Sept. 2, 1941. P. J. DE HETRE ET AL 2,254,775

INTERNAL COMBUSTION ENGINE

Filed March 10, 1939 3 Sheets-Sheet 1

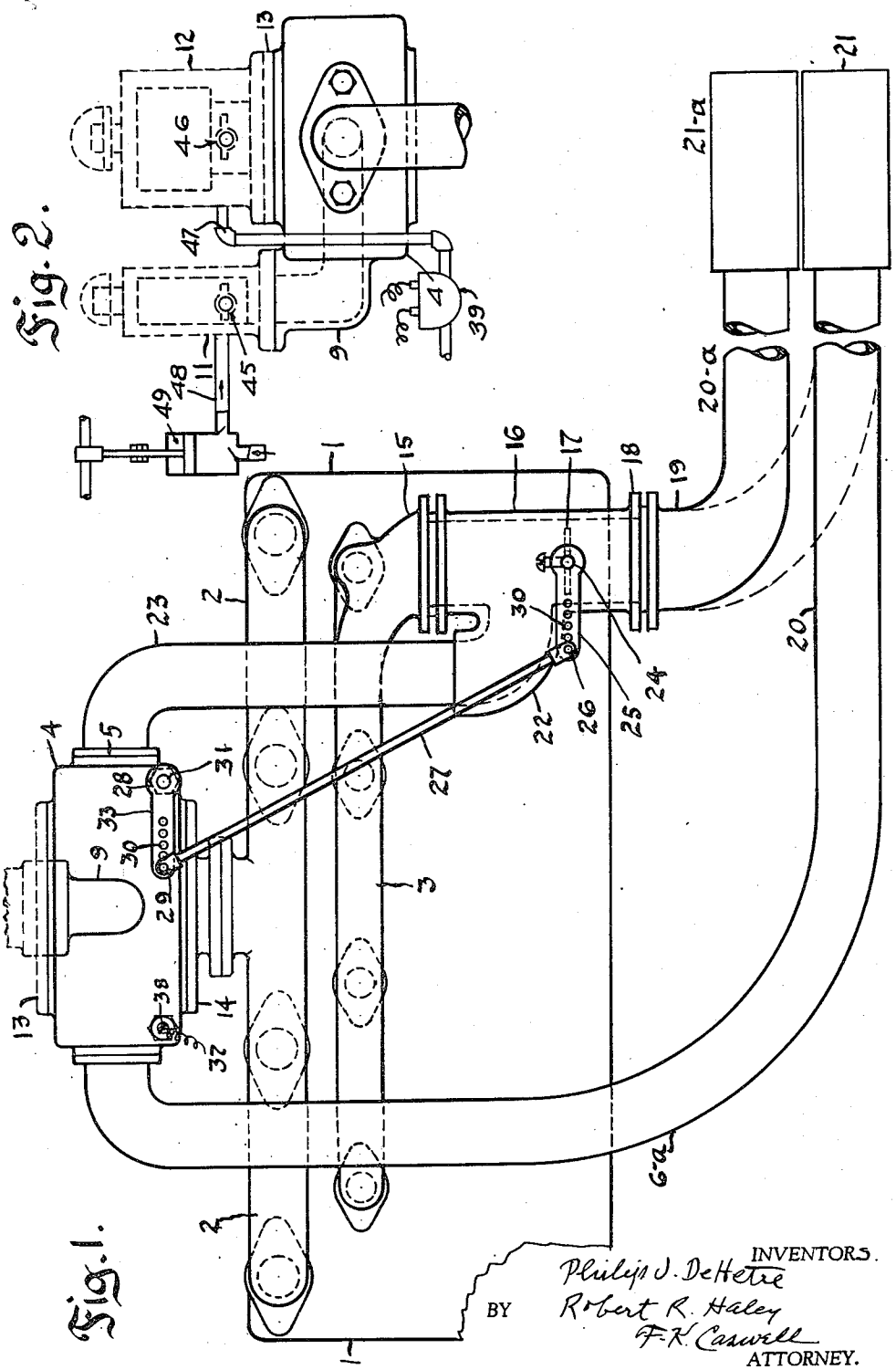


Fig. 2.

Fig. 1.

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Fig. 3.

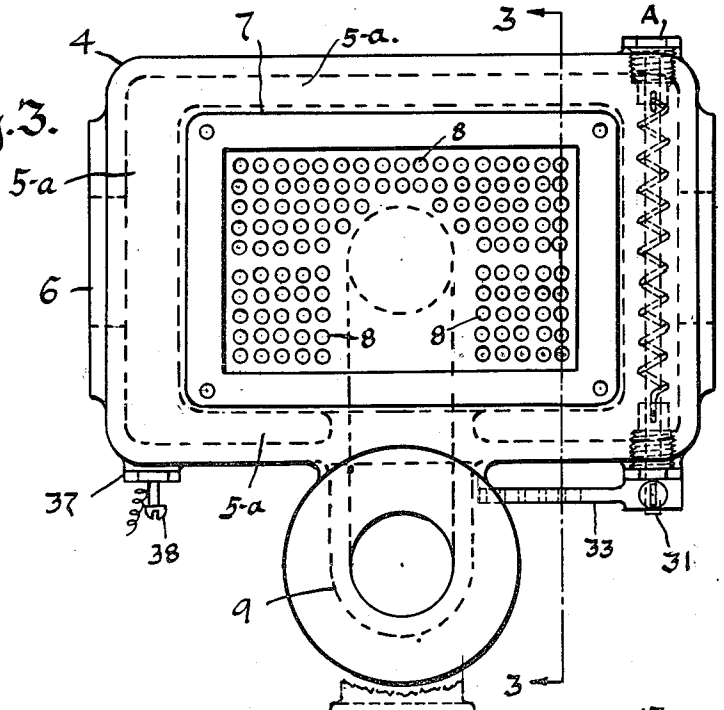


Fig. 4.

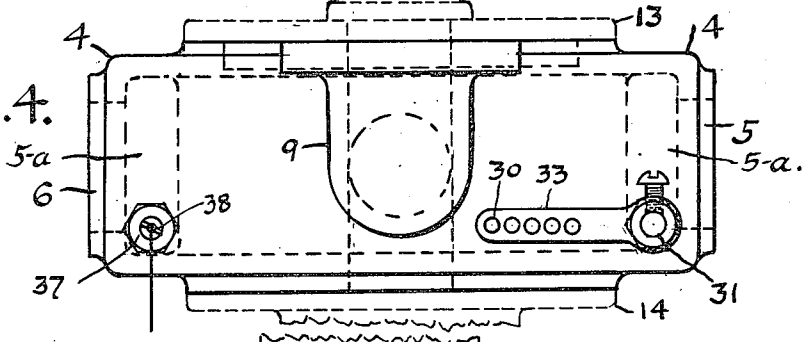
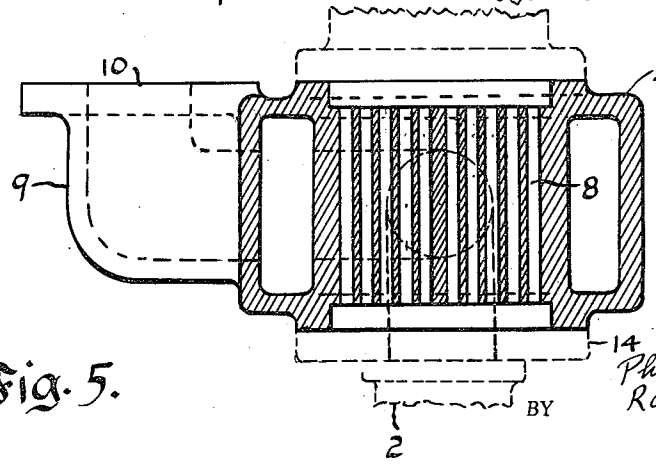


Fig. 5.



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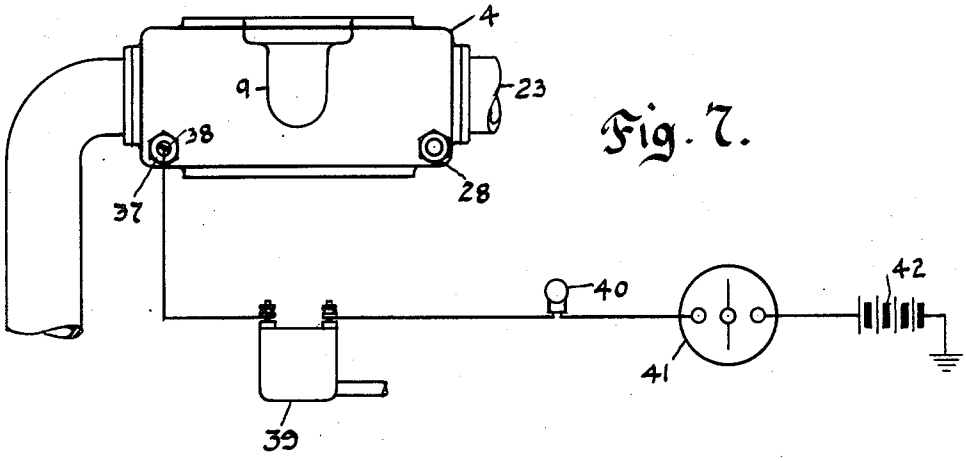


Fig. 7.

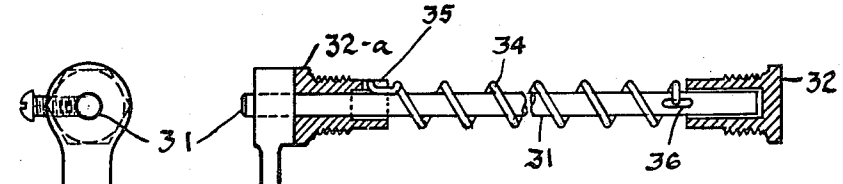


Fig. 6.

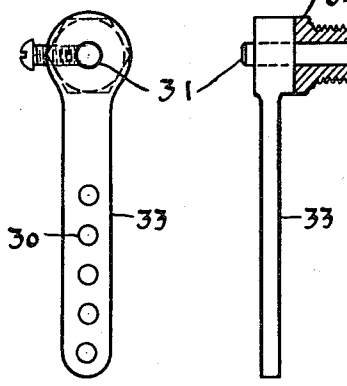


Fig. 8.

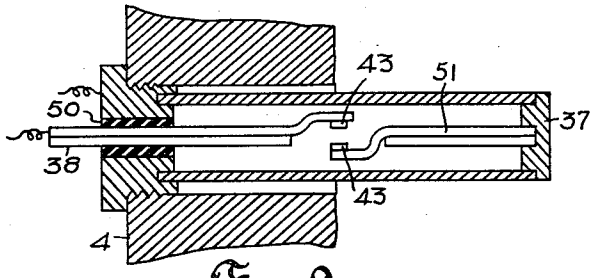


Fig. 9

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Patented Sept. 2, 1941 2,254,775

UNITED STATES PATENT OFFICE

2,254,775

INTERNAL COMBUSTION ENGINE

Philip J. De Hetre, Compton, and Robert R. Haley, Los Angeles, Calif.

Application March 10, 1939, Serial No. 260,954

1 Claim. (Cl. 123—127)

Our device relates to that class of internal combustion engines operating on gasolene or other light fuel.

The primary purpose of our invention is to provide a means whereby internal combustion engines designed to operate on gasolene or other light fuel can be converted to a type which can operate on the much cheaper fuel known as Diesel or other heavy fuel.

A further purpose is to provide such an apparatus that can be started on the gasolene or other light fuel and which will automatically change to the heavy oil operation, the change-over being thermostatically controlled; also including an indicator system to show when the change-over takes place.

A further purpose is to provide means for accomplishing the foregoing purposes without requiring the injury of any part of the present power plant either by cutting or welding, this apparatus being added to or substituted for the present equipment.

We accomplish these results by means of the apparatus illustrated by the accompanying drawings in which similar numerals refer to similar parts in the several views.

Figure 1 is a front elevation, partly diagrammatic, showing the assembly of our device. Figure 2 is a partial diagrammatic view of the heater, the two carburetors, mechanical fuel pump and electrical fuel pump. Figure 3 is a plan view of the heater with the cover removed. Figure 4 is a front elevation of the heater showing the location of the thermostat and the thermostatic switch. Figure 5 is an end view, partly in section, of the heater taken on the line 3—3 of Figure 3. Figure 6 is a detailed sectional view of the thermostat. Figure 7 is a diagrammatic illustration showing the electrical circuit including the electric pump, indicator, and thermostatic switch. Figure 8 shows the adjustable lever arm operated by a thermostat. Figure 9 is a sectional view through the thermostat.

The construction of our device is as follows:

1 represents the cylinder block and head; 2 is the intake manifold and 3 the exhaust manifold. In the diagrammatic view of Figure 1 the engine is of the four-cylinder type, but our device can be applied to any engine type with equal results.

Mounted on the top of the intake manifold 2 is a heater 4. This heater 4 is preferably a casting having an inlet port 5 and an outlet port 6, both of which are adapted to receive and discharge hot gases from the exhaust manifold 3. Centrally located within the heater casting is a block 7, provided with a number of relatively small passages 8 through which the heavy fuel can pass and receive the heat from the exhaust gases passing around the block 7 through the passages 5—*a*. These passages 8 also serve to break up the single stream of fuel into a large number of small streams, which completes the vaporization by exposing each stream to a relatively large heat radiating surface.

Integral with or secured to the heater 4 is an L-shaped member 9 having a port 10 leading through the block 7 directly into the intake manifold 2, the said member 9 being adapted to have mounted on its upper side the light fuel carburetor 11. On the top of the heater 4 is a cover plate 13 secured thereto and adapted to have mounted thereon a carburetor 12 suitable to vaporize the heavy or Diesel fuel. On the under side of the heater 4 is a similar cover plate 14 which is adapted to be connected with the intake manifold 2 which supplies fuel to the cylinders 1. Also mounted on the cylinder block 1 is an exhaust manifold 3. The outer end of the exhaust manifold 3 is secured to a valve housing 16, having its outer end 18 secured to a pipe 19 adapted to be connected to the main exhaust pipe 20 in which is located a muffler 21 if desired; or, a separate exhaust pipe 20—*a* and muffler 21—*a* may be used. The valve housing 16 has a side outlet 22 which is connected to the inlet port 5 of the heater 4 by means of the pipe 23. Revolvably mounted within the valve housing 16 is a butterfly valve 17, this valve being so located below the side outlet 22 that when it is in its closed position it connects the pipe 15 with the side outlet 22, the pipe 23, and the inlet port 5. The butterfly valve 17 is somewhat smaller in diameter than the inside diameter of the valve housing 16. This is to prevent excessive back pressure when the valve 17 is closed. The shaft 24 on which the valve 17 is mounted extends through the walls of the housing 16 and is provided with a lever arm 25 having a ball-and-socket joint 26 by which this lever can be operated by a rod 27 which in turn is actuated by a thermostat 28 and lever arm 33 provided with a similar ball joint 29. The lever arms 25 and 33 may be provided with holes 30 to allow variation in the length of the said lever arms.

Mounted at A in the heater 4 is a thermostat 28. Any desired type of thermostat may be mounted on the heater 4 in such a manner that it may be actuated by the heat from the said block 4, but in the bi-metallic form illustrated by Figure 6 the construction is as follows: A rod

31 is loosely mounted between the two bushings 32 and 32—*a*, one end of the said rod extending through one of the said bushings, 32—*a*, and having secured thereto a lever arm 33 adapted to operate the valve 17 as heretofore described. Coiled around the rod 31 is an expansion member 34, one end of which is located in a slot 35 in the bushing 32—*a*. This prevents the coil from turning at that end. The opposite end of the coil 34 is bent and passed through a slot 36 in the rod 31.

The operation of this thermostatic device is as follows: When heat is applied to this device the rod 31 and the coil 34, being made of two different metals having each a different coefficient of expansion, results in a tortional movement of the said coil due to expansion. The free end of this coil being slideably connected to the rod 31 transmits its torsional movement to the said rod, rotating the rod and rotating the lever arm 33, which in turn operates the butterfly valve 17.

Also mounted on the heater 4 is a thermostatic electric switch 37 which is diagrammatically illustrated by Figure 9. This switch consists of a casing mounted in the heater 4, having therein a bimetallic thermostatic strip 51, which is grounded. Insulated by the bushing 50 is another bi-metallic thermostatic strip 38, each of the said strips having contact points 43 arranged to close the circuit when subjected to the proper degree of heat. Adjustment means 38 are provided by which this thermostat can be set to close the circuit at any desired temperature. This temperature is usually about 174 degrees Fah. for the Diesel fuel usually provided. One side of this switch is grounded and the other side is in series with the electric heavy fuel pump 39, the dash indicating light 40, and the main switch 41, the latter being connected to the battery 42 on one side and to ground on the other side. Two throttles are provided, one for light fuel and one for heavy fuel. The light fuel carburetor 11 is provided with the usual connection 48 from the fuel tank, means for feeding the fuel to the carburetor, such as a fuel pump 49 or a vacuum tank. The heavy fuel carburetor 12 is connected by a pipe 47 to a fuel tank from which the heavy fuel is pumped by means of an electric fuel pump 39 which is controlled by the thermostatic switch.

The operation of our device is as follows: Assuming that the engine is cold, the butterfly valve 17 is closed, the thermostatic switch is open causing the electric fuel pump 39 to be inactive and the dash indicator light 40 to be unlighted. The engine is started by the usual means using the light fuel throttle. At this stage the heavy fuel elements are inactive. As soon as the engine is in operation on the light fuel, the hot exhaust gases from the exhaust manifold 3 pass into the valve housing 16, and as the valve 17 is closed the hot exhaust gases pass through the member 22, the pipe 23, through the heater inlet 5, the passages 5—*a*, around the block 7, through the heater outlet 6, the preliminary exhaust pipe 6—*a*, and out through the exhaust pipe 20 and the muffler 21. As the engine continues to operate on the light fuel the heater 4 becomes hot and transmits its heat to the thermostat 26 and to the thermostatic switch 37. Both of these thermostatic units are set to operate at a predetermined temperature, and when this degree of heat is reached the thermostat 26 actuates the lever arms 28 and 25 and opens the butterfly 17 allowing most of the hot gases to pass directly out through the pipe 19, the exhaust pipe 20—*a*, and the muffler 21—*a*. This permits a part of the exhaust gas to pass around the heater 4, and this taken together with the heat radiated by the engine serves to maintain the temperature required in the said heater.

At the same time the thermostatic switch 37 by the heat absorbed, closes its circuit and if the main switch is closed, starts the electric pump 39 and lights the indicator light 40. The operator, seeing the indicator lighted, releases the light fuel throttle 45 and transfers his control to the heavy fuel throttle 46. The engine will then be operating as a so-called semi-Diesel type. It will of course be understood that there will be two tanks or sources of fuel supply. It will also be readily understood that after the engine and heater have reached a temperature of normal operation the operator can change from the light to the heavy fuel or vice-versa by merely using one or the other of the two throttles.

We claim:

In an internal combustion engine having intake and exhaust manifolds and exhaust pipe, means for adapting said engine to operate with either light or heavy fuel, said means including a carburetor vaporizing light fuel directly to the intake manifold, a secondary carburetor vaporizing heavy fuel through a heater to the intake manifold, said heater including a block having a plurality of relatively small passages between the said secondary carburetor and the intake manifold, said heater also having other passages adjacent to said block through which hot exhaust gases may be by-passed to heat the heavy fuel by radiation, the by-passing of the said gases being effected and controlled by a valve in the exhaust pipe, said valve being operated by a thermostat located in said heater; means for supplying fuel to each of said carburetors, said means consisting of a mechanically actuated fuel pump supplying light fuel to its carburetor, and an electrically operated fuel pump supplying heavy fuel to its carburetor, the said electric fuel pump being controlled by a thermostatic switch located in said heater.

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