T. M. & H. G. EYNON.

STARTER FOR AUTOMOBILES.

APPLICATION FILED APR. 22, 1915.

1,208,115.

Patented Dec. 12, 1916.

3 SHEETS—SHEET 1.

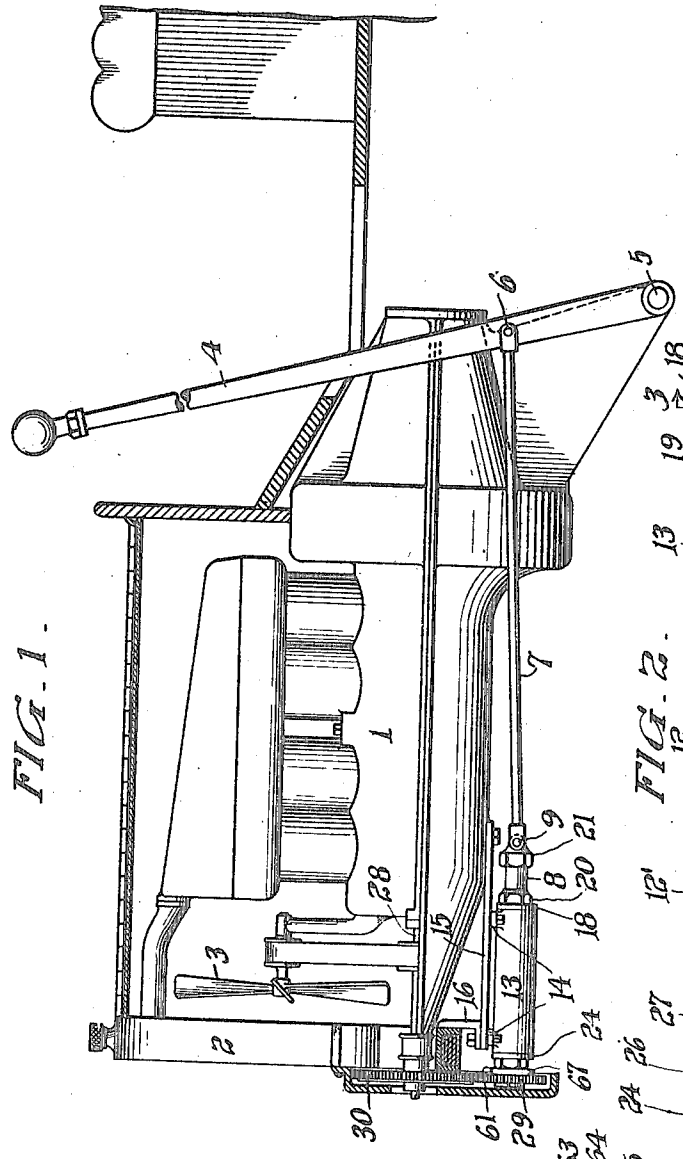


FIG. 1.

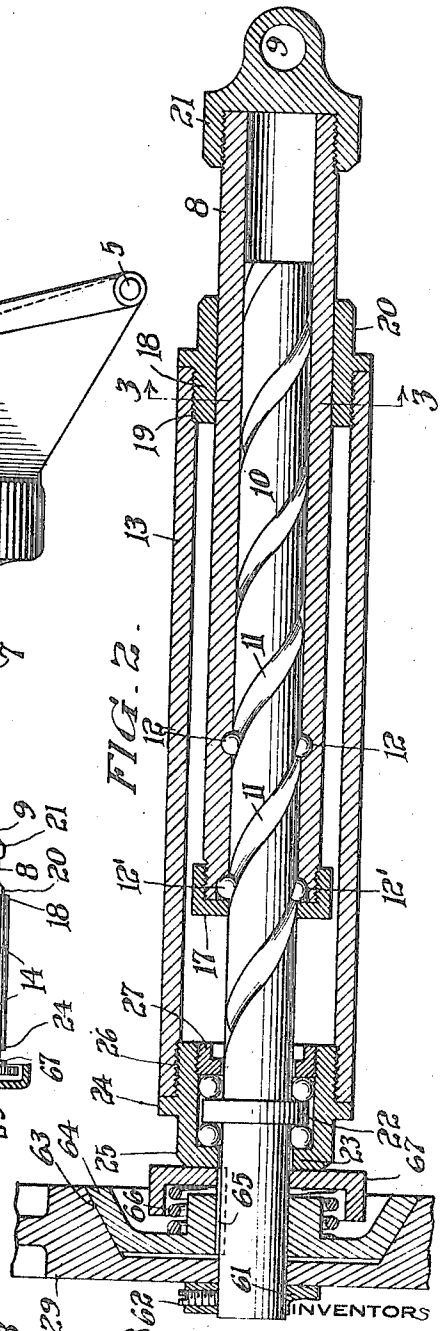


FIG. 2.

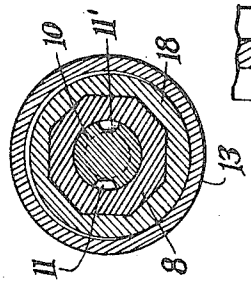


FIG. 3.

WITNESS

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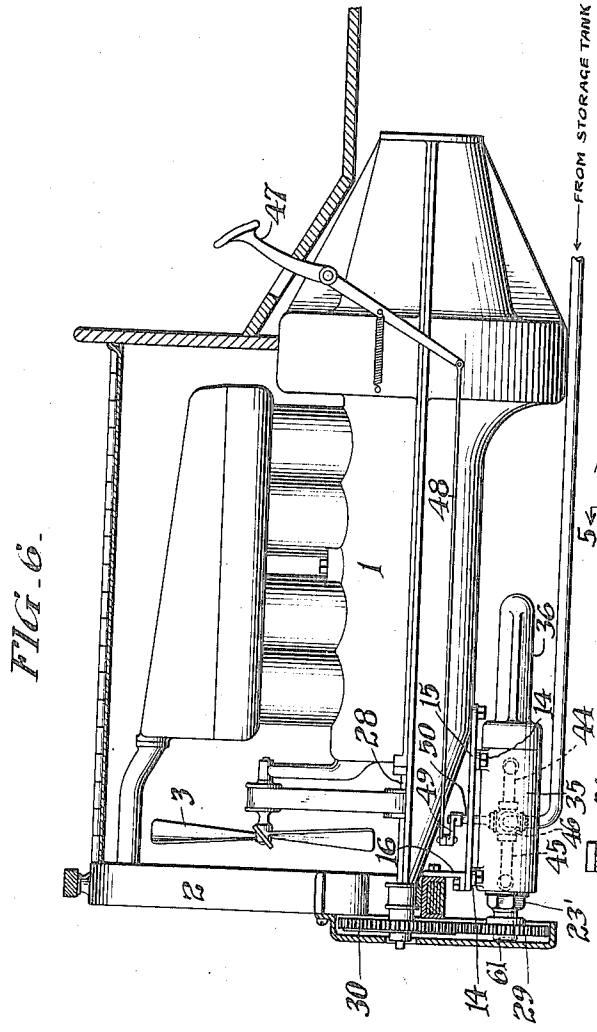


FIG. 6.

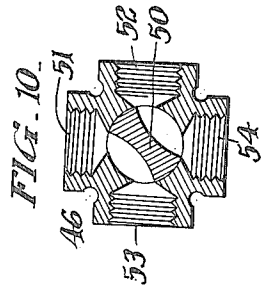


FIG. 10.

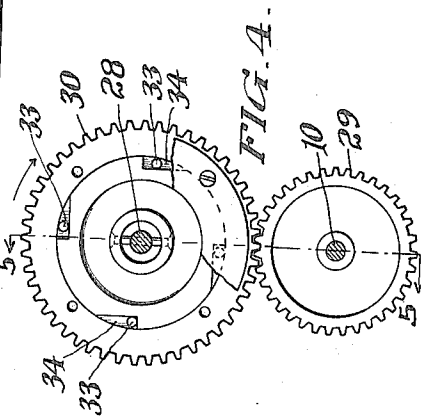


FIG. 4.

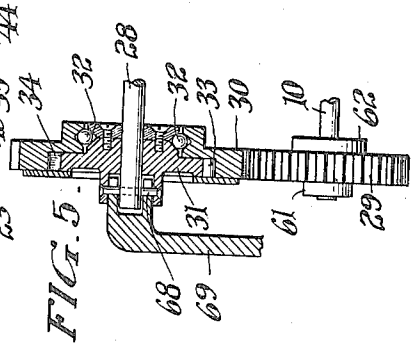


FIG. 5.

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3 SHEETS—SHEET 3.

FIG. 9.

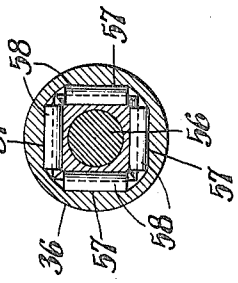


FIG. 7.

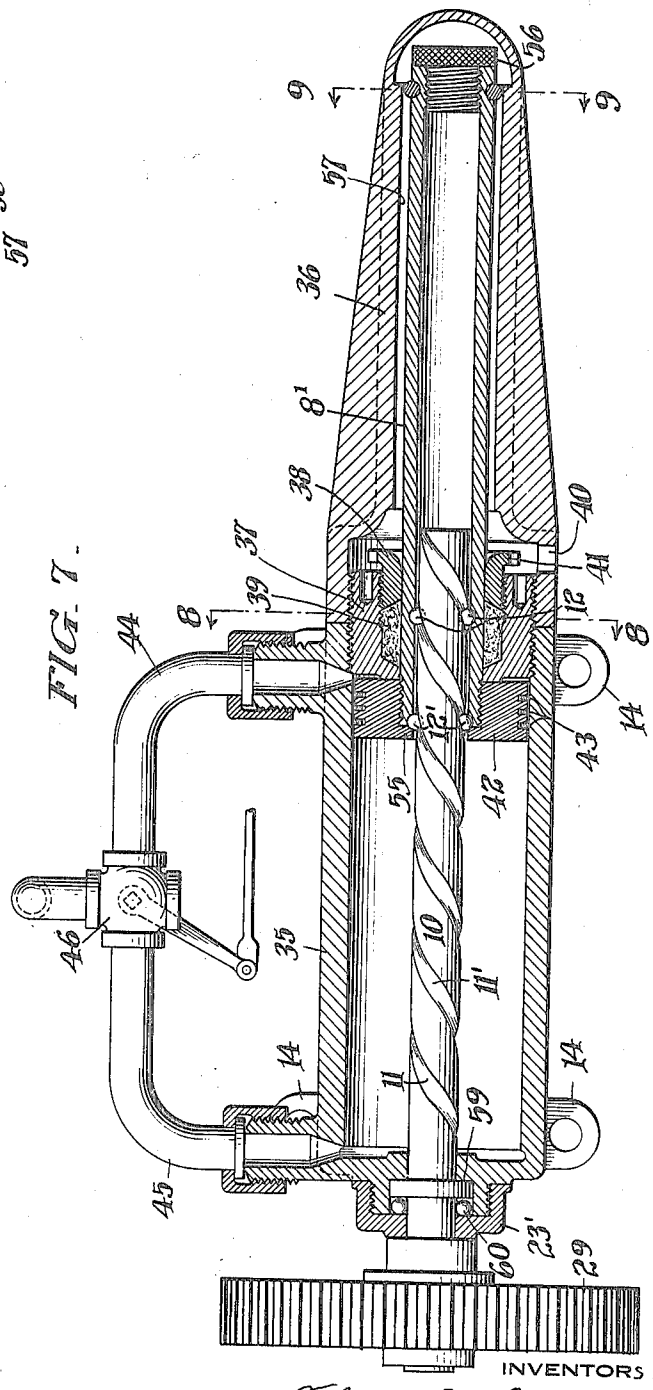
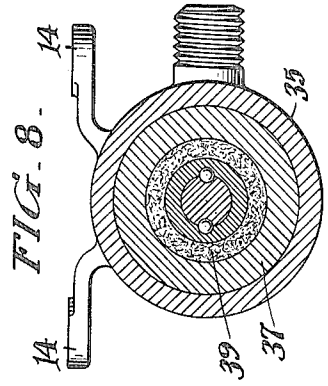


FIG. 8.



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STARTER FOR AUTOMOBILES.

1,208,115. Specification of Letters Patent. Patented Dec. 12, 1916.

Application filed April 22, 1915. Serial No. 23,042.

To all whom it may concern:

Be it known that we, THOMAS M. EYNON and HAROLD G. EYNON, citizens of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented a certain new and useful Starter for Automobiles, of which the following is a specification.

The purpose of our invention is to give rotary starting impulse to an engine shaft, preferably through gearing, by movement of an operating element engaging with a spiral track upon a shaft, preferably a separate shaft, the operating mechanism moving parallel to the axis of the shaft carrying the track. We protect the operating element by a uni-directional clutch between it and the engine shaft.

A further purpose of our invention is to change the longitudinal movement of a piston or lever into rotary movement of the engine shaft by spiral connection between, effective in one direction of movement to turn the piston and inoperative in the opposite direction by reason of an interposed clutch.

A further purpose of our invention is to connect a shaft having a spiral track upon its surface with an automobile engine shaft through a clutch and to give rotary impulse to the shaft by a piston or lever and intermediate engaging devices surrounding and engaging the track.

A further purpose of our invention is to rotate a spiraled shaft to cause starting rotation of an engine shaft by a surrounding sleeve having operative spiral connection with the shaft, to prevent rotation of the sleeve and to give longitudinal movement to the sleeve by hand or power-operated means, as convenient.

A further purpose of our invention is to provide a spiraled shaft connected for rotation of the engine shaft and inclose its end and protect it by a sleeve having operative connections with the spiral of the shaft.

A further purpose of our invention is to provide a spiraled shaft operatively connected with the engine shaft, inclose it within a support for the device and use the support as a guide for preventing rotation of an operating sleeve traveling longitudinally of the shaft to give it rotary movement.

Further purposes of our invention will appear in the specification and claims hereof.

We have preferred to illustrate our invention by but two forms thereof among the various forms in which it might be utilized and have selected the two forms which we regard as most practical, efficient and relatively inexpensive, which are best suited to automobile use and which at the same time well illustrate the principles of our invention.

Figure 1 is a side elevation, partly broken, showing one form of our invention. Fig. 2 is a longitudinal section through the center of the operating mechanism in the starter shown in Fig. 1. Fig. 3 is a section of Fig. 2 taken upon lines 3—3 and looking in the direction of the arrows. Fig. 4 is an end elevation partly broken showing a portion of the gearing used by us. Fig. 5 is a section of Fig. 4 taken upon line 5—5, looking in the direction of the arrows, supplying parts broken in Fig. 5 and a starting lever. Fig. 6 is a partial section end elevation of a second form of our invention. Fig. 7 is a longitudinal section through the starter shown in Fig. 6. Figs. 8 and 9 are sections of Fig. 7 taken upon lines 8—8 and 9—9 respectively, looking in the directions of the arrows. Fig. 10 is a central section of a valve shown in Figs. 6 and 7.

Similar numerals indicate like parts in the drawings.

Because of the general distribution of Ford automobiles and the familiarity of the public with them we have illustrated our invention as applied to a Ford engine 1 connected with radiator 2 which is cooled by fan 3.

In its simplest form our invention comprises coöperating members, one rotatable only, the other movable axially only to rotate it by means of a spiral track between and clutch connections between the rotatable member and the engine shaft operative to turn the engine shaft when the rotatable member is rotated in one direction but allow free rotation of the engine shaft in the same direction and free rotation of the member in the opposite direction. Because it is easier to construct the spiral track upon a shaft and use a surrounding collar or sleeve

for the other member, and because it is more convenient to describe one form only, we have contemplated and described a spiraled shaft form without, however, restricting ourselves to it. The devices by which the operating element is moved, and the means for connecting the shafts, preventing rotation of the operating element, reducing friction, etc., are, of course, various.

In the lever-operated form the lever 4 is shown as within reach of the operator from his position on the seat of the automobile, the most convenient of the many locations in which the lever could be placed. It is fulcrumed at 5 and is connected at 6 with rod 7 to which the operating element, sleeve 8, is connected at 9. The lever 4 and connections are thus adapted to force sleeve 8 longitudinally of the shaft 10, whose outer surface is spiraled. The track is shown as formed by fluting or grooving the shaft 10, since a track is less expensive and more enduring when depressed. Two duplicate balanced grooves 11, 11′ are shown, giving the desired pitch of the groove and balanced engaging surfaces without requiring much axial spacing of the two pairs of coöperating male members, here balls 12, 12 and 12′, 12′. In order to include all possible forms of track, whatever the cross section and whether regular or irregular in its law of progression, we shall call the shaft "spiraled".

In order to protect the spiraled shaft from dirt it is inclosed within a cover, shield, or casing 13 by which the starter is supported from the engine or appropriate frame parts of the automobile. The connections shown are ears 14 and brackets 15 and 16.

The balls 12, 12, 12′, 12′ are inserted within depressions in the inside of the sleeve 8 so as to turn within the depressions but to have no bodily movement with respect to the sleeve. The depressions may be made by any of various means known in the art which it has not been deemed necessary to illustrate. The end balls may be held in if desired by the flange of a cap 17 firmly secured to the end of the sleeve. This cap prevents accidental withdrawal of the sleeve by engagement with the inner end of a guard and guide 18 screwed into the end of the casing at 19 by the aid of its non-circular projection 20. This guide 18 is of non-circular interior contour in cross section, corresponding to the non-circular exterior of the sleeve 8. Its main function is to guide the sleeve and prevent it from turning. It also protects against dust inlet at this end.

The end of the sleeve 8 of course enters the shield to varying extents during its movement along the shaft 10 to cause rotation of the shaft with endwise movement of the sleeve. The end of the sleeve is closed by the cover 21 through which the connection at 9 is made.

The guide 18 relieves the rod 7 and lever 4 of all strain from the sleeve torsional to the sleeve and transmits this strain to the casing. We have not considered it necessary to show anti-friction connections between the sleeve and guide.

Near the outer end of the shaft 10 it is provided with thrust bearings. In the form illustrated a collar 22 upon the shaft receives the thrust of the shaft in each direction of movement of the sleeve. A bearing surface is formed upon the outer side of the collar by the flange 23 of a cap 24, of non-circular exterior form at 25. The cap is rigidly secured in the casing by threads 26. A second surface is formed on the inside of the collar by ring 27 supported in the cap. The balls, shaft and inner surface of cap 24 complete the thrust bearings.

The shaft 10 is connected with the engine shaft 28. In the form shown the shafts are out of line and the connection is through gearing. The axes of the two shafts are shown as parallel and the connection is made by means of gears 29 and 30. The gear 30 is mounted upon a clutch hub 31 by a ball bearing whose balls are shown at 32, and carries the hub with it in one direction of rotation through a roller clutch whose rollers 33 fit in inclined ways 34. This provides an effective form of clutch having ball bearings for rotation in the non-clutching direction. It was not invented by us and is not claimed by us *per se*.

In assemblage of the starter the cap 24 is placed upon the shaft 10 before the gear 29 is fixed upon it. The thrust bearing is then assembled and the cap 24 is screwed into the casing. The cap 17 is placed upon the sleeve 8, the balls 12 being permissibly placed in position about the shaft 10 first if preferred. If not, the sleeve is then started upon the shaft far enough for the balls 12 to be set in position as their seats meet the ends of the grooves 11, 11′. The balls 12′ are similarly set. The guide 18 is then placed upon the shaft 10 and screwed to place. The cover 21 is next attached.

It will be evident that movement of the lever toward the operator will force the operating element, the sleeve, to the left in Fig. 1 causing rotation of the shaft 10 in a counter-clockwise direction as viewed from the front of the machine. This will turn the gear 30 in a clockwise direction, setting the clutch and rotating the engine shaft. Up to the limit of the rotation of shaft 10 due to complete travel of the sleeve from one end of the shaft to the other, any extent of rotation of shaft 10, and hence of the engine shaft, may be given by each throw of the lever; and the lever may be reversed instantly to obtain another hold for further

turning effort. With reversal of the lever the clutch merely slips and a second pull of the lever will again set the clutch, whether the engine shaft be stopped or moving, unless the starting of the engine has kept the speed of the shaft up to the speed given by the lever pull. Any number of lever pulls may be used and there is no fixed throw which must be given to the lever.

Many automobiles already carry air pumps and air storage tanks. These air supplies are used for various purposes, among others, inflation of the tires. The presence of these air equipments in existing cars and their inexpensive character make air operation advantageous and we have accordingly applied our invention to this pressure in the second form illustrated, Figs. 6 to 10.

In the air-operated form the cylinder 35 performs the functions of the casing 13 in protecting the parts from dust and dirt. The sleeve 8′ may be entirely inclosed within the cylinder and an extension, casing 36. We have done this, securing an additional guiding and supporting function which prevents rotation and takes the weight of the sleeve from the stuffing box and protects the piston against the canting effect which the inevitable wear of the stuffing box would otherwise permit.

The cylinder and casing are conveniently joined by a stuffing box 37 which is threaded into both of them. The gland 38 holds the packing 39 against the sleeve avoiding leakage of air at this end of the cylinder. The casing is shown as provided with an opening 40 so that the notched edge 41 of the gland may be moved to tighten the packing without removal of the casing.

Upon the end of the sleeve 8′ lying within the cylinder we mount a piston 42 conventionally packed at 43 and operated in reverse directions by air admitted from a storage tank, not shown, through pipes 44, 45 controlled by valve 46. The form of attachment of the pipes to the cylinder and the type of valve used are not a part of our invention nor is the control of this valve by the specific means shown by spring-retained pedal lever 47, rod 48, arm 49 and valve stem 50. The valve is shown as having inlet opening 51, outlets 52 and 53 to the two ends of the cylinder and exhaust 54.

Our air starter is shown as supported in the same manner as the hand-operated form and as operated through the same form of gearing and clutch by a similarly placed rotatable shaft operated by a non-rotatable member through spiraled and coöperating parts. The spiraling is again shown as upon the shaft and the non-rotatable member is again called a sleeve, for convenience, without intending to imply that it must be circumferentially closed nor that it have greater length than the form of guide which may be utilized and the support of the parts (balls 12, 12′) which coöperate with the shaft may require.

Since more direct guiding of the cylinder is objectionable and it is desirable to have an extended member connected to it, guided against rotation and supported, we find it convenient to place the balls 12, 12′ in this sleeve rather than in the piston.

In the illustration the same relations of balls 12, 12, 12′, 12′ are shown and balls 12, 12 held in place by a flange 55 upon the piston. The end of the sleeve 8′ is also closed, by a plug, 56 to keep from the shaft any dirt which may enter at 40. The inside of the casing 36 is shown as flattened at circumferential intervals, at 57, here nearly square in cross section, to receive anti-friction devices 58 which are seated in the sides of the sleeve near its end. The sleeve 8′ may be of square exterior cross section at its end as shown if desired. We prefer to place the engaging devices 58 upon the sleeve rather than within the interior of the casing to get the support at a maximum distance from the piston and find the distance not objectionable in the performance of the sleeve's main function of preventing rotation.

Since the movement of the piston to the right in Fig. 7 merely turns the gearing without setting the clutch and a ball race between the shaft collar and the shoulder 59 of the cylinder would permit air leakage here and require a stuffing box or similar construction at this left end, we omit the anti-friction devices here and seal sufficiently by direct contact of the collar and shoulder. On the opposite side of the collar, however, we place balls 60 between it and the cap 23′ to receive the working thrust upon the shaft due to movement of the piston to the left in Fig. 7.

In the order of assemblage we place the shaft 10 in the cylinder, the stuffing box parts and piston upon the sleeve, fit the sleeve upon the shaft and piston within the cylinder, at the same time placing the balls within their seats, screw the stuffing box parts to place, plug the end of the sleeve if desired, put the rollers 58 in their seats, slide the casing 36 upon the sleeve and screw the casing into place, rotating the sleeve and piston.

As the pedal is pressed and the rod 48 is moved to the right in Fig. 2, the valve parts, normally in position to shut air off from both ends of the cylinder, come first to the position shown in Fig. 7, admitting air to the cylinder through the branch pipe 44. As a result, the piston, if not already at the extreme right in Fig. 2 is pushed to the right, engaging with the spiral grooves 11, 11′ in the shaft 10 through the medium of balls 12, 12′ and rotating the shaft 10. As

the clutch slips the engine shaft is not rotated. Corollarily, the engine shaft can also rotate freely without affecting the gearing.

With continued movement of the pedal the piston is forced to the left, similarly rotating the shaft 10 and gearing but rotating the engine shaft along with the gear 30 since the clutch is then set.

As the pedal is released the passage admitting air to the left end of the cylinder is opened momentarily to the air pressure forcing the piston to the right again. The valve then closes. The pedal may be released and again pressed to give the engine shafts as many rotary impulses as may be desired or required.

During the movement of the piston, the rollers 58 bear upon the four inner surfaces of the square interior of the casing, supporting the end of the sleeve. During this time, if the movement be to the right, the collar 22 is drawn against the shoulder of the cylinder end, so as to seal effectively against air leakage at this end. Leakage here would be important chiefly as wasting the air pressure, since the force required to rotate the shaft and gearing only is slight. During movement of the piston in the opposite direction thrust upon the shaft 10 is taken upon the ball bearing and cap at the left of the collar 22.

Thus far we have described our invention as if the gear 29 and the shaft 10 were rigidly united for driving purposes and the invention would be effective in this way during normal operation of the motor. However, occasionally during starting an engine will back fire. While the starter with the gearing is moving in a forward direction against a moderate resistance it is suddenly met by the back fire engine pressure in the reverse direction tending to break the starter. For the purpose of relieving against this we have inserted a conventional type of spring pressed friction clutch between the shaft 10 and the gear 29. This clutch is intended to be engaged at all times with a pressure sufficient to carry the gear 29 with the shaft 10 against the normal starting resistance of the engine, but to slip with excessive pressure and relieve against breakage in case of back fire from the engine.

In the construction shown we have secured a collar 61 upon the shaft 10 by set screw 62 and have mounted the gear 29 loosely upon the shaft. Upon the inside face of the gear 29 we have formed a friction clutch face 63 engaged by the clutch 64 movable along the shaft and connected with it by spline 65. The clutch is spring-pressed by spring 66 bearing against a collar 67 tight upon the shaft.

We recognize that other forms of uni-directional clutch and slipping mechanism or relief for the clutch against being driven backward by the engine may be used.

Obviously, the engine shaft may be accommodated to receive a separate starting lever for which accommodation we have shown one conventional form in Fig. 5. Here the pin 68 may be used to help hold the clutch hub to the shaft as well as to be engaged by the ratchet face of lever 69.

It will be evident that undue projection of our spiraled shaft at the end of the engine is avoided by placing the spiraled shaft out of the line of the engine shaft and connecting by gearing.

It will be further evident that the lever and piston operating forms shown are illustrative merely of one form each of hand and power-operated device of which many forms will occur to those skilled in the art.

Having thus described our invention, what we claim as new and desire to secure by Letters Patent is:—

1. In a device of the character stated, an engine shaft, a second shaft, gearing therebetween, a uni-directional clutch within the gearing, an operating element for the second shaft movable axially of it and connections between the element and the shaft transforming the longitudinal movement of the element into rotary movement of the shaft.

2. In a device of the character stated, a shaft, bearings therefor, a sleeve movable longitudinally of the shaft and surrounding it, means for preventing rotation of the sleeve, coöperating engaging devices between the sleeve and shaft giving rotation to the shaft with longitudinal movement of the sleeve, an engine shaft, operative connections between the two shafts and a uni-directional clutch located between the sleeve and the engine shaft.

3. In a device of the character stated, a spiraled shaft, bearings supporting it for rotation, an engine shaft, connections between the engine shaft and the spiraled shaft, a uni-directional clutch in the connections, a non-rotatable operating element movable longitudinally along the spiraled shaft to rotate it and hand-operated means for driving the element along the spiraled shaft.

4. In a device of the character stated, a spiraled shaft, an engine shaft, connections between the spiraled shaft and engine shaft, bearings for the shafts, a sleeve surrounding the spiraled shaft and coöperating with it to rotate the spiraled shaft with longitudinal movement of the sleeve, a casing surrounding the spiraled shaft and end of the sleeve, a guide for the sleeve carried by the casing and supporting the sleeve against rotation and means for driving the sleeve longitudinally along the spiraled shaft.

5. In a device of the character stated, an

engine shaft, a spiraled shaft, gearing connecting the shafts, a uni-directional clutch in the connections between the shafts, a sleeve movable longitudinally of the spiraled shaft for rotating it, a guide and connections between the sleeve and guide for supporting the sleeve.

6. In a device of the character stated, an engine shaft, a spiraled shaft, gearing connecting the shafts, a uni-directional clutch in the connections between the shafts, a sleeve movable longitudinally of the spiraled shaft for rotating it, a guide and roller connections between the end of the sleeve and guide for supporting the end of the sleeve.

7. In a device of the character stated, an engine shaft, a spiraled shaft, gearing connecting the shafts, a uni-directional clutch between the shafts, a sleeve surrounding and inclosing one end of the spiraled shaft, said sleeve having an exterior surface of non-circular contour in cross section, operating connections between the sleeve and spiraled shaft to rotate the latter with axial movement of the former, a casing surrounding the sleeve and shaft and a non-circular guide connected with the casing allowing longitudinal movement of the sleeve without rotation thereof.

8. In a device of the character stated, a casing, a cap for one end of the casing, a flange on the cap, a ring fitting within the cap, a spiraled shaft passing through the cap and ring, a collar upon the shaft, balls on each side of the collar bearing against it and against the cap and ring, a guide at the opposite end of the casing having a non-circular opening, a sleeve passing through the opening, retained against rotation by the guide and adapted to receive the spiraled shaft and devices within the sleeve coöperating with the spiral of the shaft to rotate the shaft with longitudinal movement of the sleeve.

9. In a device of the character stated, a casing, a spiraled shaft fitting within the casing, bearings for the shaft at one end of the casing, a sleeve surrounding the shaft, entering the casing, extending beyond the casing at one end and there supported against rotation, coöperating engaging means between the sleeve and shaft for rotating the shaft with movement of the sleeve longitudinally thereof, a cover for the end of the sleeve and operating means for the sleeve engaging the cover.

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