Sept. 25, 1956 V. J. CRIMI 2,764,134

UNITARY INTERNAL COMBUSTION ENGINE

Filed Feb. 12, 1954

3 Sheets-Sheet 1

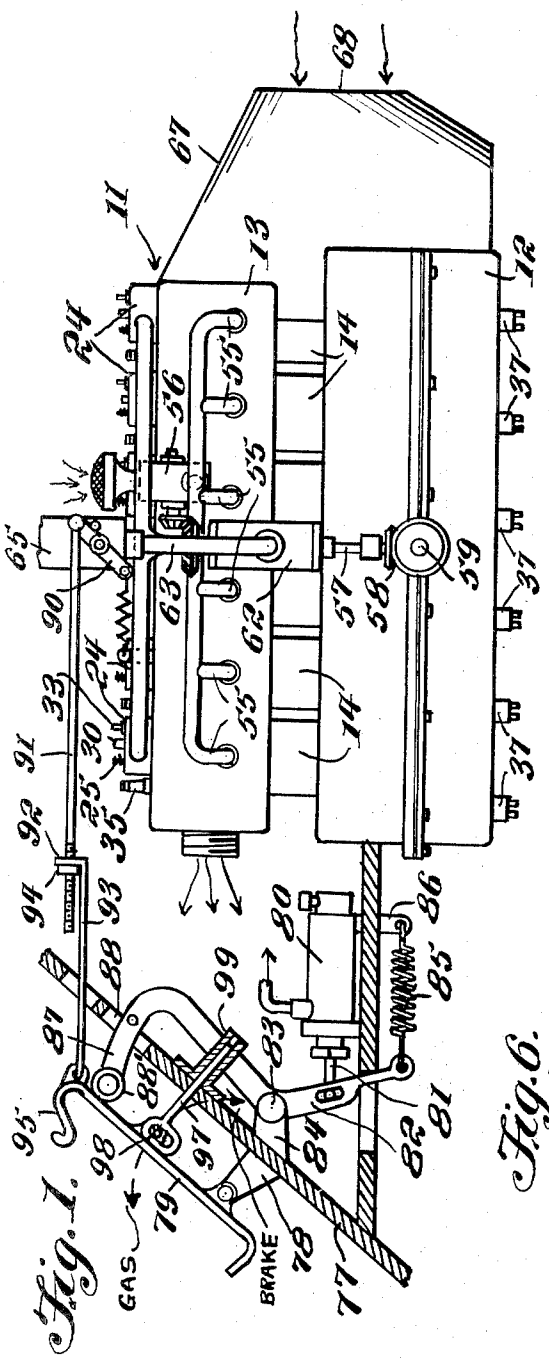


Fig. 1.

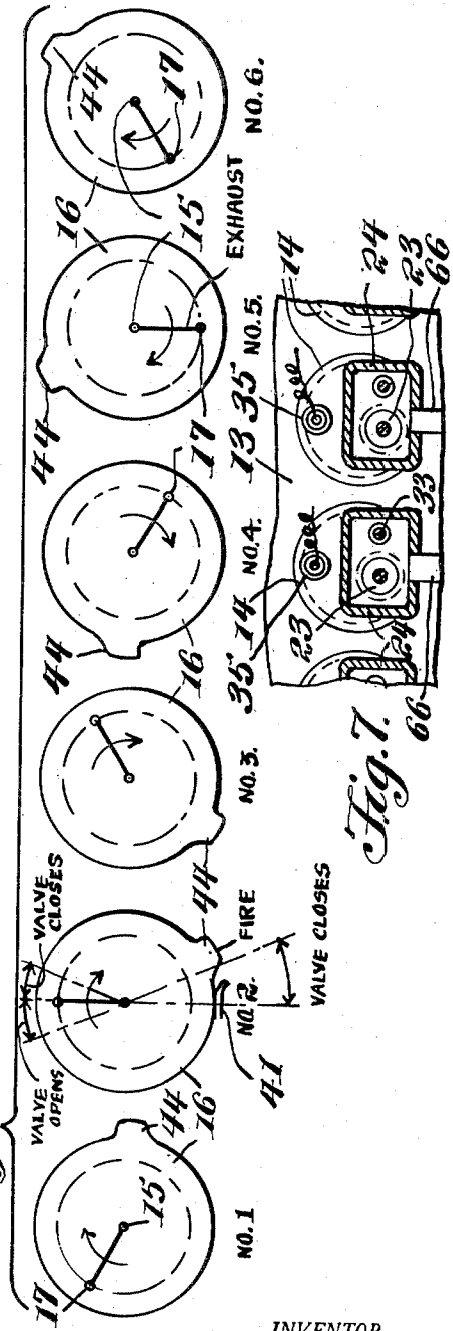


Fig. 6.

Fig. 7.

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3 Sheets-Sheet 2

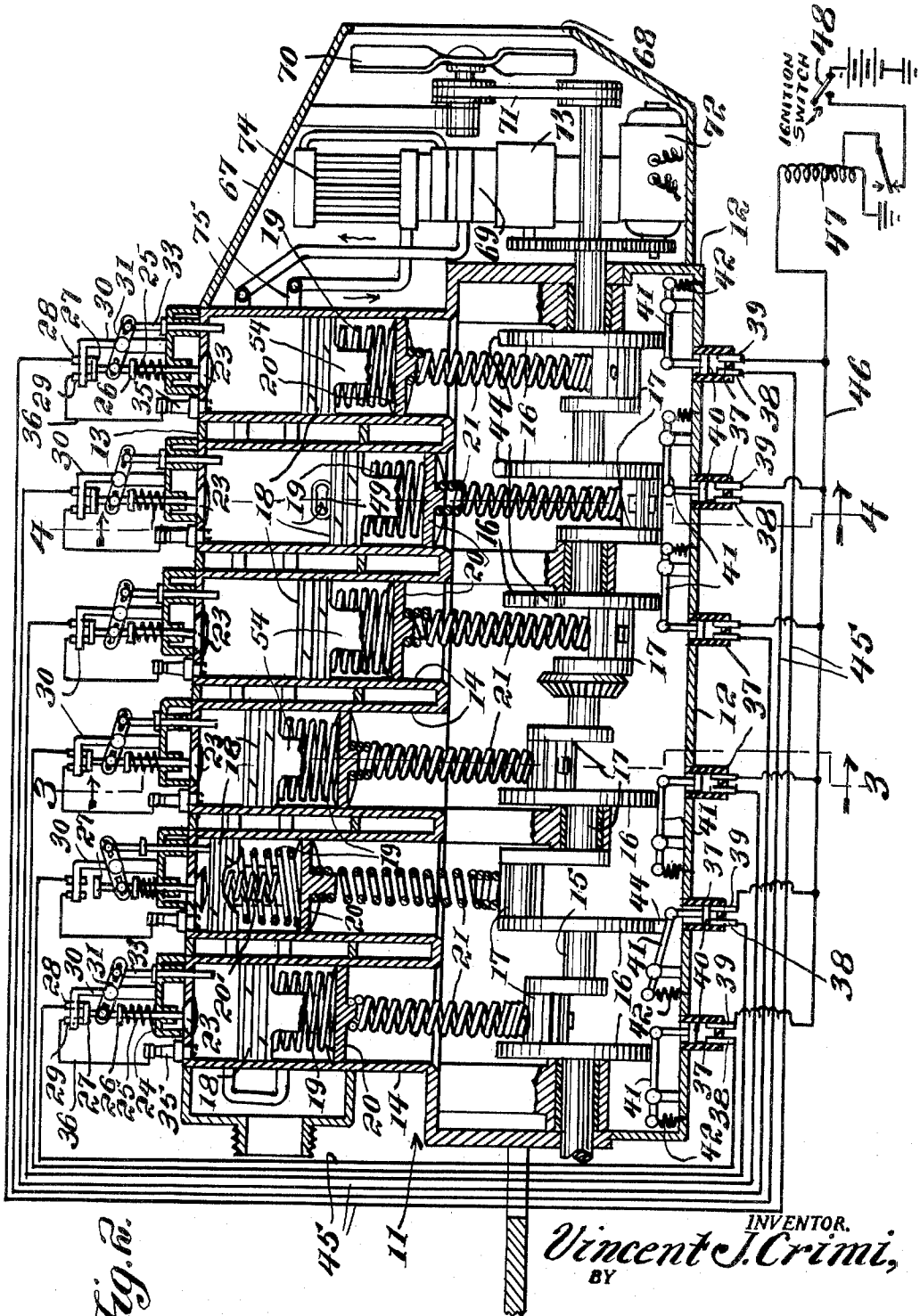


Fig. 2.

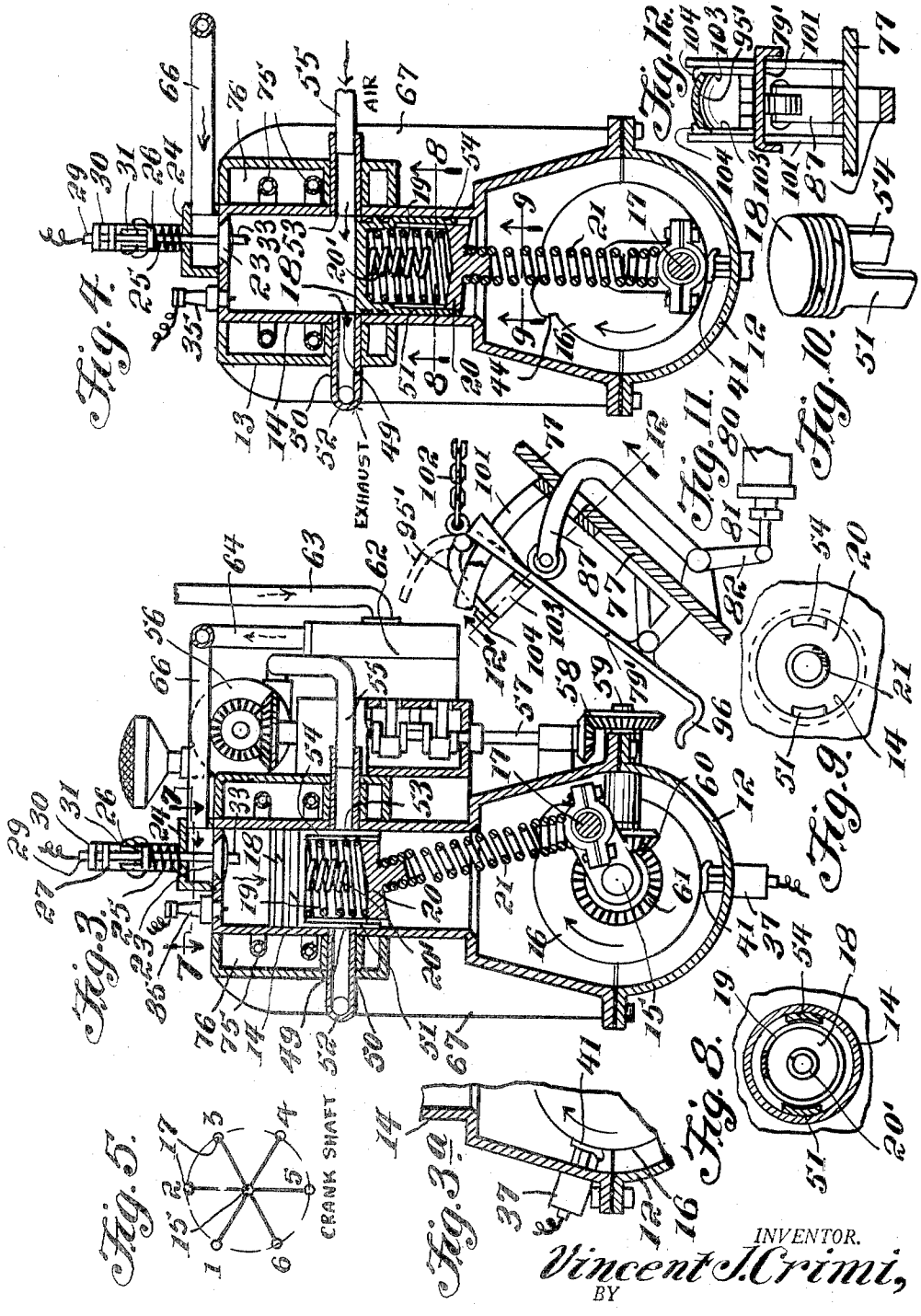
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United States Patent Office

2,764,134

Patented Sept. 25, 1956

2,764,134

UNITARY INTERNAL COMBUSTION ENGINE

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Application February 12, 1954, Serial No. 409,840

3 Claims. (Cl. 121—117)

This invention relates to internal combustion engines, and more particularly to an improved motor vehicle internal combustion engine.

A main object of the invention is to provide a novel and improved unitary internal combustion engine for a vehicle, said engine being relatively simple in construction, being compact in size, and eliminating the necessity of employing external accessory items, such as a radiator, a distributor, a starting motor, a timing chain, a cam shaft, a flywheel, exhaust valves, a water pump, automatic drive and clutch devices, separate brake and accelerator pedals, wrist pins, and other items now employed on conventional motor vehicles.

A further object of the invention is to provide an improved unitary internal combustion engine for a motor vehicle, said engine being arranged to be controlled by the brake pedal of the vehicle, the engine providing safer driving, longer life, more economical fuel and gas consumption, and lower maintenance expenses than the internal combustion engine and associated items now employed on conventional motor vehicles.

A further object of the invention is to provide an improved unitary internal combustion engine for motor vehicles, said engine being easy to start, being reliable in operation, and being arranged for control by the brake pedal of the motor vehicle in which it is installed so that a separate accelerator pedal is not required.

A still further object of the invention is to provide an improved unitary internal combustion engine particularly suitable for use in motor vehicles, said engine being characterized by the absence of wrist pins and employing resilient connections between the pistons and the crank shaft, whereby smooth performance of the engine is obtained over a wide range of loading conditions, the engine being further arranged so that at least one cylinder thereof is always in a firing position, whereby the engine may be started by merely providing a spark at the spark plug of said one cylinder, thus eliminating the necessity for a starting motor, the engine being further arranged so that the admisstion of fuel into the cylinders is controlled by means for closing the ignition circuits of the respective cylinders, and this means is further controlled by the movement of the pistons in the cylinders, the ignition circuits being additionally controlled by movements of the crank shaft of the engine.

Further objects and advantages of the invention will become apparent from the following description and claims, and from the accompanying drawings, wherein:

Figure 1 is a side elevational view of an improved unitary internal combustion engine according to the present invention, shown installed in a motor vehicle, illustrating the connection of the carburetor throttle to the brake pedal of the vehicle, whereby the throttle may be controlled by movement of the pedal in one direction and the brakes may be controlled by movement of the same pedal in the opposite direction.

Figure 2 is an enlarged longitudinal vertical cross sectional view taken through the engine shown in Figure 1.

Figure 3 is a vertical transverse cross sectional view taken on the line 3—3 of Figure 2.

Figure 3*a* is a fragmentary horizontal cross sectional detail view showing an alternative location of the spark plugs in the cylinder block, in accordance with the present invention.

Figure 4 is a vertical transverse cross sectional view taken on the line 4—4 of Figure 2.

Figure 5 is a diagram illustrating the angular separation of the respective cranks associated with the respective cylinders and illustrating the firing sequence of the engine of Figures 1 to 4.

Figure 6 is a schematic view illustrating the relative positions of the respective crank discs associated with the respective cylinders of the engine of Figures 1 to 4 and showing the angular spacing of the respective firing lugs on the crank discs.

Figure 7 is a horizontal fragmentary cross sectional detail view taken on the line 7—7 of Figure 3.

Figure 8 is a cross sectional detail view taken on the line 8—8 of Figure 4.

Figure 9 is a cross sectional detail view taken on the line 9—9 of Figure 4.

Figure 10 is a perspective view of one of the pistons employed in the engine of Figures 1 to 9.

Figure 11 is a vertical cross sectional view taken longitudinally through the vehicle floor board and showing a modified form of control pedal which may be employed with the engine of the present invention and which forms a part of the invention.

Figure 12 is a cross sectional view taken on the line 12—12 of Figure 11.

Referring to the drawings, and more particularly to Figures 1 to 10, 11 generally designates an internal combustion engine which comprises a crankcase 12 and a cylinder block 13 located above the crankcase and connected therto by the vertically arranged cylinders 14.

Journaled longitudinally in the crankcase 12 is the crankshaft 15, said crankshaft being provided with the spaced crank discs 16, each disc 16 being associated with and being located beneath a respective cylinder 14, each disc 16 being associated with a respective crank 17 provided on the crankshaft 15, the crank 17 being located beneath the respective cylinder with which the disc 16 is associated. Slidably disposed in each cylinder 14 is a respective piston 18, each piston 18 being biased upwardly, as viewed in Figure 2, and being supported on a relatively large coiled spring 19 which bears on a rockable disc member 20 slidably mounted in the cylinder below the piston 18. Each rockable disc member 20 is connected to a respective crank 17 by a coiled spring 21 which exerts an upward force on the disc member, said force being transmitted to the piston 18 by the spring 19. Secured to the piston concentrically with the outer spring 19 is a subsidiary or smaller coiled spring 20′ which assists in cushioning the piston 18 relative to the associated rockable disc 20 and which assists the disc 20 in transmitting compression force to the piston 18. The ends of the spring 19 are respectively connected to the piston 18 and to the associated disc 20, and the disc 20 is connected by a spring 21 to the crank 17, so that at times, the springs 19 and 21 may exert a force sufficient to cause the piston 18 to follow the downward movement of the crank 17 at the end of the downward stroke of the piston.

As shown in Figure 5, the respective cranks 17 are separated by equal angles around the axis of the crankshaft 15, for example, in a six cylinder engine, as illustrated, the cranks 17 are separated by angles of 30°.

The discs 20 are free to rotate in the cylinders 14, and transmit force between the crank 17 and the pistons 18 through the flexible springs 19, 20′ and 21 without re-

quiring the use of wristpin connections between the pistons 18 and the crank 17.

Each cylinder is provided at its top portion with a fuel admission valve 23 which is slidably mounted in a supporting housing 24 and which has a conical valve head at its lower end biased toward seating engagement with a valve opening formed in the top wall of the cylinder, the valve being urged upwardly by the biasing spring 25. Spring 25 bears on the housing 24 at its lower end and bears upwardly on a collar 26 on the valve rod, urging the valve upwardly toward seating position. The top end of each valve rod carries a transverse contact element 27 which is normally conductively engaged with a pair of switch contacts 28 and 29 supported on suitable insulated bracket means 30 mounted on the valve housing 24. The valve rod is pivotally connected to one end portion of a lever 31, which in turn is pivotally connected at its intermediate portion to the bracket 30. Pivoted to the other end portion of the lever 31 is a depending rod member 33 which extends slidably and sealingly through the housing 24 into the top portion of the cylinder 14 and which is of a sufficient length so that it will be engaged by the piston 18 as the piston moves upwardly toward the top of the cylinder. As the piston engages the rod 33, it causes the lever 31 to rotate counterclockwise, as viewed in Figure 2, causing the fuel admission valve 23 to open. After a short period, during which fuel is admitted into the top end of the cylinder and is ignited by a spark plug 35, the contact 27 disengages from the stationary contacts 29 and 28, opening the ignition circuit.

The spark plug 35 may be located in the top wall of the cylinder, or alternatively, may be mounted in a side wall thereof, as shown in Figure 3*a*, wherein the spark plug 35 is illustrated as mounted in the side wall of the engine block with its electrodes exposed in the upper lateral portion of the associated cylinder, providing the same effect as in the arrangement illustrated in Figure 2.

As is clearly illustrated in Figure 2, the high tension electrode of each spark plug 35 is connected by a terminal wire 36 to a respective stationary contact 29. Provided in the bottom wall of the crankcase 12 are respective switch cylinders 37 containing spaced stationary contacts 38 and 39, each cylinder 37 being provided with a conductive plunger 40 slidable in the cylinder. Each plunger 40 is pivotally connected to the end of a lever 41, the opposite end of the lever 41 being connected to the bottom wall of the crankcase 12 by a spring 42 biasing the lever 41 counterclockwise, as viewed in Figure 2, and thereby biasing the conductive plunger 40 upwardly out of engagement with the contacts 38 and 39. Each lever 41 has its forward portion, adjacent the conductive plunger 40 thereof disposed beneath the periphery of a respective crank disc 16, said discs being formed with respective cam-like projections 44 adapted to engage the levers 41 to bridge the contacts 38 and 39 of the respective plunger switches, at the times corresponding to the respective firing times for the respective cylinders. Thus, as shown in Figure 6, the projections 44 are separated by angles of 30°, and the respective projections are arranged to engage the levers 41 to close the associated contacts 38 and 39 when the associated fuel admission valve 23 is opened and just before the associated conductive switch element 27 disengages from its contacts 28 and 29. The length of closure of the plunger 40 with its contacts 38 and 39 is in accordance with the length of dwell of the associated cam-like projection 44, and the length of the stationary contacts 28 and 29 may be made sufficiently long so that the wiping contact member 27 engaging the contacts 28 and 29 will not disengage from said contacts 28 and 29 until the contacts 38 and 39 have been closed for a sufficient time to cause the associated spark plug 35 to fire.

As is shown in Figure 2, the switch contact 28 is connected to the switch contact 38 by a conductor 45 and the switch contact 39 is connected to a high tension wire 46 which is energized by any suitable means, such as a spark coil 47 of conventional construction.

The projections 44 preferably are formed to have sufficient engagement at their edges with the levers 41, and the contacts 28 and 29 are of sufficient length, so that at any time, one of the cylinders will be in firing position. Of course, at this time the associated fuel admission valve is open. Thus, in order to start the engine, it is merely necessary to close the ignition switch, shown at 48, to energize the spark coil 47, providing a spark in the top portion of the said one cylinder, wherein fuel is admitted through the open fuel admission valve, producing combustion of the fuel, and causing the engine to start.

The intermediate portion of each cylinder is formed with an exhaust port 49 connected to an exhaust conduit 50. Each piston 18 is formed at one side with a depending exhaust valve plate element 51 which covers the exhaust port while the piston is in the portion of the cylinder above the port, allowing the port to be exposed when the piston is moved downwardly past the port. Thus, after the cylinder has fired and the piston is moved downwardly on its power stroke, when the port 49 is exposed, at the conclusion of said power stroke, the products of combustion may escape from the cylinder through the conduit 50.

The conduits 50 are connected to a conventional exhaust manifold 52.

Each cylinder is formed opposite the exhaust port 49 with a blower port 53, and each piston 18 is provided opposite the valve plate element 51 with a second, similar depending valve plate element 54 which covers the blower port 53 while the piston is in the portion of the cylinder above the ports 49 and 53, the blower port 53 becoming exposed when the piston moves below the port, whereby air may be blown through the cylinder to provide a scavenging action and to blow the products of combustion out of the cylinder through the exhaust port 49.

Each blower port 53 is connected by a conduit 55 to the outlet of a blower 56. The blower 56 is drivingly coupled by a suitable gearing to a vertical shaft 57, which in turn is drivingly coupled by gearing 58 and a transmission shaft 59 to the crankshaft 15.

As shown in Figure 3, the shaft 59 is journaled in the wall of the crankcase 12 and has an external bevel gear meshing with a bevel gear on the lower end of the shaft 57. At its inner end, the shaft 59 is provided with a bevel gear 60 which meshes with a bevel gear 61 provided on the crankshaft 15.

The driven shaft 57 also is employed to drive a compressor 62 which is provided between the carbureter and the fuel admission housings 24 to suitably compress the fuel mixture furnished by the carbureter, shown at 65, and to deliver the compressed fuel mixture into the fuel admission valve housings 24. As shown in Figure 3, the outlet conduit 63 from the carbureter 65 connects to the intake port of the compressor 62, and the outlet port of the compressor 62 is connected by a conduit 64 to the respective fuel conduits 66 leading to the respective fuel admission valve housings 24.

Secured to the forward ends of the engine crankcase 12 and cylinder block 13 is an air admission housing 67 having the air admission opening 68 at its forward end and containing a refrigerator 69. A fan unit 70 is provided in the housing 67 adjacent the air admission opening 68, said fan unit 70 being driven from the crankshaft 15 by a belt 71. Also driven from the crankshaft 15 is the generator 72 and the compressor 73 associated with the refrigeration assembly 69. Said refrigeration assembly 69 includes the condenser 74 which is disposed rearwardly adjacent the fan unit 70 so as to be cooled by air blown into the housing 67 by said fan unit. The refrigerant from the compressor 73 is supplied to cooling coils 75 which extend through the cooling jacket 76 surrounding the cylinders 14. The jacket 76 may contain a suit-

able heat transfer medium, such as water or the like, for conducting heat away from the cylinders 14 to the cooling coils 75. Therefore, a water cooling radiator is not necessary and the refrigerator 69 may be employed in place thereof, providing a considerable saving in space and reducing the overall size of the engine.

As shown in Figure 1, the vehicle is provided with the floor board 77. Pivoted to a bracket 78 is the brake pedal 79. Designated at 80 is the brake cylinder in which is disposed the brake piston having the piston rod 81. The rod 81 is connected to a lever 82 which is pivoted at 83 to a bracket 84 secured to the under side of the floor board 77. A spring 85 connects the end of the lever 82 to a depending lug 86 secured to the chassis of the vehicle beneath the cylinder 80, biasing the lever 82 counterclockwise, as viewed in Figure 1, namely, toward brake-release position. When the lever 82 is rotated clockwise, the rod 81 applies braking force on the brake piston to apply the vehicle brake. The lever 82 is provided with an arm 87 extending through an opening 88 in the floor board and having a roller 88 journaled to its end which engages beneath the forward portion of the brake pedal 79. When the forward portion of the brake pedal 79 is depressed, the lever 82 is rotated clockwise, as viewed in Figure 1, to apply braking force.

The carbureter 65 is provided with the throttle lever 90, and the end of the lever 90 is pivotally connected to a rod 91. Rod 91 extends slidably through an aperture in a lug 92 provided on a link rod 93 pivotally connected to the forward end of the brake pedal 79, a stop nut 94 being provided on the rod 91 to allow a pulling force to be applied to the rod 91 when the brake pedal 79 is rotated counterclockwise, as viewed in Figure 1, namely in a direction opposite to that for applying the brakes.

The brake pedal 79 is provided at its forward end with an upstanding, rearwardly directed arm 95 which defines a channel portion therebeneath for receiving the operator's toe. The brake pedal 79 is provided on its rear end with an upstanding stop element 96 to engage the operator's heel.

As shown in Figure 1, the motion of the brake pedal 79 is guided by the provision of a guide rod 97 which is pivotally and slidably connected to the under side of the brake pedal 79 by a pin and slot connection 98, the guide rod 97 being slidably received in a guide sleeve 99 secured to the under side of the floor board 77, the guide rod 97 extending slidably through the floor board and through the sleeve 99, as is clearly shown in Figure 1. Thus, when the operator desires to accelerate the engine, he rotates the brake pedal 79 counterclockwise, as viewed in Figure 1, and this causes the throttle lever 90 to open the throttle valve in the carbureter 65. This provides an increased fuel charge in the cylinders, causing the desired acceleration. On the other hand, when it is desired to apply the brakes, the operator rotates the brake pedal 79 clockwise, as viewed in Figure 1, causing the brake lever 82 to apply a braking force to the piston of the brake cylinder 80, and since the rod 93 is free to slide relative to the rod 91 when the brake pedal is moved clockwise, the braking motion of the brake pedal 79 has no affect on the throttle lever 90.

In the modified form of the invention shown in Figures 11 and 12, the brake pedal is shown at 79' and is guided for movement in a vertical plane between a pair of arcuate, upstanding guide bars 101, 101 secured to the floor board 77 in upstanding parallel positions adjacent the opposite forward portions of the side edges of the brake pedal. The forward portion of the brake pedal, shown at 79', is connected to the carbureter throttle valve by a flexible chain 102, providing the same type of connection as that obtained by the use of the rods 91 and 93 in the previously described form of the invention. Pivoted to the forward end of the brake pedal 79' is the upstanding, rearwardly directed arm 95' which may be at times rotated to a position disengaged from the operator's toe,

as shown in dotted view in Figure 11, but which is at other times releasably engaged by resilient latch members 103, 103 secured to the brake pedal at opposite sides thereof, said latch members being provided with inwardly directed detent elements 104 at their top ends adapted to lockingly engage with the side edges of the arm 95' to retain said arm in a position defining a channel at the forward end of the brake pedal to receive the operator's toe. As in the previously described form of the invention, the pedal 79' may be employed both to apply the brakes, as when the pedal is rotated in a clockwise direction, as viewed in Figure 11, or to accelerate the engine, as when the pedal is rotated counterclockwise by elevating the operator's toe.

When the arm 95' is to be moved to an inoperative position, the operator merely flexes the latch arms 103, 103 outwardly, allowing the arm 95' to be released and to be rotated upwardly to the inoperative position shown in dotted view in Figure 11, allowing the operator to control acceleration by merely exerting the proper force on the pedal 79' adjacent the heel stop 96 to produce the desired amount of acceleration.

While certain specific embodiments of an improved internal combustion engine and control means therefor have been disclosed in the foregoing description, it will be understood that various modifications within the spirit of the invention may occur to those skilled in the art. Therefore, it is intended that no limitations be placed on the invention except as defined by the scope of the appended claims.

What is claimed is:

1. In an internal combustion engine, a crankcase, a crankshaft having a plurality of crank discs arranged in spaced relation therealong, a cylinder block including a plurality of cylinders arranged over said crankshaft so that a cylinder is above a crank disc of said crankshaft, a piston slidable in each of said cylinders, a disc member slidably mounted in each cylinder below and spaced from said piston, a first spring means connecting each of said disc members to the associated piston, and a second spring means connecting each of said disc members to the associated crank disc.

2. In an internal combustion engine, a crankcase, a crankshaft having a plurality of crank discs arranged in spaced relation therealong, a cylinder block including a plurality of cylinders arranged over said crankshaft so that a cylinder is above a crank disc of said crankshaft, a piston slidable in each of said cylinders, a disc member slidably mounted in each cylinder below and spaced from said piston, a first coil spring interposed between each of said disc members and the associated piston and having one end operatively connected to said disc member and having the other end operatively connected to said piston, and a second coil spring interposed between each of said disc members and the associated crank disc and having one end operatively connected to said disc member and having the other end operatively connected to said crank disc.

3. In an internal combustion engine, a crankcase, a crankshaft having a plurality of crank discs arranged in spaced relation therealong, a cylinder block including a plurality of cylinders arranged over said crankshaft so that a cylinder is above a crank disc of said crankshaft, a piston slidable in each of said cylinders, a disc member slidably mounted in each cylinder below and spaced from said piston, a first coil spring interposed between each of said disc members and the associated piston and having one end operatively connected to said disc member and having the other end operatively connected to said piston, a second coil spring interposed between each of said disc members and the associated crank disc and having one end operatively connected to said disc member and having the other end operatively connected to said crank disc, and a subsidiary coil spring concentrically disposed with respect to said first named coil

spring and secured to the under face of each of said pistons and the other end of said first named coil spring.

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