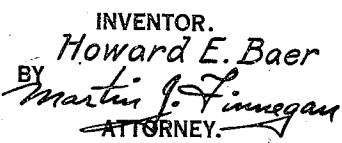


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ENGINE STARTING MECHANISM

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2 Sheets-Sheet 1



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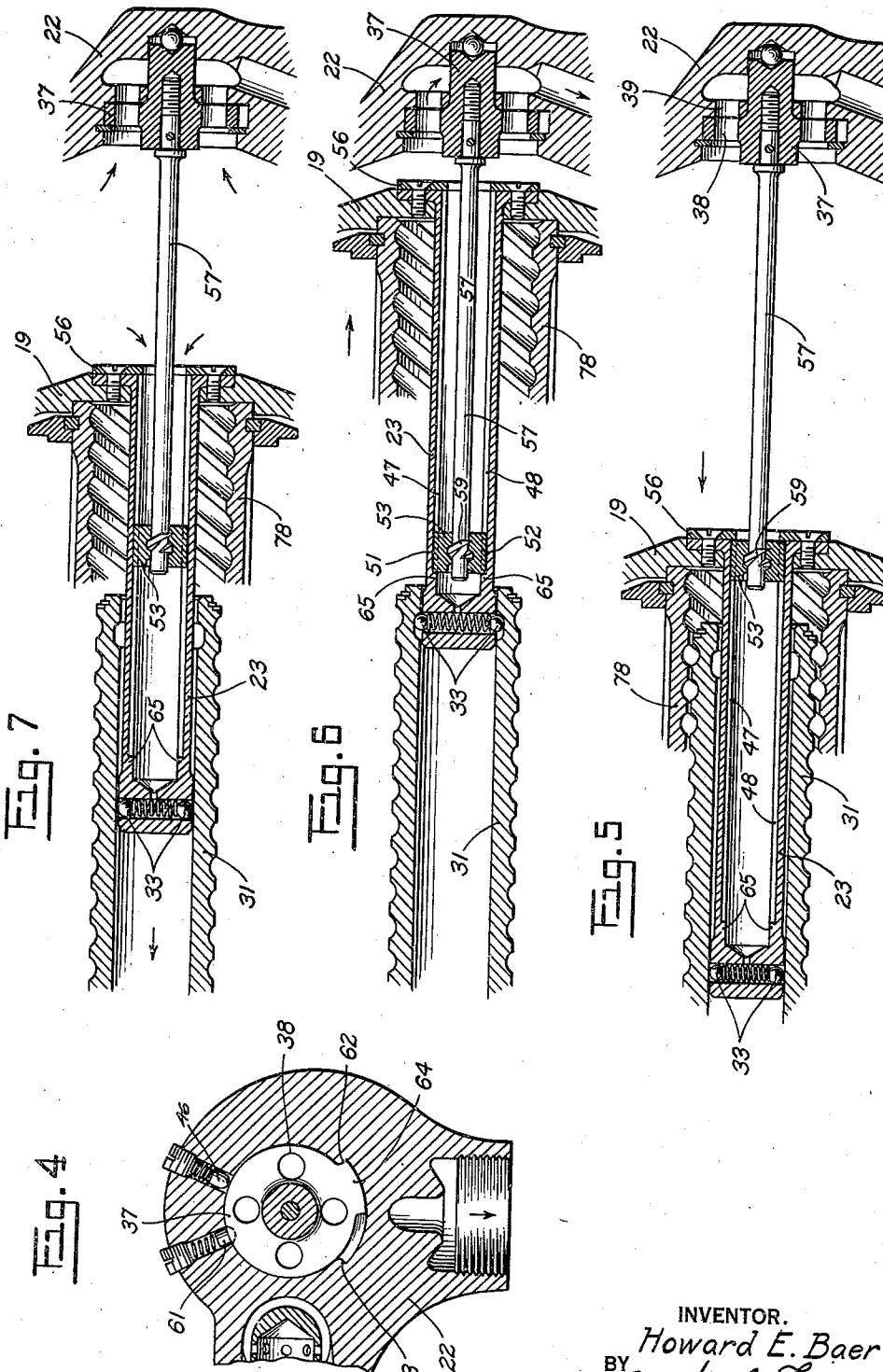
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2,284,358

ENGINE STARTING MECHANISM

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2 Sheets-Sheet 2



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ENGINE STARTING MECHANISM

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6 Claims. (Cl. 121—37)

This invention relates to engine starters adapted for utilizing fluid pressure, as from air pre-compressed into a reservoir or from an explosive cartridge, the fluid pressure being operable upon a confined piston in the illustrated embodiment of the invention.

One of the objects of this invention is to provide a novel method of and means for protecting the starter parts from the adverse effects that might otherwise be produced by a "back-fire," or premature ignition of the engine to be started.

Another object of the invention is to provide a novel valve mechanism and other improvements in the type of engine starter disclosed in Patent No. 2,144,196 granted by the United States Patent Office on January 17, 1939, the nature and scope of which improvements are indicated in the accompanying drawings and the following particular description of one form of mechanism embodying the invention. It is to be understood, however, that the drawings are for the purpose of illustration only, and are not designed as a definition of the limits of the invention, reference being had to the appended claims for this purpose.

In the drawings,

Fig. 1 is a longitudinal sectional view of a device embodying the invention;

Fig. 2 is a transverse sectional view on line 2—2 of Fig. 1;

Fig. 3 is an exploded perspective view of the novel valve and control means therefor;

Fig. 4 is a view similar to Fig. 2, but showing the valve in its other position; and

Figs. 5, 6 and 7 show the valve control means in three positions successively assumed.

Where the engine starter is of the type having a clutch element shiftable along, and rotatable about, the axis of an engine member to be engaged thereby, the housing of the starter will include a part 10 having a circumferential flange 11 for registry with and supported on a mounting flange 12 of the engine crank-case, preferably with the aid of bolts 13. Part 10 also includes a threaded shank 14 to receive cylinder 16 whose inner surface is engaged by the packing rings 17 and skirt 18 of the piston 19 constituting the "part to be moved," and whose outer surface includes a threaded portion 21 to receive the head end 22 of the motor. Integrated with the piston 19 is a long tube 23 which coacts with the assembly (to be described) governing exhaust of pressure fluid from the cylinder 16. Admission of pressure fluid is by way of the tube 26 (Fig. 2) leading from a pressure source and intruding

into chamber 27 of the head 22, from which chamber the fluid passes into working chamber 28 to act upon the piston 19; there being a constantly open passage directly connecting chambers 27 and 28.

Rectilinear travel of piston 19, induced by the pressure of the fluid admitted to chamber 28, causes rotation of the engine-engaging clutch element 29, the translation from rectilinear to rotative movement being brought about through the agency of the inter-engaging screw threads on sleeves 31 and 32 (Fig. 1), the former being advanced longitudinally by the advance of the piston, and the rotation of the sleeve 31 being communicated to the clutch element 29 due to the splined connection 33 therebetween. Spring-pressed balls 34 transmit thrust to sleeve 31, spring 35 and clutch 29 to shift the latter into engagement with engine member 30, to be driven. Following such engagement, which is facilitated by the friction of sealing ring 36 exerted on the outer cylindrical surface of clutch 29, the balls 33 are pressed toward each other by the telescoping action of tube 23 within sleeve 31, caused by the continuing advance of piston 19.

The subsequent exhaust of the fluid from chamber 28 takes place through a valve mechanism of novel construction, and including a rotary head 37 having a number of equally spaced ports 38 adapted to register with an equal number of ports 39 cut through the partition 41 which separates the working chamber 28 from the exhaust chamber 42, feeding exhaust conduit 43; the latter being retained in threaded socket 22a of head 22 by suitable retaining means 25. During admission of fluid to the working chamber 28 (by way of inlet conduit 26 and inlet chamber 27) the valve head 37 is yieldably held (as by spring-pressed detent 46) in the position indicated in Fig. 2, in which position the ports 38 are out of registry with ports 39 and therefore no fluid can escape to the exhaust chamber 42. Registry between ports 38 and 39 is subsequently effected, to permit fluid discharge, by reason of the following valve actuating elements: The tube 23 (heretofore described) is internally splined, at 47 and 48 (see Fig. 3) to receive the splines 51 and 52, respectively, formed on the periphery of a screw-nut 53, and slides upon a screw rod 57 having threads 58 at its rear end, for attachment to the threaded bore of valve head 37, and additional threads 59 near its front end, for coaction with the mating threads cut internally of screw-nut 53. Upon admission of fluid under pressure, said fluid acts to advance piston 19, and

also acts upon member 53, tending to move the latter forward and thus rotate valve rod 57 and valve head 37; but the adjustment of the spring pressure on detent 46 is such that the restraining influence of said detent is just sufficient to resist such turning tendency during normal fluid pressure conditions. When the advance of piston 19 brings the piston-carried collar 56 into engagement with the splines 51 and 52 of screw-nut 53, further advance causes corresponding axial movement of said screw-nut, as shown in Fig. 5. Such axial movement of the screw-nut 53 (rotation being prevented by splines 47, 48) produces a motion translation, by reason of threads 59, resulting in rotation of screw-rod 57. At this time the detent 46 necessarily yields; its resistance being no longer sufficient to prevent rotation of rod 57. This rotation of screw-rod 57 carries the valve head 37 from the angular setting shown in Fig. 2, to a new angular setting as shown in Fig. 4, thereby effecting registry between ports 38 and 39, and opening a path for exhaust of the operating fluid from the working chamber 28. During this exhaust action detent 61 yieldably holds the valve, and the shoulder 62 in head 22 positively prevents over-travel of the valve in one direction, as does shoulder 63 in the opposite direction; both being in the path of valve tail 64.

The return stroke of piston 19 (induced by spring 74 acting through parts 76, 77 and 78) occurs while exhaust valve 37 remains in the open position (Fig. 4); but near the end of said return stroke there is a re-engagement of splines 51 and 52 with the shoulders 65 of splines 47 and 48 (as indicated in Fig. 6) whereupon the final stage of return movement draws screw-nut 53 to the right, as viewed in Fig. 6, and produces a screw action upon screw-rod 57 which rotates said screw-rod (and valve 37, integrated therewith) in a clockwise direction, as viewed in Fig. 4, thereby returning the valve 37 to the closed position, as shown in Fig. 2; all fluid having by this time been discharged. The parts then come to rest in the original position (Fig. 1).

The cycle above described is the normal one by which the engine is successfully cranked. There are occasions, however, when the cranking is interrupted by a premature ignition in one or more cylinders, causing the engine crankshaft to rock in the reverse direction and thereby producing a corresponding reverse rotation of the engine-engaging member 29, and of the starter-driven screw 31 to which said member 29 is splined, as shown at 32. Such reverse rotation will stop the forward movement of the driving screw 78, but as the fluid supplied through conduit 27 will continue to enter the chamber 28, it will steadily increase the pressure therein. Now as this pressure acts not only upon the piston 19, but also upon the right-hand end surface of valve controlling member 53—the fluid having access thereto by reason of the clearance between collar 56 and sleeve 57, as shown best in Fig. 3—the increased pressure thus created upon said right-hand surface will be effective to overcome the restraining effect of yieldable detent 46, and move member 53 to the left, thus producing motion translation to rotate rod 57 in the same manner as it is normally rotated by the engagement of collar 56 with member 53, as above described. Such rotation of rod 57 will open valve 37 and thus the accumulative fluid will be vented to exhaust, thereby preventing an excessive pressure build-up to a dangerous point. Follow-

ing this pressure release, spring 74 will return the piston 19 in the usual manner, thus re-closing valve 37 and conditioning the starter for a new cranking stroke; the reverse rotational impulse of the engine under the "backfire" having in the meantime expended a major portion of its reversely acting force, so that it will be comparatively easy for the starter to resume cranking.

What is claimed is:

1. In an engine starter, in combination, a cylinder and piston, said cylinder constituting a fluid receiving chamber in which said piston moves when subjected to fluid pressure, inlet and exhaust chambers at one end of said cylinder, said inlet chamber having constant communication with said fluid receiving chamber, rotary valve means normally preventing communication between said fluid receiving chamber and said exhaust chamber, and valve opening means responsive to fluid pressure of abnormal magnitude to rotate said valve means to a position establishing communication between said fluid receiving chamber and said exhaust chamber.

2. In an engine starter, in combination, a cylinder and piston, said cylinder constituting a fluid receiving chamber in which said piston moves when subjected to fluid pressure, inlet and exhaust chambers at one end of said cylinder, said inlet chamber having constant communication with said fluid receiving chamber, rotary valve means normally preventing communication between said fluid receiving chamber and said exhaust chamber, valve opening means to rotate said valve means to a position establishing communication between said fluid receiving chamber and said exhaust chamber, and piston-carried means engageable with said valve opening means to cause the latter to open said valve means when the piston reaches a predetermined position in its movement in said cylinder.

3. In an engine starter, in combination, a cylinder and piston, said cylinder constituting a fluid receiving chamber in which said piston moves when subjected to fluid pressure, inlet and exhaust chambers at one end of said cylinder, said inlet chamber having constant communication with said fluid receiving chamber, rotary valve means normally preventing communication between said fluid receiving chamber and said exhaust chamber, valve opening means responsive to fluid pressure of abnormal magnitude to rotate said valve means to a position establishing communication between said fluid receiving chamber and said exhaust chamber, and piston-carried means engageable with said valve opening means to cause the latter to open said valve means when the piston reaches a predetermined position in its movement in said cylinder, independently of the degree of fluid pressure then existing.

4. In an engine starter, in combination, a cylinder and piston, said cylinder constituting a fluid receiving chamber in which said piston moves when subjected to fluid pressure, inlet and exhaust chambers at one end of said cylinder, said inlet chamber having constant communication with said fluid receiving chamber, valve means normally preventing communication between said fluid receiving chamber and said exhaust chamber, valve opening means responsive to fluid pressure of abnormal magnitude to shift said valve means to a position establishing communication between said fluid re-

ceiving chamber and said exhaust chamber, and piston-carried means engageable with said valve opening means to cause the latter to open said valve means when the piston reaches a predetermined position in its movement in said cylinder, independently of the degree of fluid pressure then existing.

5. In an engine starter, in combination, a cylinder and piston, said cylinder constituting a fluid receiving chamber in which said piston moves when subjected to fluid pressure, inlet and exhaust chambers at one end of said cylinder, said inlet chamber having constant communication with said fluid receiving chamber, valve means normally preventing communication between said fluid receiving chamber and said exhaust chamber, valve opening means responsive to fluid pressure of abnormal magnitude to shift said valve means to a position establishing communication between said fluid receiving chamber and said exhaust chamber, piston-carried means engageable with said valve opening means to cause the latter to open said valve means when the piston reaches a predetermined position in its movement in said cylinder, independently of the degree of fluid pressure then existing, and

means for returning said piston to its initial position in said cylinder, said piston-carried means being operative, during such return movement, to reclose said valve means.

6. In an engine starter, in combination, a cylinder and piston, said cylinder constituting a fluid receiving chamber in which said piston moves when subjected to fluid pressure, inlet and exhaust chambers for said cylinder, said inlet chamber having constant communication with said fluid receiving chamber, valve means normally preventing communication between said fluid receiving chamber and said exhaust chamber, to shift said valve means to a position establishing communication between said fluid receiving chamber and said exhaust chamber, reciprocable means engageable with said valve shifting means to cause the latter to open said valve means when the piston reaches a predetermined position in its movement in said cylinder, independently of the degree of fluid pressure then existing, and means for returning said piston to its initial position in said cylinder, said reciprocable means being operative, during such return movement, to re-close said valve means.

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