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MEANS FOR STARTING AND REVERSING INTERNAL COMBUSTION ENGINES.

APPLICATION FILED NOV. 20, 1918.

1,298,455. Patented Mar. 25, 1919.

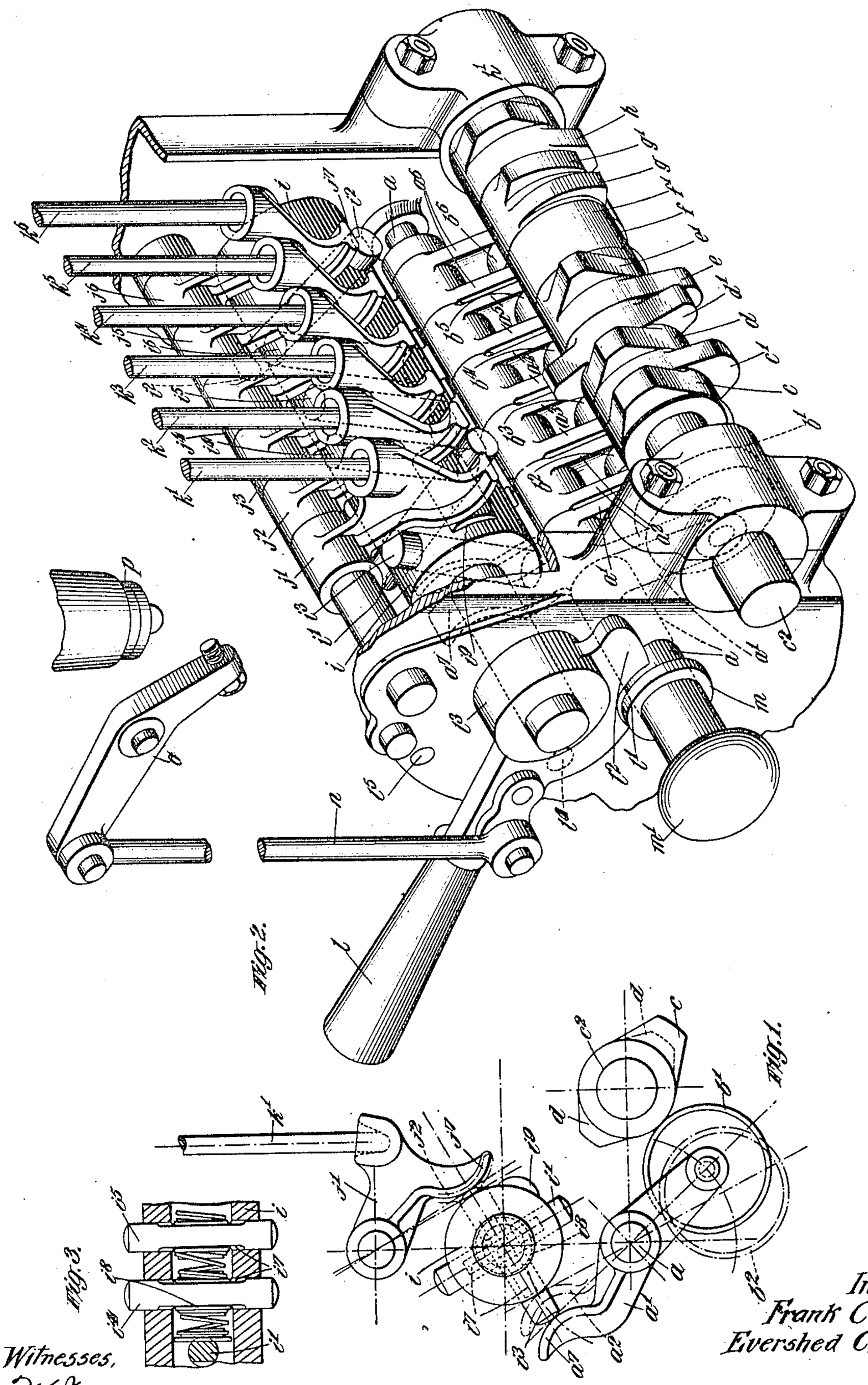

Fig. 2.

Fig. 3.

Fig. 1.

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MEANS FOR STARTING AND REVERSING INTERNAL-COMBUSTION ENGINES.

1,298,455. Specification of Letters Patent. Patented Mar. 25, 1919.

Application filed November 20, 1918. Serial No. 263,300.

To all whom it may concern:

Be it known that we, FRANK CARTER and EVERSHED CARTER, subjects of the King of Great Britain, and both residents of Stamford, in the county of Lincoln, England, have invented a new and useful Improvement in Means for Starting and Reversing Internal-Combustion Engines, of which the following is a specification.

Our invention relates to internal combustion engines of the kind using compressed air for starting, and in which during starting the engine works on a two-stroke cycle, and then is changed over to a four-stroke cycle, and the said invention has for its object the provision of simple and efficient means for starting and for reversing such engines.

According to our invention we provide a double set of levers, the first set being operated by means of cams in the usual manner. The second set which actuates the various valves, fuel pump and the like are operated from the first set by a series of plungers or distance pieces. These plungers are arranged in two sets, the one appropriate for operating the valves for starting the engine and the other for operating the valves for working after the change over to the four-stroke cycle has been made.

The plungers are conveniently mounted in a rock shaft, at right angles to the axis of said shaft, one set being arranged at a suitable angle to the other set, in such a manner that by turning the rock shaft either set can be brought to the operative position, or the rock shaft can be turned to a neutral position in which neither set of plungers is operative.

When it is desired to provide for starting the engine in either direction, two sets of operating cams are used and means are provided for moving the cam bowls out of the path of one set into the path of the other set. Cams may also be fixed on the rock shaft to hold the exhaust valve or valves open, when the rock shaft is turned to bring both sets of plungers in the intermediate inoperative or neutral position.

The accompanying drawings illustrate the invention:—

Figure 1 is an end view of a valve gear, showing our invention applied to the starting and running cams of one of the valves of an engine.

Fig. 2 is an isometrical view of our valve gear applied to a single cylinder engine of the Diesel or semi-Diesel type, starting on compressed air admitted at every out stroke and then subsequently working on the four-stroke cycle.

Fig. 3 is a sectional view illustrating a detail.

a^1, a^2, a^3, a^4, a^5, a^6 is a series of levers pivoted on a fulcrum shaft a and carrying bowls b^1, b^2, b^3, b^4, b^5, b^6 adapted to be actuated by the cams c, c'; d, d'; e, e'; f, f'; g, g'; h, h' on the cam shaft c^2 which revolves at half the crankshaft speed.

The cams c, d, e, f, g, h are for forward running and the cams c', d', e', f', g', h' for backward running. i is a rock shaft carrying the starting plungers i^1, i^2 and the running plungers i^3, i^4, i^5, i^6.

The rock shaft is hollow and the plungers have flats i^7 formed on them against which press spring washers i^8, Fig. 3, arranged between the plungers in order to hold them in position, and prevent them dropping out.

i^9 is a cam on the rock shaft for holding the exhaust valve open when the shaft is neutral, *i. e.*, with both sets of plungers out of action. j^1, j^2, j^3, j^4, j^5, j^6 is a second series of levers operated by the plungers, and actuating the push rods k^1, k^2 for the exhaust valve, and k^3, k^4, k^5, k^6 for the working air valve, the fuel injecting air valve, the fuel pump, and the starting air valve respectively. l is a handle for turning the rock shaft, shown in the neutral position in Fig. 2, and m is a retaining collar on the fulcrum shaft a which, when the handle l is neutral, is adapted to pass by a recess l' in the flange l^2 on the rock shaft lever boss l^3 allowing the fulcrum shaft a with its levers to be moved to the right or left by means of the knob m'. The flange l^2 retains the shaft and levers in position when the lever l is moved out of neutral. A catch, not shown, in the handle l engages a hole l^4 for holding the rock shaft in its start position, or a hole l^5 for holding it in the running position. n is a rod connecting the handle l with a lever o which, when the handle is in its lower position, holds open the control valve p for admitting compressed air to the cylinder starting valve.

The series of levers operated by the cams is so constructed that the cam bowls fall away from the cam shaft of their own

weight when the rock shaft is neutral so as to allow them to be moved axially clear of the cams. Both sets of levers are formed with curved faces a^7, j^7, and the plungers have rounded ends to give them a lead when the rock shaft is moved into the start or work positions. The curved faces a^7, j^7 are wide enough to engage the plungers with the levers in either position.

What we claim is:—

1. In a valve gear for internal combustion engines of the kind specified, the combination of a series of cam-operated levers, a series of cams for operating the levers, a second series of levers actuated from the first series by plungers, said plungers, and means for moving the plungers in and out of engagement with the levers.

2. In a valve gear for internal combustion engines of the kind specified, the combination of a series of cam-operated levers, a series of cams for operating the levers, a second series of levers actuated from the first series by plungers, said plungers, a rock shaft carrying said plungers, and means for turning the rock shaft to move the plungers in and out of engagement with the levers.

3. In a valve gear for internal combustion engines of the kind specified, the combination of a series of cam-operated levers, a series of cams for operating the levers, a second series of levers actuated from the first series, a rock shaft, two sets of plungers passing transversely through the rock shaft, one set being arranged at an angle to the other set, and means for turning the rock shaft to bring either set of plungers in line with the two series of levers to form the operative connection between said two series of levers, or to arrange the plungers so that neither set is in the operative position.

4. In a valve gear for internal combustion engines of the kind specified, the combination of a series of cam-operated levers, a series of cams for operating the levers, a second series of levers actuated from the first series, a rock shaft, two sets of plungers passing transversely through the rock shaft, one set being arranged at an angle to the other set, and means for turning the rock shaft to bring either set of plungers in line with the two series of levers to form the operative connection between said two series of levers, or to arrange the plungers so that neither set is in the operative position, and a cam on the rock shaft serving to hold up the lever that controls the exhaust valve when the plungers are in the neutral position.

5. In a valve gear for internal combustion engines of the kind specified, the combination of a series of cam-operated levers, a series of cams for operating the levers, a second series of levers actuated from the first series, a rock shaft, two sets of plungers passing transversely through the rock shaft, one set being arranged at an angle to the other set, means for turning the rock shaft to bring either set of plungers in line with the two series of levers to form the operative connection between said two series of levers, or to arrange the plungers so that neither set is in the operative position, a double set of cams for operating the first series of levers, and means for sliding said cam-operated levers laterally to bring them into position for operation by either set of cams.

6. In a valve gear for internal combustion engines of the kind specified, the combination of a series of cam-operated levers, a series of cams for operating the levers, a second series of levers actuated from the first series, a rock shaft, two sets of plungers passing transversely through the rock shaft, one set being arranged at an angle to the other set, means for turning the rock shaft to bring either set of plungers in line with the two series of levers to form the operative connection between said two series of levers, or to arrange the plungers so that neither set is in the operative position, a double set of cams for operating the first series of levers, means for sliding said cam-operated levers laterally to bring them into position for operation by either set of cams, and means for retaining the cam-operated levers in either position to which they have been moved.

7. In a valve gear for internal combustion engines of the kind specified, the combination of a series of cam-operated levers, a series of cams for operating the levers, a second series of levers actuated from the first series, a rock shaft, two sets of plungers passing transversely through the rock shaft, one set being arranged at an angle to the other set, means for turning the rock shaft to bring either set of plungers in line with the two series of levers to form the operative connection between said two series of levers, or to arrange the plungers so that neither set is in the operative position, a starting air control valve, and means connected with the rock shaft for operating said air control valve when the rock shaft is turned.

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