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CONTROLLED VARIABLE COOLANT SYSTEM FOR ENGINES

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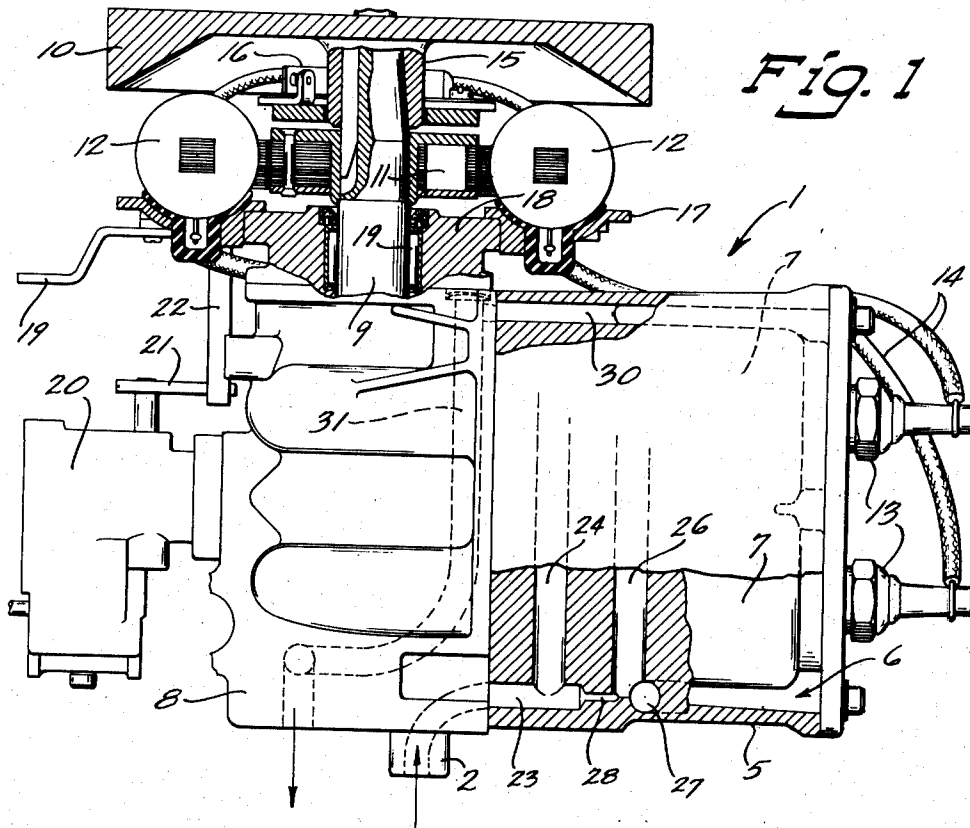


Fig. 1

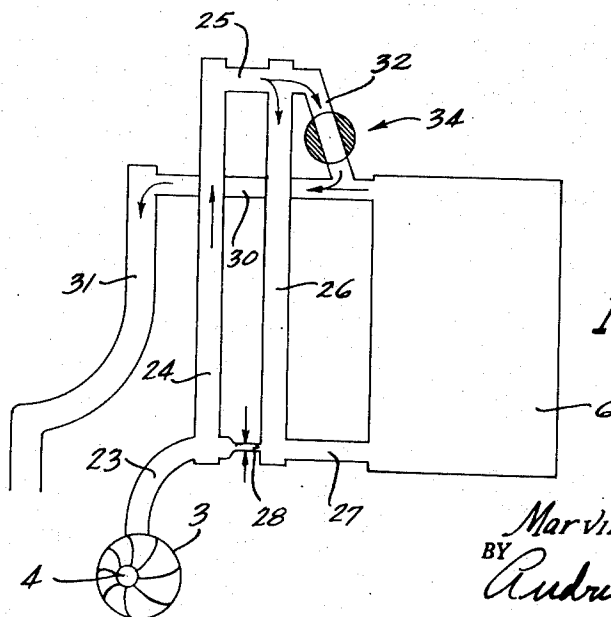


Fig. 8

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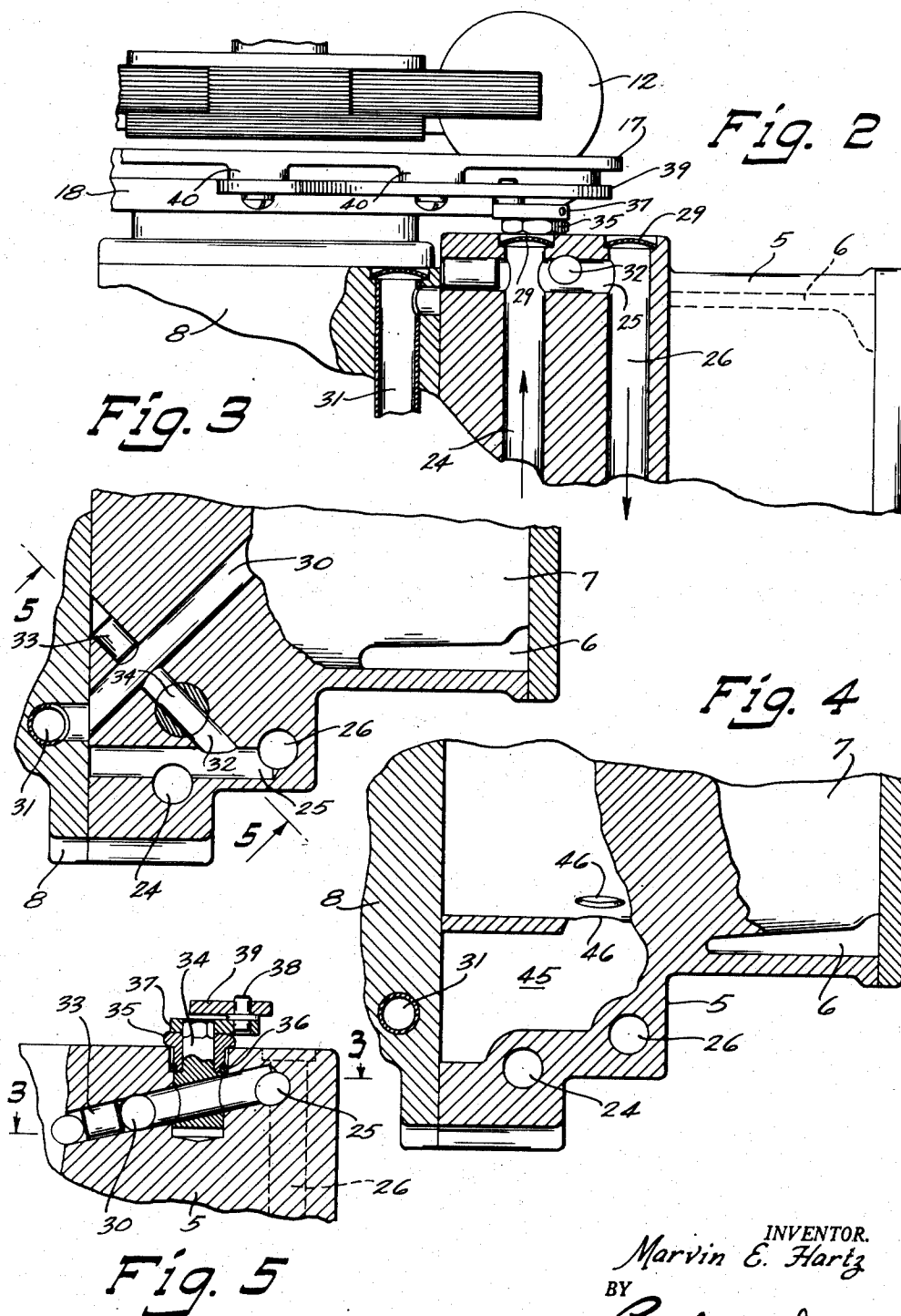
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Fig. 6

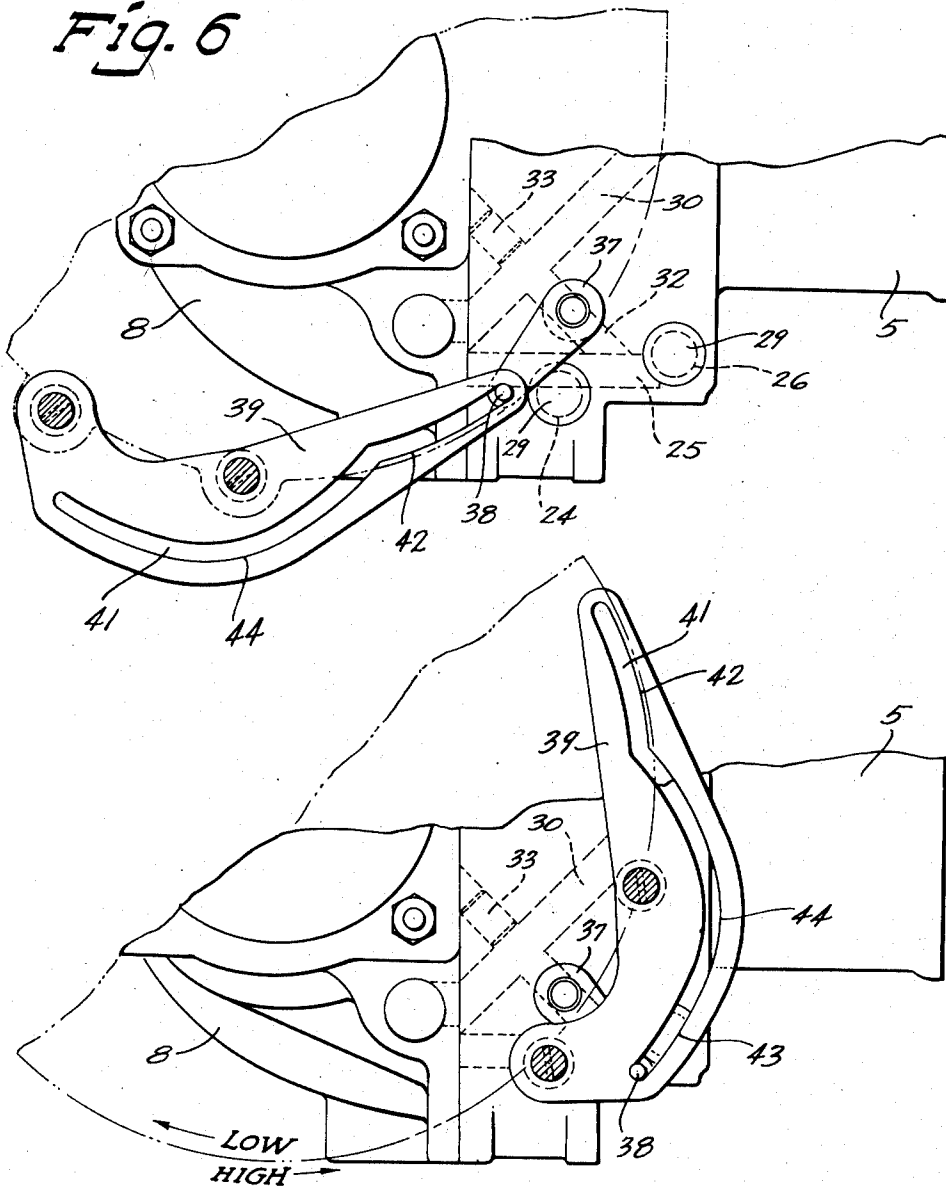


Fig. 7

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CONTROLLED VARIABLE COOLANT SYSTEM
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7 Claims. (Cl. 123—41.13)

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This invention relates to water or liquid coolant cooling systems for engines and to means providing a positive controlled minimum rate of flow at low engine speeds, particularly without the use of restrictions to flow of coolant in the system.

The invention provides a controlled water supply system coordinated with the speed of the engine to provide optimum cooling conditions for the different operating speeds of the engine. The invention is particularly adapted for outboard motors where restricted orifices and the like are subject to clogging and closing by the accumulation of sand and other foreign matter carried by the water and circulated through the motor.

The invention also provides for the cooling of the exhaust chamber or another particular part of the engine at a relatively level rate which is substantially independent of the controlled adjustment.

A principal object of the invention is to eliminate the possibility of overheating of the cylinder block while controlling within close limits the circulation of water through the cylinder block coolant cavity at low speeds of the motor to maintain a minimum temperature for dependable operation at such low speed.

A more particular object of the invention is to provide limited coolant circulation at low speeds at a given reduced pressure and at high speeds entirely by pressure means effected by the circulatory pump.

Another object is to assure control of the circulation automatically with the spark adjustment of the engine while providing full circulation of coolant to other parts of the engine.

These and other objects and advantages will be more fully set forth in the following description of a preferred embodiment of the invention as illustrated in the accompanying drawings.

In the drawings:

Figure 1 is a side elevation of the upper end of an engine for an outboard motor with parts thereof broken away and sectioned;

Fig. 2 is an enlarged side elevation of part of the engine with parts broken away showing the interconnection of the magneto and coolant control valve and several of the coolant passages;

Fig. 3 is a sectional view taken on line 3—3 of Fig. 5 through the valve stem in open position in the interconnecting passage of the cooling system;

Fig. 4 is a horizontal sectional view showing the exhaust chamber and a part of a cylinder of the engine opening into said chamber;

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Fig. 5 is a vertical cross-sectional view on line 5—5 of Fig. 3 through the valve showing the control crank and pin operating the valve;

Fig. 6 is a plan view of the cam plate carried by the magneto and operatively engaging the valve crank pin with the latter in the closed position shown in Fig. 3;

Fig. 7 is a view similar to Fig. 6 showing the valve crank pin in the open position; and

Fig. 8 is a diagrammatic illustration of the cooling system.

The engine 1, shown in the drawings, is provided with the fitting 2 adapted to receive a pipe for connection with a suitable supply of cooling water under nominal pressure. The pump 3 shown diagrammatically in Fig. 8 is operated by engine 1 connected to the shaft 4 of the pump and provides a constant supply of cooling water which varies with the speed of operation of the engine.

Engine 1 includes the cylinder block 5 having a coolant chamber 6 which surrounds the two combustion cylinders 7. The crankcase member 8 joined to block 5 supports the crankshaft 9 which latter carries the flywheel 10 above the motor.

The magneto for engine ignition includes the rotor 11 and stators 12 which are connected to the spark plugs 13 by suitable wires 14. A timing mechanism for each stator 12 includes the cam 15 carried by crankshaft 9 above rotor 11 and a contact breaker means 16 operated by cam 15 at predetermined intervals corresponding with the rotation of crankshaft 9.

Breakers 16 and stators 12 are carried by the plate 17 which is mounted on the circular collar 18. Collar 18 is formed integrally with crankcase 8 and is provided with the bearing 19 supporting the upper end of the crankshaft which projects upwardly through the collar. Plate 17 is supported on the rim of collar 18 and adapted to be turned or rotated on the crankshaft centerline by the control lever 19 which is secured to the underside of plate 17 and projects forwardly of the engine.

In the operation of the engine, plate 17 when turned as with lever 19, locates the stators 12 and breaker means 16 with respect to rotor 11 and cam 15, respectively, whereby the operation of the ignition means with relation to the crankshaft is adjusted for the desired operating speed of the engine.

The carburetor 20 for the engine includes the control cam 21 which engages the pin 22 carried by plate 17. Adjustment of the carburetor as pre-

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determined by the profile of cam 21 is coordinated with the adjustment of the ignition means so that the control of the engine speed may be effected by the movement of lever 19 alone.

The conduit 23 connects pump 3 and the lower end of the first vertical standing passage 24 formed in block 5 as will be described. The horizontal passage 25 in the upper end of block 5 connects the upper end of standing passage 24 and the second standing passage 26 formed in block 5 adjacent to and parallel with passage 24. The lower end of passage 26 opens through passage 27 into the lower end of chamber 6 formed in block 5 as described and provides for the normal delivery of water thereto from pump 3 through conduit 23 and passages 24, 25, and 26.

The small passage 28 connecting the lower ends of the standing passages 24 and 26 is provided for draining of the cylinder block of water when the motor is stopped and remains not in use. A nominal amount of water passing therethrough by-passes passages 24 and 26 and flows directly into chamber 6. The amount of such water passing directly into chamber 6 does not materially affect the circulation as provided by the invention.

The two vertical standing passages 24 and 26 are cored or otherwise formed in block 5 and closed at the upper ends thereof by the plugs 29 pressed in the seats formed in block 5.

The discharge passage 30 in block 5 from the upper end of chamber 6 therein registers with an opening in crankcase 8 and the upper end of the passage or drain conduit 31 which opens from the crankcase for the suitable discharge of the water from the chamber.

The passage 32 located at the upper level of chamber 6 connects passages 25 and 30 and may be drilled in block 5, as shown, and closed by the plug 33. The barrel valve 34 is seated in the upper face of block 5 to control or open and close passage 32, as will be described.

Valve 34 is retained by the threaded screw plug 35 and sealed by the O-ring 36 seated in block 6. The crank 37 secured to the projecting stem of the valve carries the crank pin 38 which is disposed adjacent to and just below plate 17. Valve 34 is adapted to open and close passage 32 with a quarter turn of crank 37.

The cam-plate 39 is carried by and secured to the projections 40 on the underside of plate 17 and is provided with the slot 41 through which pin 38 projects. The two arcuate sectors 42 and 43 at opposite ends of the slot are located with respect to the turning axis of plate 17 on radii to locate pin 38 in fully open and fully closed positions, respectively. Sectors 42 and 43 are relatively located with respect to the quarter of turning of crank 37 so that pin 38 is actuated in the direction of movement of plate 39 with a minimum of friction and without binding.

Sector 42 is located to maintain opening of conduit 32 through a certain range of low speed adjustment and sector 43 to provide closing of conduit 32 through a range of high speed adjustment. The intermediate portion 44 of slot 41 provides a graduated opening or closing of conduit 32 corresponding to the intermediate range of engine speed.

Valve 34 closes passage 32 at high speeds so that substantially all of the water passes through the cored passages 24 and 26 and all of the water delivered by pump 3 passes through chamber 6 as described.

In engine 1, each of cylinders 7 opens into the

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expansion chamber 45 through ports 46 for the discharge of the exhaust. Chamber 45 opens downwardly of the engine into suitable means, not shown, providing preferably for the under-water discharge of the exhaust from the motor.

Passages 24 and 26 are cored adjacent to the exhaust chamber 45 and drain conduit 31 is also located near chamber 45 in crankcase 8 which closes the recess in block 5 forming the chamber.

The circulation of water through passages 24 and 26 and conduit 31 serves to prevent overheating of adjacent parts of the engine by the exhaust and to cool the exhaust for more efficient engine operation and the entire water delivered to the engine flows through at least one of the passages and conduit 31 at all speeds and independently of the adjustments of the engine. Valve 34 when open provides for the release of a certain part of the water delivered to the engine by pump 3 and for discharge of that amount through drain conduit 31.

According to the present invention such circulation is effected by reason of the height of the column of water in passage 26 above passage 30 and the upper level of chamber 6. Passage 32 opens into passage 25 connecting standing passages 24 and 26 at a level substantially above the level of discharge passage 30 and chamber 6.

At low speed adjustment of the engine, valve 34 is opened as described, so that the water in excess of that required to maintain passage 26 filled is allowed to escape through passage 32 to discharge passage 30. The amount of water required to maintain passage 26 filled to the level of passage 32 represents the water being circulated through passages 26 and 27 and chamber 6.

The height referred to in linear measure provides a readily calculated positive and constant pressure effecting circulation of water through chamber 6 at low speeds at the required rate of flow. The pressure required to effect such circulation overcomes the resistance to fluid flow through relatively unrestricted passages which are not subject to closing. The height referred to remains constant so that the pressure may be relied on to effect and maintain a constant rate of flow.

At high speed adjustment of engine 1, valve 34 is closed and the entire delivery of pump 3 is circulated through chamber 6 as described.

At intermediate engine speeds the rate of water delivered to the engine is reduced by the amount allowed to pass through the valve while the difference is circulated through chamber 6 at a reduced pressure. At intermediate speeds the water by-passing chamber 6 to discharge passage 30 is controlled principally by the restriction effected by valve 34. It should be noted, however, that the restriction referred to does not limit the circulation of water through chamber 6. If closed, as by an accumulation of sand, circulation of water through chamber 6 is not diminished, but is raised to the rate effected as when valve 34 is closed.

The water delivered to engine by pump 3 is always circulated through passage 24 and conduit 31 to maintain the required cooling of the engine adjacent to chamber 45. In all positions of adjustment of the engine spark control lever 19 and valve 34 or speeds of the engine the proper cooling of the engine is thus assured.

The invention is particularly adapted for use in engines including a coolant circulating pump operated by the engine and delivering at rates

which do not otherwise correspond with the cooling requirements of the engine and specifically where the rate is in excess of the engine requirements at low speeds.

Various embodiments of the invention may be employed within the scope of the following claims. I claim:

1. In an engine having speed control means movable to high and low speed positions of adjustment, a coolant chamber, a standing passage extending above the height of and adjacent to said chamber and communicating at its lower end with the lower level of said chamber, water supply means operated by said engine and connected with the upper end of said supply passage for delivery of water thereto during the operation of the engine, a water discharge passage from the upper level of said chamber, a passage connecting said discharge passage and the upper end of said standing passage at a level above said chamber, and valve means controlling said conduit and coordinated with said speed control means whereby when said control means is adjusted to a low speed position said conduit is open to the water in said standing passage at said higher level and the circulation of water through said chamber obtains corresponding to the pressure effected by the water maintained in said standing passage above said chamber and discharge passage and independently of any greater delivery of said supply means, and when said control means is adjusted to a high speed position said conduit is closed to the water delivered to said standing passage and the circulation of water through said chamber is directly effected by the delivery of said supply means.

2. In an internal-combustion engine including a cylinder block having a coolant chamber adjacent to and substantially surrounding the cylinder, a carburetor having a manual control arm for adjusting the carburetor to the desired engine speed, a coolant supply pump operated by and at the speed of the engine, a supply passage from said pump for the delivery of coolant from said pump to the lower level of said chamber, a drain passage from the upper level of said chamber, a conduit connecting said passages and having at least a part thereof at or above the upper level of said chamber, a valve controlling said conduit, and cam means connecting said carburetor control arm and said valve to operate the latter upon movement of said control arm in coordinated relation therewith whereby when said carburetor is adjusted to a low speed position said conduit is open to water to by-pass said chamber, said conduit having at least a part thereof at or above the upper level of said chamber whereby said chamber is at least filled to such level notwithstanding said valve being open.

3. In an internal-combustion engine including a cylinder block having a coolant chamber adjacent to and substantially surrounding the cylinder, a carburetor having a manual control arm for adjusting the carburetor to the desired engine speed, a coolant supply pump operated by and at the speed of the engine, a supply passage from said pump for the delivery of coolant from said pump to the lower level of said chamber, a drain passage from the upper level of said chamber, a conduit connecting said passages and extending above the upper level of said chamber and drain passage, a valve controlling said conduit, and cam means connecting said carburetor control arm and said valve to operate the latter upon movement of said control arm in coordi-

nated relation therewith whereby when said carburetor is adjusted to a low speed position said conduit is open to water to by-pass said chamber, the height of the coolant maintained in said conduit providing circulation of water through said chamber independently of any greater delivery of water by said pump and circulated through said passages.

4. In an internal-combustion engine including a cylinder block having a coolant chamber adjacent to and substantially surrounding the cylinder, a carburetor having a manual control arm for adjusting the carburetor to the desired engine speed, a coolant supply pump operated by and at the speed of the engine, a supply passage from said pump for the delivery of coolant from said pump to the lower level of said chamber, a drain passage from the upper level of said chamber, selectively controlled by-pass means from said supply passage above the level of said drain passage and connecting with said drain passage, and cam means connecting said carburetor control arm and said valve to operate the latter upon movement of said control arm in coordinated relation therewith whereby when said carburetor is adjusted to a low speed position said conduit is open to water to by-pass said chamber, said conduit having at least a part thereof at or above the upper level of said chamber whereby said chamber is at least filled to such level notwithstanding said valve being open.

5. In an internal-combustion engine including a cylinder block having a coolant chamber adjacent to and substantially surrounding the cylinder, a carburetor having a manual control arm for adjusting the carburetor to the desired engine speed, a coolant supply pump operated by and at delivery rates corresponding with the speed of the engine, a supply passage from said pump for the delivery of coolant from said pump to the lower level of said chamber, a drain passage from the upper level of said chamber, a conduit connecting said passages and having at least a part thereof above the upper level of said chamber, a valve controlling said conduit, and cam means connecting said carburetor control arm and said valve to operate the latter upon movement of said control arm in coordinated relation therewith whereby when said carburetor is adjusted to a low speed position said conduit is open to water to by-pass said chamber, said conduit having at least a part thereof above the upper level of said chamber whereby coolant is circulated at a given rate through said chamber independently of any greater delivery of water by said pump and circulated through said passages, and when said carburetor is adjusted to a high speed position said conduit is closed and the water delivered by said pump is entirely circulated through said chamber under pressure.

6. In an internal-combustion engine, a cylinder block having a coolant chamber adjacent to and surrounding a substantial part of the cylinder, an expansion chamber formed by a part of said engine and disposed to receive the exhaust from the engine cylinder, a coolant supply passage extending adjacent to said expansion chamber and connected to the lower end of said coolant chamber, a coolant drain passage from the upper level of said coolant chamber extending adjacent to said expansion chamber, and by-pass means selectively connecting said supply and drain passages whereby a predetermined portion only of the coolant delivered to the engine is circulated through said coolant cham-

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ber, said passages being disposed adjacent to said expansion chamber for controlling the temperature thereof by circulation therethrough of the entire coolant delivered to the engine irrespective of the portion circulated through said coolant chamber.

7. In an internal-combustion engine including a cylinder block having an expansion chamber adjacent to the cylinder to receive the exhaust therefrom and a coolant chamber adjacent to and substantially surrounding the cylinder, a carburetor having a manual control arm for adjusting the carburetor to the desired engine speed, a coolant supply pump operated by and at the speed of the engine, a supply passage from said pump for the delivery of coolant from said pump to the lower level of said chamber, a drain passage from the upper level of said chamber, said passages extending adjacent to said expansion chamber whereby the coolant circulated there-through controls the temperature of the adjacent parts of said engine, a conduit connecting said passages, a valve controlling said conduit, and cam means connecting said carburetor control arm and said valve to operate the latter upon movement of said control arm in coordinated relation therewith whereby when said carburetor

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is adjusted to a low-speed position said conduit is open to water to by-pass said chamber, said conduit extending substantially above the upper level of said chamber whereby circulation of coolant through said chamber is effected by reason of the standing said valve being open, and when said carburetor is adjusted to a high-speed position said conduit is closed and the water delivered by said pump is entirely circulated through said chamber under pressure.

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