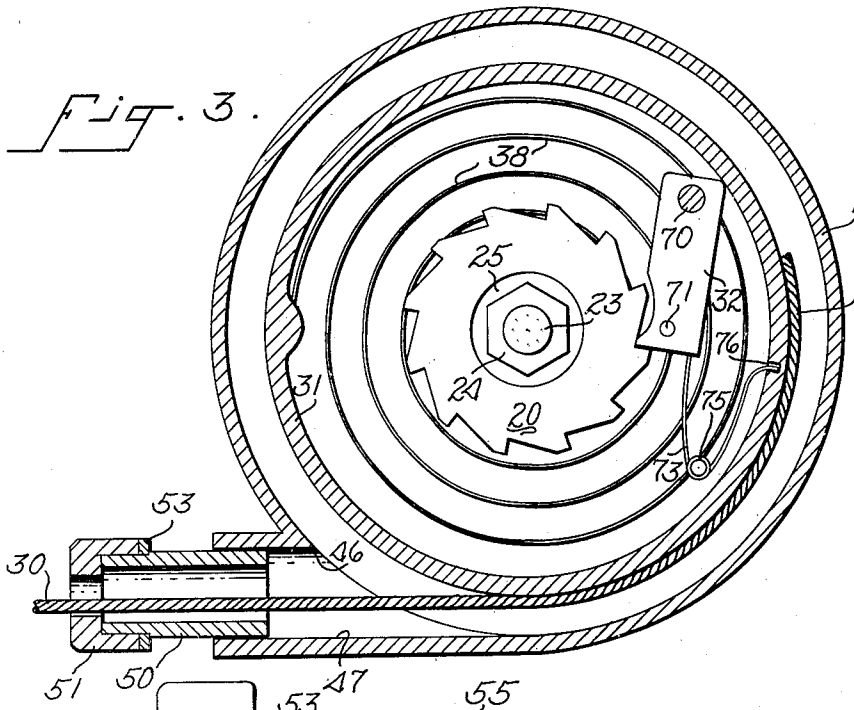
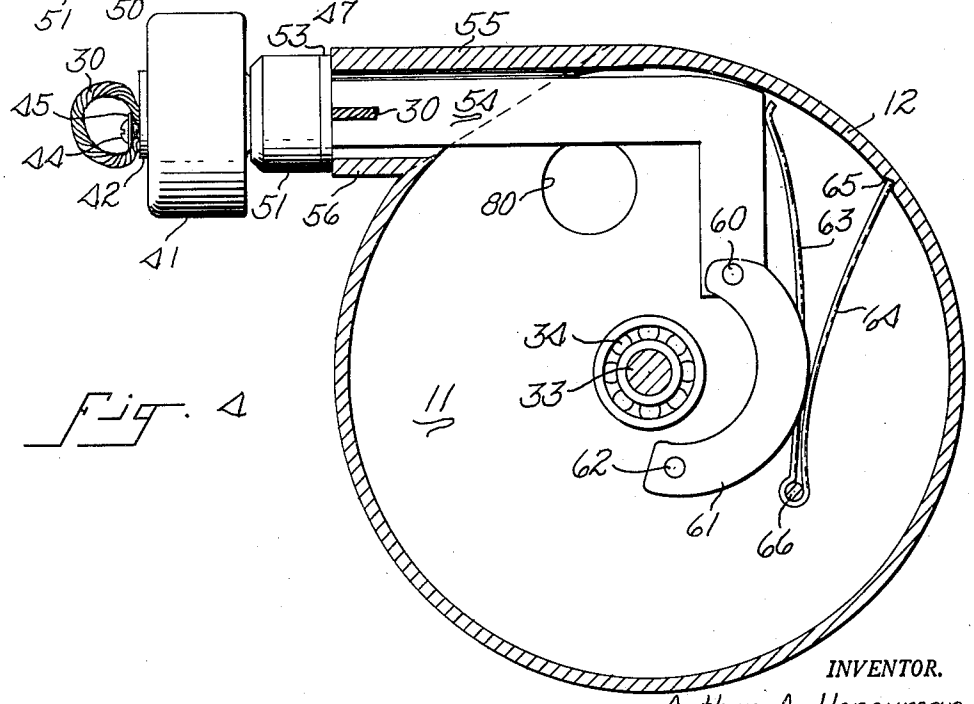


Fig. 4



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RATCHET STARTER FOR MOTORS

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7 Claims. (Cl. 74—140)

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The present invention comprises a starting device for internal combustion engines, particularly engines of the type having an end of an engine shaft projecting from the crankcase. The engine shaft in such case is usually the crankshaft to which the pistons are connected, but it is to be understood that the invention is not limited to connection to a crankshaft as it may be connected to an auxiliary shaft which in turn is geared to or otherwise driven by the crankshaft.

The present invention is of greatest utility in small industrial equipment such as portable chain saws, tree drilling equipment, or other similar equipment for which it is impractical or inconvenient to supply electric starting equipment. An example of an other than industrial machine to which the present invention might be applied is in outboard motor for propelling boats.

In the field of greatest utility, namely in portable industrial equipment, it is imperative that the starting equipment should be as sturdy as possible, hence the starting device preferably comprises a starting pulley adapted to be connected to the engine shaft and a wire rope, cable or other durable, flexible element adapted to be wrapped about the pulley. When a wire rope or cable is so employed a backfire or series thereof may retract the flexible element until the hand grip thereon is jammed against the housing of the starting device with resulting breakage of the equipment or, in the event the operator has not released the hand grip, with resulting injury to his hand. The principal object of the present invention is to provide a starting device of the character described in which damage to the equipment or injury to the operator is positively prevented in the event of reverse rotation of the engine shaft due to backfiring.

A further object of the present invention is to provide a sturdy mechanism of the character described which may be manufactured of relatively few, easily formed and assembled parts.

The foregoing objects and advantages of the present invention will be more readily understood by reference to the following specification taken in connection with the accompanying drawing wherein like numerals refer to like parts throughout, while the features of novelty will be more distinctly pointed out in the appended claims.

In the drawings—

Fig. 1 is a horizontal section taken through a preferred form of the device substantially along line 1—1 of Fig. 2;

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Fig. 2 is a vertical section thereof taken substantially along the line 2—2 of Fig. 1;

Fig. 3 is a horizontal section taken substantially along line 3—3 of Fig. 2; and

Fig. 4 is a horizontal section taken substantially along the line 4—4 of Fig. 2, but showing certain parts in another relation to each other.

The device is herein illustrated as comprising a housing including a base section 10 and an outer section including an end wall 11 and a substantially cylindrical side wall 12, the two sections being united by providing a flange 14 on the base section 10 adapted to fit within the cylindrical wall 12 and be attached thereto by screws 15. The base section 10 is adapted to be attached to the crankcase of an engine by means of screws 16 for which threaded openings are provided in a portion of the crankcase 17 of the engine. The crankshaft or connected engine shaft 18 is provided with an end projecting through a central opening in the base section 10.

The starting device comprises a driven part, in this instance a toothed ratchet wheel 20. The ratchet wheel 20 comprises a hub portion, the central part of which is provided with a stepped bore, into the base of which a reduced intermediate portion 21 on the shaft is inserted and retained by a key 22. The tip of the shaft is provided with a reduced threaded portion 23 on which a nut 24 is mounted to retain a washer 25 extending over the stepped base portion of the bore in the hub of the ratchet wheel and thus locking the wheel 20 and key 22 in position. The ratchet wheel is provided with a plurality of ratchet teeth all facing in a direction such that a ratchet pawl may drive the shaft 18 in the direction of normal rotation.

The starting mechanism comprises a driving assembly including a pull cord 30, a pulley 31 about which the pull cord may be wrapped, and a ratchet pawl 32 mounted upon the pulley in position to engage the teeth of the ratchet wheel. The pulley 31 is mounted upon a bolt 33 extending coaxially of the shaft 18 through an opening in the end wall 11, there preferably being provided a ball-bearing assembly 34 to reduce friction. The pull cord 30 is wrapped about the sheave portion of the pulley several times, and its inner end extends through an opening in the wall of the sheave and terminates in a knot or other enlargement 35 which is situated in a countersink 36 in the outer face of the pulley. A pin 37 projects downwardly from the sheave portion of the pulley, and one end of a spiral spring 38 is affixed to the projecting end of the pin. The opposite end of the spiral spring 38

is hooked into a slot in a flange 40 on the base section 10 surrounding the hub of the ratchet wheel 20. The spiral spring is so connected between the housing and the pulley as to be tensioned when the pull cord 30 is pulled from the housing, thereby providing means for retracting the pull cord into the housing.

The outer end of the pull cord is adjustably affixed to a pull grip including a body 41 of soft or resilient material such as rubber or the equivalent. The cord extends through a central opening in the body 41 and a central opening in a metallic plug 42 seated in a depression in the outer surface of the body. The plug is provided with a second opening 43 into which the extreme end of the pull cord may be inserted, and the plug is also provided with a threaded opening for reception of a screw 44. A washer 45 preferably surrounds the outer end of the stem of the screw. The screw is so positioned relative to adjacent portions of the pull cord that tightening thereof causes the washer 45 to spread and jam the ends of the pull cord to prevent slippage thereof relative to the body 41.

The pull cord extends tangentially from the pulley through an opening 46 in the side wall 12, and the side wall 12 is provided with a tangentially extending projection in which a communicating, tangential passage 47 is provided. The passage 47 slidably guides a tubular guide 50 fixed to the outer end of a pawl releasing device and having its end projecting into the outer end of the passage 47. A cap 51 is retained on the outer end of the tubular guide by a screw 52, the cap being provided with a central opening through which the cable 30 extends. The outer end of the guide 50 is reduced in diameter for reception of the cap 51 and a vertically extending ring 53 is clamped between the cap and the shoulder of the reduced portion. The ring 53 is integral with a bar 54 which is slidably guided between flanges 55 and 56 on the upper part of the housing projection and slidably extends through a slot in the side wall 12 adjacent the opening 46. The inner end of the bar 54 has an arm thereon which carries a pivot pin 60, the pin being pivotally attached to the free end of a movable pawl shifting cam 61 which is pivotally mounted on a stud 62 extending inwardly from the end wall 11. The cam 61 is substantially in the shape of a half-moon and the inner surface thereof surrounds a boss on the end wall 11 in which the bearing 34 is mounted. A cam spring of the wishbone type, comprising one leg 63 bearing against the inner end of the bar 54 and a second leg 64 retained in a notch 65 in the side wall 12, is mounted upon the housing by a stud 66 extending inwardly from the end wall 11 and having a large head 67 to retain the legs of the spring against the end wall 11. The cam spring therefore acts normally to hold the cam 61 in the position illustrated in Figs. 1 and 2, and also to hold the cam shifting bar 54 in the extended position illustrated in Figs. 1, 2 and 3 in which the ring portion 53 is spaced from the end of the housing projection.

The ratchet pawl 32 is pivotally mounted upon a pivot 70 projecting below the pulley 31. A portion of the ratchet pawl 32 is positioned so as to be engageable by the cam 61, the portion in the present illustration comprising a pin 71 projecting through an opening 72 in the pulley 31. A wire spring 73 is mounted upon a stud 74 having an enlarged head to retain the wire spring against the inner surface of the pulley. One end of the wire spring is retained in a slot in the free end of the ratchet pawl 32 and the other end is retained in a small hole drilled into the flange of the pulley, the intermediate portion of the wire being wrapped around the stem of the stud. The wire spring therefore constitutes a ratchet pawl spring so arranged as to urge the ratchet pawl into engagement with the ratchet wheel. When the pawl is so engaged the pin 71 is toward the inner side of the hole 72 through the pulley. If the cam 61 is shifted outwardly, a portion thereof will engage the pin 71 to move the pawl against the tension of spring 73 until the pin 71 strikes the outer side of the opening 72. When so moved the pawl is held free of the ratchet wheel so that backfiring of the engine causing reverse rotation of the shaft 18 will not cause continued rewinding rotation of the pulley 31.

In order that the pawl may be disengaged at the proper time, the length of cable 30 from its point of attachment to the pulley to the inner surface of the hand grip body 41 must be fixed within limits such that the movement of cam 61 will disengage the ratchet pawl when the cable is fully retracted. In order that the device may be assembled with the hand grip in proper relation to the cable, the ratchet wheel is mounted upon the end of the shaft after the section 10 of the housing is mounted in its proper position, the spring 38 is assembled to the driving portion of the starting mechanism which is mounted in the outer section of the housing, and the two parts of the housing are slipped together while making certain that the inner end of the spring is hooked into the slot in the flange 40. A certain amount of initial tension is imposed upon the spring 38 by rotating the outer housing section in a direction to tighten the spring before inserting the screws 15. As soon as sufficient initial tension has been imposed upon the spring the pulley is arrested with the countersink opening 36 beneath an opening 80 in end wall 11. The opening 80 is adjacent the inner end of the passage 47 so that the end of the cable 30 may be slipped through the opening in the flange of the pulley and projected through the passage 47 until the knot 35 is drawn tightly against the bottom of the countersink 36. The tension of the spring 38 is sufficient to cause the cable to be drawn onto the pulley for the desired distance corresponding to the distance which the cable may be moved when manually pulled in the starting action with sufficient additional tension to overcome the force of the cam spring and the pawl spring. The projecting end of the cable 30 is now slipped through the grip body 41 and anchored to the plug 42 as previously described. With the remaining tension of the spring exerted against the hand grip in engagement with the outer end of the shifting bar the cam is moved outward to the position seen in Fig. 4. The length of the cable is fixed such that the outward movement of cam 61 occurs when the pin 71 on the pulley is adjacent or close to the movable end of the cam in order to insure sufficient movement of the ratchet pawl. When the pin 71 strikes the outer edge of the opening 72 the ring portion 53 will be adjacent the end of the housing projection. It is to be remarked that the length of the cam 61 having sufficient movement to disengage the ratchet pawl is so great that in the event the fingers of the operator are caught between the body 41 and the outer end of the cap 51, the bar 54 will be moved inwardly after the pin 71 has moved beyond the pivot 60. The cam spring will

hold the cam in inoperative position at all other times, but it is to be observed that someone might manually move the bar 54 inward when the pin 71 is on the side opposite the cam 61. In order to prevent damage from occurring as a result of the pin 71 striking the end of the cam 61 adjacent pivot 60 in such event, the outer corner thereof is preferably cut away so as to provide a cam surface which will insure engagement of the pin with the outer surface of the cam.

The guiding portions of the cam shifting mechanism comprising the portion of the bar 54 engaged between the flanges 55 and 56 and the tubular guide 50 engaged in the passage 47 are loosely fitted to allow slight pivotal movement of the inner end of the bar as the cam swings about the stud 62. It is also to be appreciated that the bar 54 may take other forms than that herein illustrated and that the arrangement of the mechanism, as well as the proportion and design of the particular parts, may be varied while still retaining the essence of the invention. All such modifications in arrangement and detail as come within the purview of the appended claims are considered to be a part of my invention.

I claim:

1. A starting device for an internal combustion engine having an end of an engine shaft projecting from the crankcase, comprising a driving assembly adapted to be mounted on the crankcase and including a pull-cord having a handgrip fixed thereto, a pulley rotated by the pull-cord and spring return means therefor, a driven part adapted to be mounted on the engine shaft, a pawl normally connecting said driving assembly to said driven part for rotation in the normal direction of engine shaft rotation when said pull-cord is pulled, and a pawl releasing device including a movable part engageable by said handgrip for disconnecting said driving assembly from said driven part in the event of complete rewinding of said pull-cord on said pulley.

2. A starting device for an internal combustion engine having an end of an engine shaft projecting from the crankcase, comprising a driving assembly adapted to be mounted on the crankcase and including a pull-cord having a handgrip at its free end, a pulley rotated by the pull-cord and spring return means therefor, a driven part adapted to be mounted on the engine shaft, a pawl normally connecting said driving assembly to said driven part for rotation in the normal direction of engine shaft rotation when said pull-cord is pulled, and a pawl releasing device including a movable part engageable by said hangrip or the pulling hand of the operator and a pawl-engaging cam connected to said movable part for disconnecting said driving assembly from said driven part in the event of reverse rotation of said engine shaft due to backfiring.

3. A starting device for an internal combustion engine having an end of an engine shaft projecting from the crankcase, comprising a housing adapted to be secured to the crankcase in position to enclose the projecting end of the engine shaft and having an opening through the side thereof, a ratchet wheel adapted to be secured to the end of the engine shaft, a pulley mounted within said housing, a flexible element attached to said pulley at one end and having its other end projecting through said opening, a spiral spring having one end secured to said pulley and its other end secured to said housing in such manner as to cause winding of said flexible element onto said pulley, a pull grip on the free end of said flexible element, a ratchet pawl pivotally mounted on said pulley in position to engage the teeth of said ratchet wheel, a pawl spring mounted on said pulley and urging said ratchet pawl toward engaging position whereby manual withdrawal of said flexible element causes rotation of the engine shaft, and pawl releasing means mounted on said housing, said means comprising a cam movably mounted on said housing, a cam spring normally urging said cam toward an inoperative position, a movable cam shifter extending through said housing adjacent said opening and engaged with said cam at its inner end, and a guide on the outer end of said cam shifter through which said flexible element extends, said cam shifter upon inward movement thereof causing movement of said ratchet pawl to a position such as to engage said ratchet pawl and force it from engagement with the teeth of said ratchet wheel.

4. A starting device for an internal combustion engine having an end of an engine shaft projecting from the crankcase, comprising a housing adapted to be secured to the crankcase in position to enclose the projecting end of the engine shaft and having an opening through the side thereof, a ratchet wheel adapted to be secured to the end of the engine shaft, a pulley mounted within said housing, a flexible element attached to said pulley at one end and having its other end projecting through said opening, a spiral spring having one end secured to said pulley and its other end secured to said housing in such manner as to cause winding of said flexible element onto said pulley, a pull grip on the free end of said flexible element, a ratchet pawl pivotally mounted on said pulley in position to engage the teeth of said ratchet wheel, a pawl spring mounted on said pulley and urging said ratchet pawl toward engaging position whereby manual withdrawal of said flexible element causes rotation of the engine shaft, and pawl releasing means mounted on said housing, said means comprising a cam movably mounted on said housing, a cam spring normally urging said cam toward an inoperative position, a movable cam shifter extending through said housing adjacent said opening and engaged with said cam at its inner end, and a guide on the outer end of said cam shifter through which said flexible element extends, said guide being restricted to prevent passage of said pull grip whereby winding of said flexible element onto said pulley until said pull grip engages said guide and moves said cam shifter causes movement of said cam into disengaging relation to said ratchet pawl.

5. A starting device for an internal combustion engine having an end of an engine shaft projecting from the crankcase, comprising a housing adapted to be secured to the crankcase in position to enclose the projecting end of the engine shaft and having an opening through the side thereof, a ratchet wheel adapted to be secured to the end of the engine shaft, a pulley mounted within said housing, a flexible element attached to said pulley at one end and having its other end projecting through said opening, a spiral spring having one end secured to said pulley and its other end secured to said housing in such manner as to cause winding of said flexible element onto said pulley, a pull grip on the free end of said flexible element, a ratchet pawl

pivotally mounted on said pulley in position to engage the teeth of said ratchet wheel, a pawl spring mounted on said pulley and urging said ratchet pawl toward engaging position whereby manual withdrawal of said flexible element causes rotation of the engine shaft, and pawl releasing means mounted on said housing, said means comprising a cam pivotally mounted on said housing, a cam shifter pivotally attached to said cam and including an extension projecting through the side of the housing in position to be engaged by said pull grip upon movement of said pulley in the direction causing winding of said flexible element thereon, and a cam spring biased between said cam shifter and said housing to hold said cam out of the path of rotation of said ratchet pawl and to hold said cam shifter in a position such that said extension projects from said housing to its fullest extent, said cam being arranged to project into the path of a portion of said ratchet pawl upon inward movement of said cam shifter against the force of said cam spring.

6. The combination disclosed in claim 5 wherein said cam is mounted adjacent the outer surface of said pulley, said ratchet pawl is mounted upon the inner surface of said pulley, said pulley is provided with an opening therethrough adjacent said ratchet pawl, and the portion of said ratchet pawl engageable by said cam comprises a pin projecting through said opening.

7. The combination disclosed in claim 5 wherein said housing comprises a portion having a passage therein communicating with said opening, and said extension comprises a tubular guide slidably extending into the outer end of said passage and through which said flexible element extends.

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