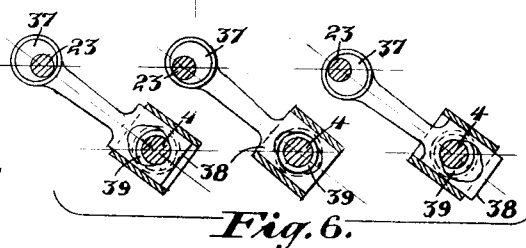
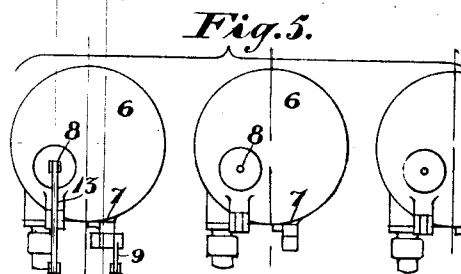
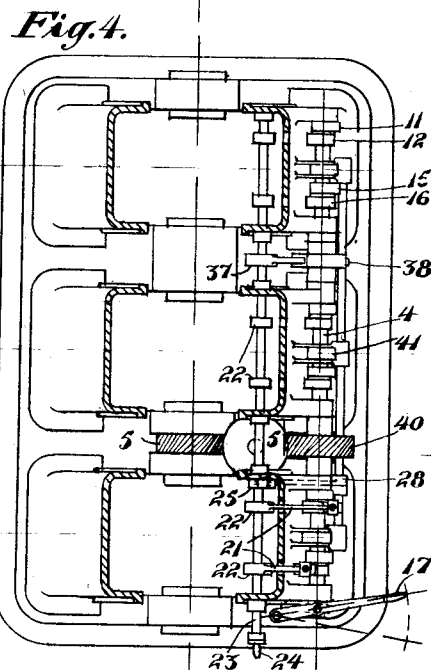
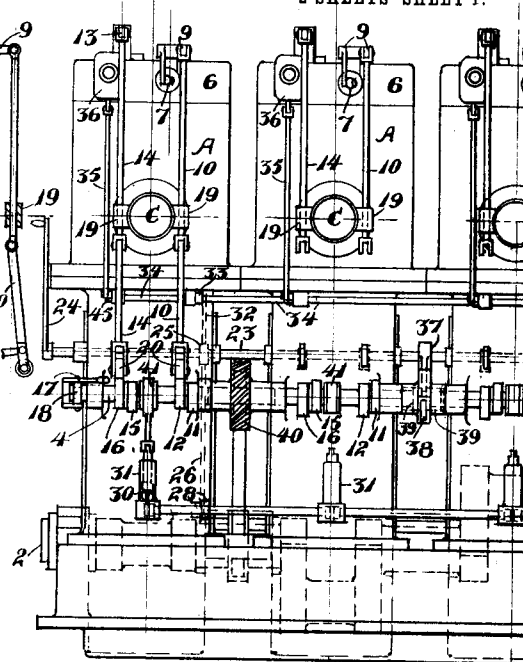
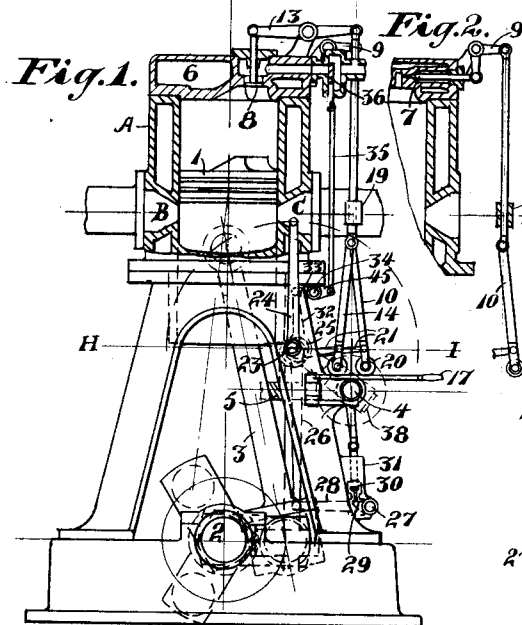


J. HAUG.
 STARTING AND REVERSING APPARATUS FOR INTERNAL COMBUSTION ENGINES.
 APPLICATION FILED JULY 12, 1911.
 1,066,108. Patented July 1, 1913.

2 SHEETS—SHEET 1.



WITNESSES

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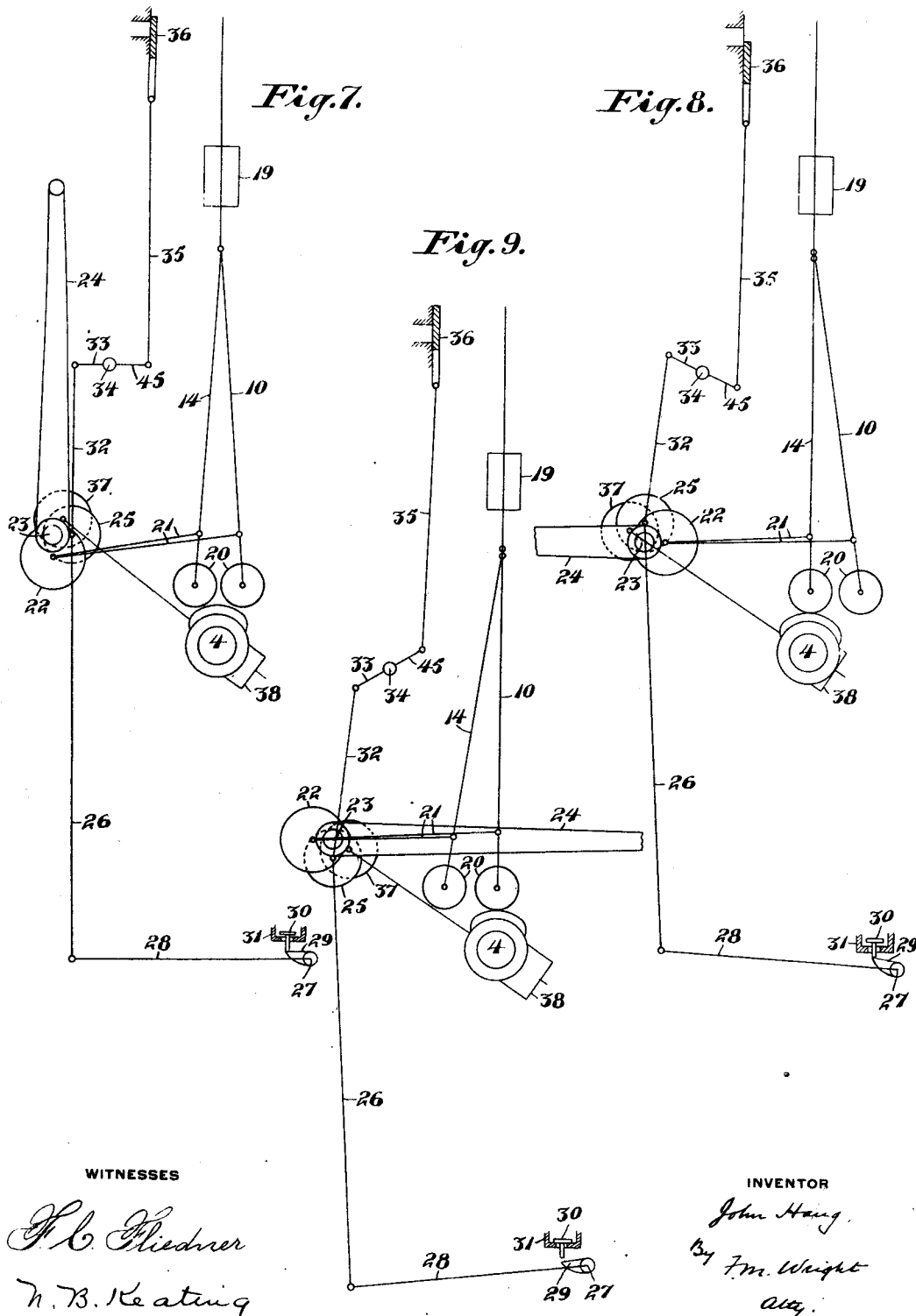
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2 SHEETS—SHEET 2.



UNITED STATES PATENT OFFICE.

JOHN HAUG, OF BERKELEY, CALIFORNIA.

STARTING AND REVERSING APPARATUS FOR INTERNAL-COMBUSTION ENGINES.

1,066,108.

Specification of Letters Patent.

Patented July 1, 1913.

Application filed July 12, 1911. Serial No. 638,136.

To all whom it may concern:

Be it known that I, JOHN HAUG, a citizen of the United States, residing at Berkeley, in the county of Alameda and State of California, have invented new and useful Improvements in Starting and Reversing Apparatus for Internal-Combustion Engines, of which the following is a specification.

The object of the present invention is to provide a means for starting, reversing, and operating an internal combustion engine which will be simple, reliable and direct, and which will dispense with the necessity of employing for such purposes special maneuvering cylinders or gear wheels.

In the accompanying drawing, Figure 1 is a front view, partly in section, of a portion of an internal combustion engine of the two-cycle type, constructed in accordance with my invention; Fig. 2 is a broken vertical cross-section through the fuel valve; Fig. 3 is a side view of a portion of said engine; Fig. 4 is a horizontal section thereof on the line H—I of Fig. 1; Fig. 5 is a plan view, showing the cylinder covers; Fig. 6 shows details of locking device for cam shaft; Fig. 7 is a diagrammatic view of the valve gear as shown in Fig. 1, in its mid-way position; Fig. 8 is a similar view when starting with compressed air; Fig. 9 is a similar view when continuing the motion of engine with oil fuel.

Referring to the drawings, A indicates a cylinder of usual construction having an exhaust opening B, and admission port C for low pressure air, to clean out the exhaust gases, and provide air for the next power stroke.

1 indicates the trunk piston in the usual way joined to the crank shaft 2 by a connecting rod 3.

4 indicates the cam shaft driven from the crank shaft 2 by suitable gearing 5 and having for each cylinder four cams, namely, a cam 11 for operating the fuel valve when going ahead, a cam 12 for operating the same when going back, a cam 15 for starting ahead with compressed air, and a cam 16 for starting back with the same.

The low pressure and high pressure air compressors usually required for this type of engine are not shown as they can be of the ordinary construction, driven either by the main engine or by an independent motor.

Each cylinder cover 6 is provided with a

fuel oil valve 7, and an air starting valve 8, all being of the ordinary construction. The fuel oil valve is operated by a bell crank lever 9, a rod 10 and a cam 11 or cam 12 for going ahead or back respectively. The air starting valve 8 is operated by a lever 13, a rod 14 and a cam 15 or cam 16 for going ahead or back respectively. The lever 17, by means of the collar 18, shifts the cam shaft to bring on to the valve rods 10, 14 those cams which are to govern the direction or motion.

The valve rods 10 and 14 have guides 19, and are jointed just below them, their lower ends have rollers 20 to engage the cams constituting controlling devices for the valve, and they are attached by shifting means, as rods 21 to eccentrics 22 on a shifting shaft 23 which can be turned by a hand lever 24. The shaft 23 has another eccentric 25, the lower portion of which is connected by a rod 26 and arm 28 to a shaft 27, which by means of an arm 29, regulates the suction valve 30 of the corresponding fuel oil pump 31, while the upper portion of said eccentric 25 is connected by a rod 32 and arm 33 to a shaft 34, said shaft being connected by arms 45 and rods 35 with the compressed air valves 36, these connections being so arranged that, when the fuel pump is operating, compressed air is shut off, and conversely. Another eccentric 37 on the shaft 23 moves a slide 38, shown in detail in three different positions in Fig. 6, which slides between collars 39 on the cam shaft 4, so constructed as to permit lateral shifting of the cam shaft for reversing only when the hand lever 24 is in mid gear. All rollers on ends of valve rods are then clear of cams and both air and fuel valves are shut off. This position is shown in Figs. 1 and 7.

Fig. 8 is a diagrammatic view showing the position of the valve mechanism, when starting ahead on compressed air. At that time the valve 8 is opened, and the lever 13, the rod 14 and the cam 15 will keep it open until at the passage of an adjacent piston past its upper center, the latter receives a supply of compressed air to continue the motion. Whenever it is desired to use oil, the hand lever 24 is thrown over 180 degrees to the right, as in Fig. 9, closing, by means of the eccentric 25, rod 32, arm 33, shaft 34, arm 45, and rod 35, the air valves 36, and, at the same time, by means of a rod 26, arm 28, shaft 27, and arm 29, letting down the suc-

tion valve of the oil pump 31, which will set the pump working. At the same time the rod 14 is moved away from the cam 15 and the rod 10 is placed over the cam 11 which will then, at the proper time, open the fuel valve.

When it is desired to reverse the engine the hand lever 24 is placed in mid-gear as shown in Figs. 1 and 7, both air and fuel are cut off by the gear connected to the eccentric 25, while the rods 10 and 14 are held clear of cams. The slide 38 is now in a position, as shown in the central position of Fig. 6, to permit the collars 39 on the cam shaft to pass through the opening in said slide. Consequently the cam shaft can be shifted by the lever 17 so that the cams 12 and 16 are brought under the rods 10 and 14. The hand lever 24 is now turned through 90° to the left, bringing the rod 14 to its cam, and the eccentric 25 will open the air supply, and by lifting the suction valve of the oil pump, put the pump out of action. The engine will now start back with compressed air, the parts being in the position shown in Fig. 8. When it is desired to operate with oil the hand lever 24 is thrown 180° to the right, cutting off the air valves 36, letting down the suction valves of the oil pumps and putting the latter to work, also shown in Fig. 9.

By giving the hand lever 24 a range of 180° considerable leverage is secured for working the gear, and side strains due to cams working against rollers on the ends of the valve rods are taken direct by the shaft 23, thus avoiding all tendency to lateral vibrations of the valve rods. The gear wheel 40, and the eccentrics 41 for operating the oil pumps, are fitted between bearings which hold them laterally whenever the cam shaft is shifted.

In constructing engines with the above described improvements not less than three cylinders, on cranks 120° apart, should be used, to secure a balance of the working parts. If the cams 15 and 16 be given lifting faces of from 130° to 140°, the engine could be started by compressed air in any position. With an engine of four cylinders and cranks 90° apart, cams having lifting faces of 100° would be sufficient, and with a still greater number of cylinders the maneuvering ability would be still further improved.

In this construction a moderate amount only of high pressure starting air is required, as each cylinder takes its usual supply of low pressure air through the port C when the piston is at the bottom, which is then compressed in the usual manner when the piston comes to the top, and sufficient high pressure air is required only to overcome friction, inertia, and compression in the succeeding cylinders.

I claim:—

1. In an engine having internal combustion cylinders, a shaft, means for supplying fuel to said engine, a valve for controlling said fuel supply, means for supplying compressed air to start said engine, and a valve for controlling said compressed air supply, a cam shaft having an operative connection with said shaft, cams on said latter shaft, and independent devices operable by said cams for controlling said valves, the combination therewith of a shifting shaft, means for rocking said shifting shaft, and operative connections from said shifting shaft to said independent devices operable in unison to shift one of said independent devices into a position wherein it can be operated by a cam in the rotation of the cam shaft and the other of said independent devices into a position wherein it can not be so operated.

2. In an engine having internal combustion cylinders, a shaft, means for admitting fuel and compressed air to said cylinders, valves for controlling respectively the passage of the fuel and the compressed air, a cam shaft operatively connected to the shaft of the engine, and devices operable by said cam shaft for controlling the respective valves, the combination therewith of means for shifting either of said devices into a position to be operated by said cam shaft and the other of said devices into a position in which it can not be so operated.

3. In an engine having internal combustion cylinders, a shaft, means for admitting fuel and compressed air to said cylinders, valves for controlling respectively the passage of the fuel and the compressed air, and devices for controlling said valves, a cam shaft operatively connected to the shaft of the engine, and cams thereon, the combination therewith of means for simultaneously shifting either of said controlling devices into a position to be operated by a cam in the rotation of said cam shaft and the other into a position in which it can not be so operated, said means being also operative to shift each of said devices into a position in which it can not be so operated.

4. In an engine having a plurality of internal combustion cylinders, a shaft, means for supplying fuel and compressed air to said cylinders, valves for controlling the passage of said fluids, and devices for controlling said valves, the combination of independent means for shifting said controlling devices, a longitudinally movable cam shaft operatively connected with said engine shaft, and having thereon for each cylinder a plurality of cams, said cams in longitudinally different positions of said cam shaft being each adapted by the rotation of the cam shaft to actuate a controlling device of the corresponding cylinder, and means for shifting simultaneously said con-

trolling devices, whereby either controlling device is brought into a position to be so actuated and the other out of such position.

5 In an engine having a plurality of internal combustion cylinders, a shaft, means for supplying fuel and compressed air to said cylinders, valves for controlling the passage of said fluids, and devices for controlling said valves, the combination of independent means for shifting said controlling devices, a longitudinally movable cam shaft operatively connected with said engine shaft, and having thereon for each cylinder a plurality of cams, said cams in 10 longitudinally different positions of said cam shaft being each adapted by the rotation of the cam shaft to actuate a controlling device of the corresponding cylinder, means for moving simultaneously said shifting means, whereby either of said controlling devices is brought into a position to be so actuated and the other out of such position, said latter means being capable of moving said shifting means into intermediate 15 positions in which neither of said controlling devices can be so actuated, a device for preventing said shaft being moved longitudinally, and means for rendering said device inoperative, automatically moved into its operative position when said shifting means are both moved into said intermediate positions.

6. In an engine having internal combustion cylinders, a shaft, and means for supplying fluid fuel and compressed air to said cylinders, valves for controlling respectively said latter means, devices for controlling said valves, independent means for shifting said controlling devices, a cam shaft operatively connected with the engine shaft and having cams thereon corresponding to the several cylinders and adapted to actuate said controlling devices, a shaft, means connecting said latter shaft with said controlling devices whereby said controlling devices may be simultaneously moved, one of them into a position to be actuated by the corresponding cam in the rotation of the cam shaft and the other out of such position, a fluid fuel pump, a valve controlling the same, and means operatively connected with said second named shaft whereby, when the device for controlling the fluid fuel supply valve is actuated to open said valve, said fluid fuel pump valve is also made operative, 25 and whereby the latter is made inoperative when the former is closed.

7. In an engine having internal combustion cylinders, a shaft, and means for supplying fluid fuel and compressed air to said cylinders and adapted to actuate said controlling means, devices for controlling said valves, independent means for shifting said controlling devices, a cam shaft operatively connected with the engine shaft and having cams thereon corresponding to the several cylinders and adapted to actuate said controlling devices, a shifting shaft, means connecting said shifting shaft with said shifting means whereby said controlling devices may be simultaneously moved, one of them into a position to be actuated by the corresponding cams in the rotation of the shaft and the other out of such position, a compressed air supply, a valve controlling the same, and means operatively connected with said shifting shaft, whereby, when the device for controlling the fluid fuel supply valve is actuated to open said valve, said compressed air valve is also made operative, and whereby the latter is made inoperative when the former is closed.

8. In an engine having internal combustion cylinders, a shaft, and means for supplying fluid fuel and compressed air to said cylinders, valves for controlling respectively said latter means, devices for controlling said valves, independent devices for shifting said controlling devices, a cam shaft operatively connected with the engine shaft and having cams thereon corresponding to the several cylinders and adapted to actuate said controlling devices, a shifting shaft, means connecting said shifting shaft with said shifting means whereby said controlling devices may be simultaneously moved, one of them into a position to be actuated by the corresponding cam in the rotation of the shaft and the other out of such position. a fluid fuel pump, a valve controlling the same, and means operatively connected with said shifting shaft whereby, when the devices for controlling the fluid fuel supply valve is actuated to open said valve, said fluid fuel pump valve is made operative, and the compressed air supply valve is made inoperative.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

JOHN HAUG.

Witnesses:

F. M. WRIGHT,
D. B. RICHARDS.