United States Patent [19]

Stinebaugh

[11] **3,859,968**

[45] **Jan. 14, 1975**

[54] **SUPERCHARGED ENGINES**

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[73] Assignee: **Power Research & Development, Inc.,** Spokane, Wash.

[22] Filed: **Aug. 20, 1973**

[21] Appl. No.: **389,992**

Related U.S. Application Data

[63] Continuation of Ser. No. 135,627, April 20, 1971, abandoned.

[52] **U.S. Cl.**..... **123/75 CC,** 123/75 B, 123/73 V, 123/119 C, 123/97 B

[51] **Int. Cl.** **F02b 75/02,** F02d 33/02, F02n 7/00

[58] **Field of Search** ..... 123/75 CC, 75 EC, 75 B, 123/75 R, 73 V, 97 B, 119 C, 119 CB, 119 CA

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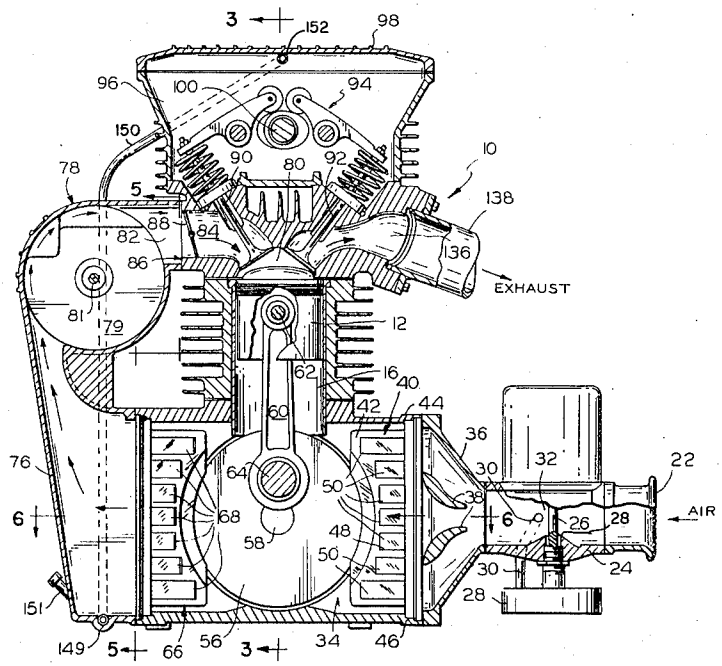
Attorney, Agent, or Firm—Klarquist, Sparkman, Campbell, Leigh, Hall & Whinston

[57] **ABSTRACT**

A fuel-air mixture is supercharged by a stuffed crankcase of an engine and is forced into a large volume reservoir from which it is metered by a throttle to intake valves of the engine. The fuel-air mixture in a carburetor is adjusted automatically by vacuum and/or mechanical linkage in accordance with air flow through the carburetor. Oil is forced from a sump in the reservoir by the pressure of supercharged mixture in the reservoir, through small orifices in an oil line to lubricate the engine. A second engine has radically cammed intake valves in addition to conventionally cammed valves, and valving provided between a large volume reservoir and the radically cammed valves is closed at engine speeds below 4,500 r.p.m. and is opened at speeds above 4,500 r.p.m.

28 Claims, 10 Drawing Figures



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SHEET 1 OF 6

FIG. 1

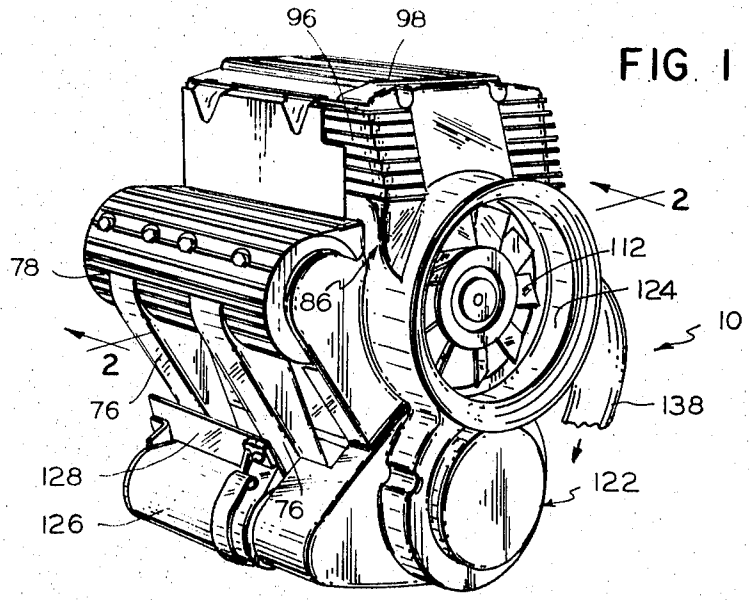

FIG. 2

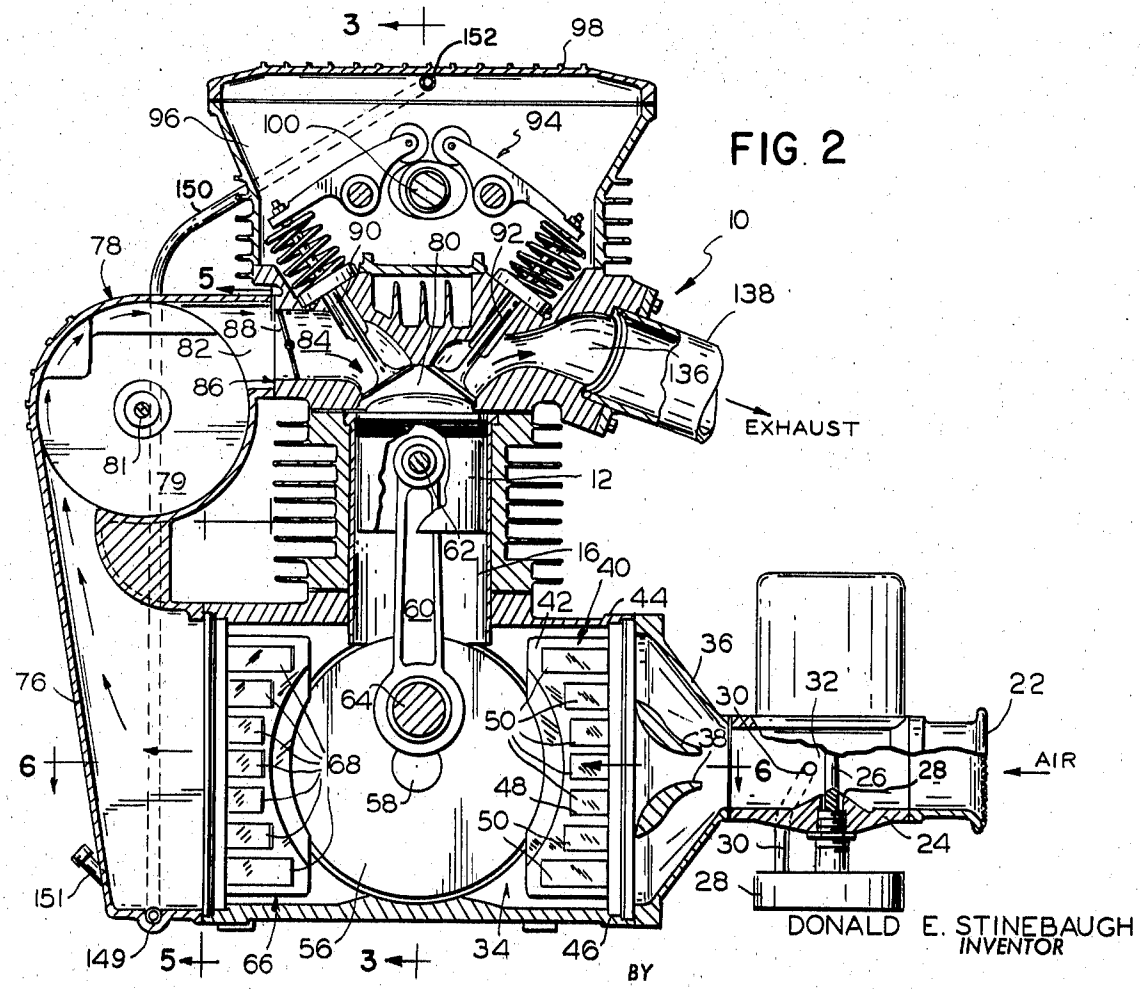

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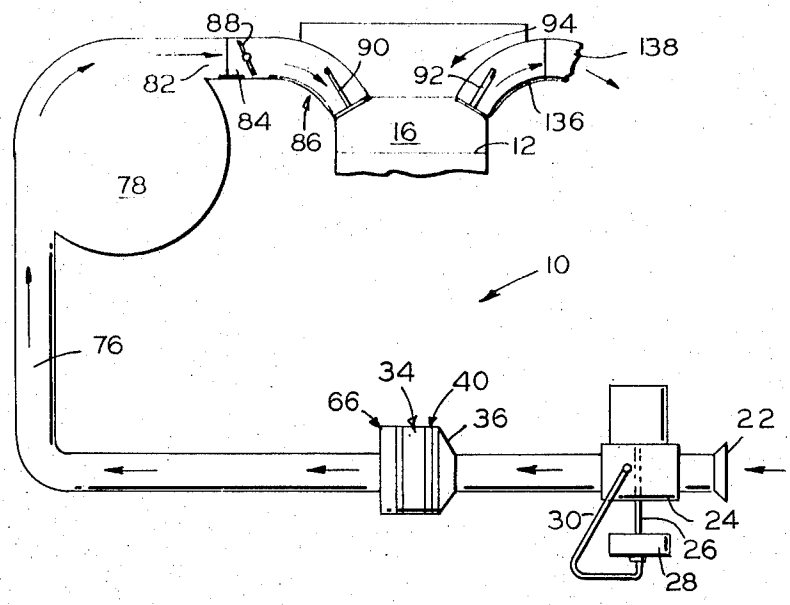
FIG. 4



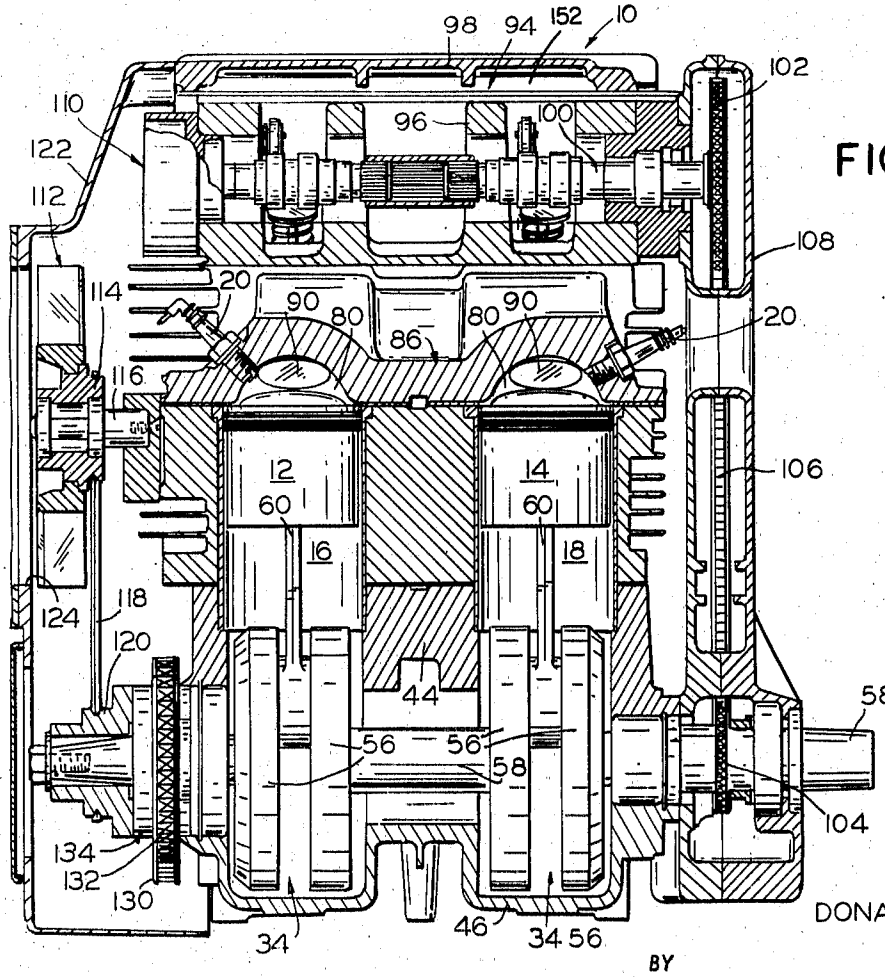


FIG. 3

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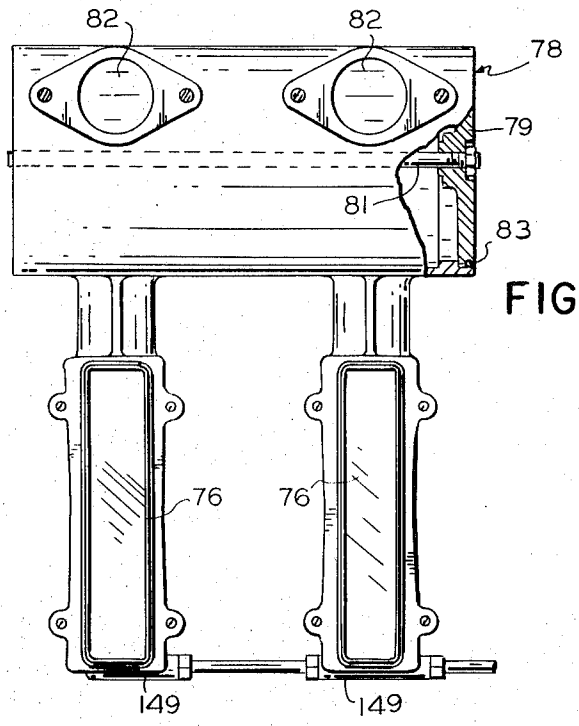

FIG. 5

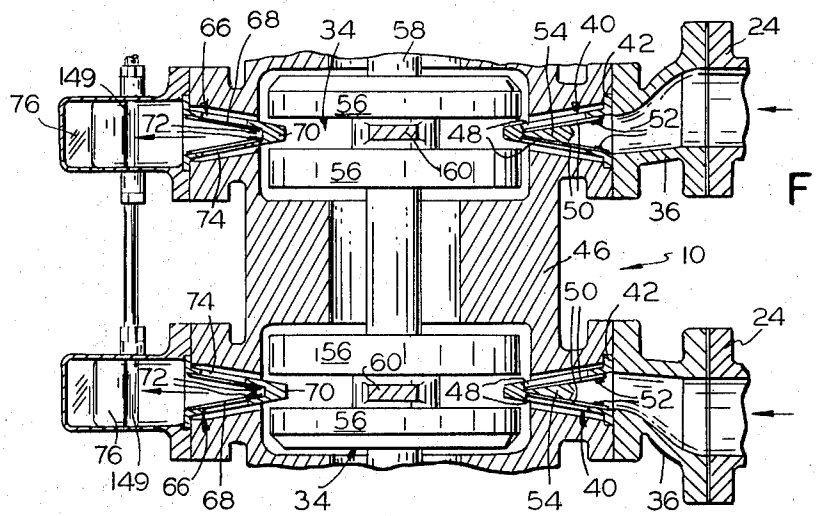

FIG. 6

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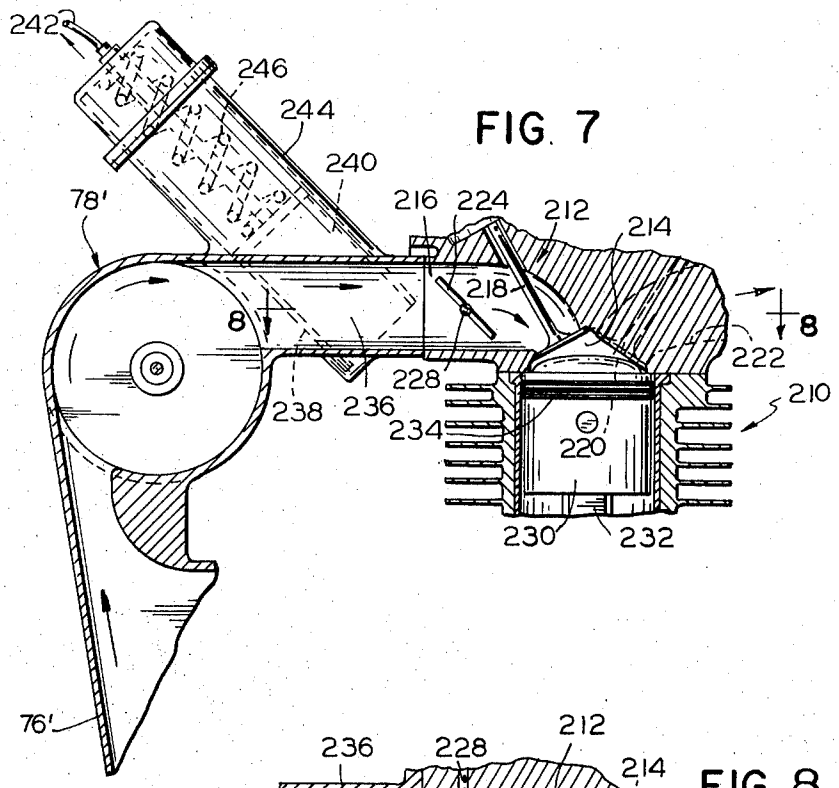

FIG. 7

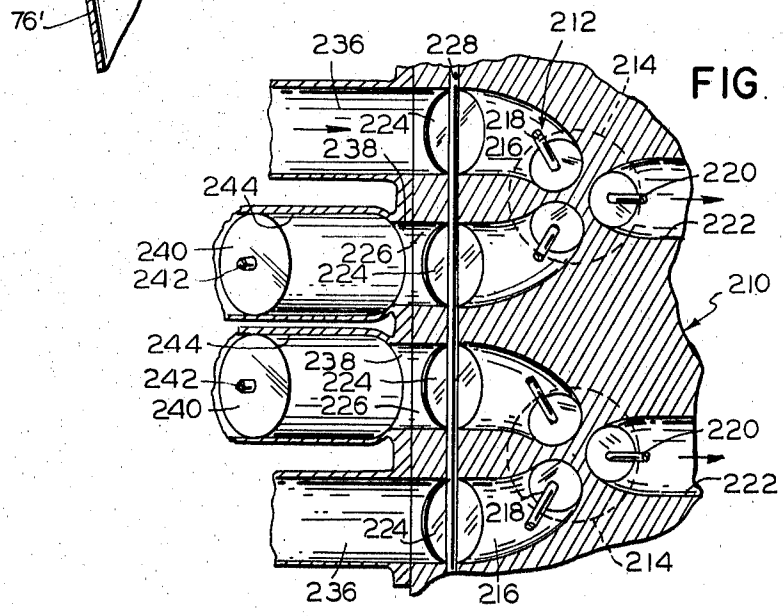

FIG. 8

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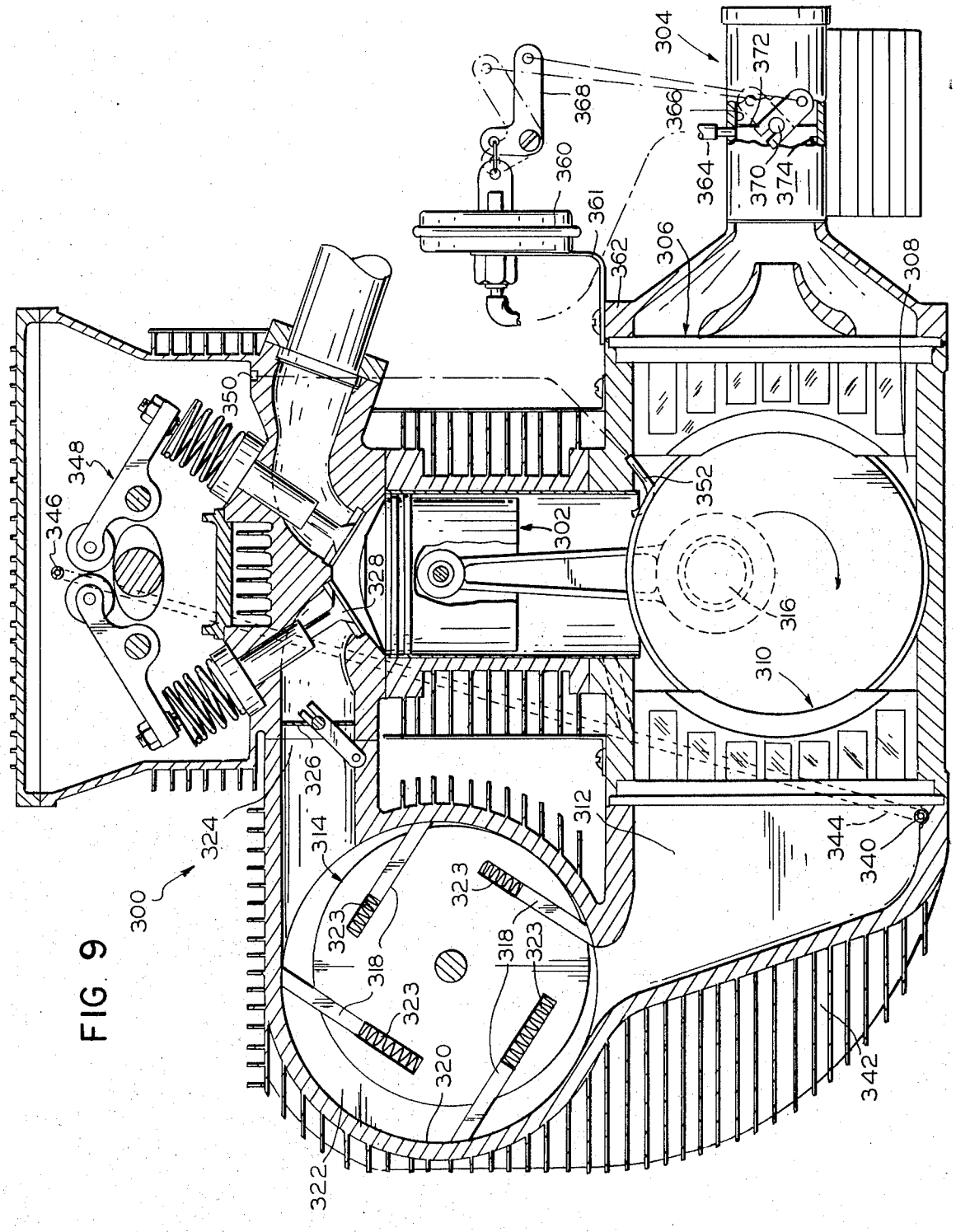

FIG 9

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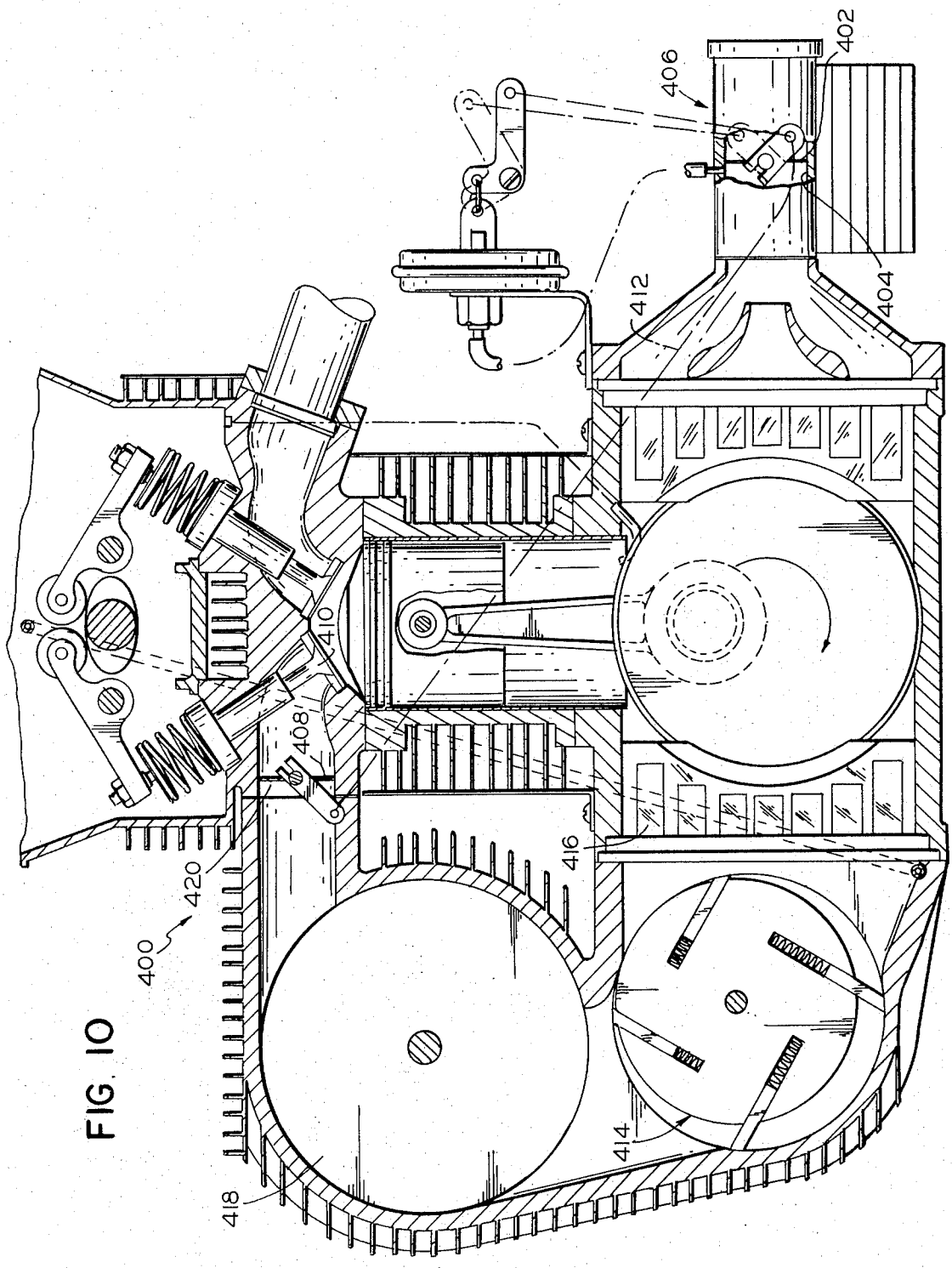

FIG. 10

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SUPERCHARGED ENGINES

This is a continuation of application Ser. No. 135,627 filed Apr. 20, 1971, now abandoned.

DESCRIPTION

This invention relates to supercharged engines, and more particularly to reservoired supercharged engines.

An object of the invention is to provide new and improved supercharged engines.

Another object of the invention is to provide reservoired supercharged engines.

A further object of the invention is to provide a supercharged engine having a supercharged fuel-air reservoir of a volume several times that of the displacement of the engine.

Another object of the invention is to provide a supercharged engine having a supercharged fuel-air reservoir and a throttle between the reservoir and intake valving of the engine.

Another object of the invention is to provide a supercharged engine having a reservoir mounted on and connecting a crankcase and a head of the engine.

Another object of the invention is to provide a supercharged engine having a check valve assembly attachable as a unit to a crankcase of the engine.

Another object of the invention is to provide a supercharged engine having a carburetor having a needle valve in its throat controlling the fuel-air mixture by flow of air through the throat via vacuum and/or mechanical linkage.

Another object of the invention is to provide a supercharged engine including a reservoir of a supercharged fuel-air mixture and a lubrication system wherein the pressure of the mixture is utilized to feed oil through the system.

Another object of the invention is to provide a supercharged engine having a first set of conventionally cammed intake valving and a second set of radically cammed intake valving paralleling the first set and closed at low engine speeds.

In the drawings:

FIG. 1 is a perspective view of a supercharged engine forming one embodiment of the invention;

FIG. 2 is a vertical sectional view taken along line 2—2 of FIG. 1;

FIG. 3 is a vertical sectional view taken along line 3—3 of FIG. 2;

FIG. 4 is a schematic view of the fuel and air mixture flow to the cylinder;

FIG. 5 is an elevational view taken along line 5—5 of FIG. 2;

FIG. 6 is a fragmentary horizontal sectional view taken along line 6—6 of FIG. 2;

FIG. 7 is a fragmentary vertical sectional view of a supercharged engine forming an alternate embodiment of the invention;

FIG. 8 is a fragmentary horizontal sectional view taken along line 8—8 of FIG. 7;

FIG. 9 is a vertical sectional view of a supercharged engine forming an alternate embodiment of the invention; and

FIG. 10 is a vertical sectional view of a supercharged engine forming an alternate embodiment of the invention.

Referring now in detail to the drawings, there is shown in FIGS. 1–6 a supercharged engine **10** of the four-stroke cycle type and forming one embodiment of the invention. The engine preferably has two pistons **12** and **14** reciprocated in phase in cylinders **16** and **18**, and fired alternately by spark plugs **20** (FIG. 3) fired by a known ignition system (not shown) driven in synchronism with the pistons. One each upward stroke of the pistons **12** and **14**, air is drawn into inlets **22** (FIGS. 2 and 4) through carburetors **24** where the air is mixed with fuel (gasoline) metered by needle valves **26** having vane or baffle portions **27** forming variable venturis and controlled by vacuum operated diaphragms **28** regulated by vacuum control lines **30** connected to throats **32** of the carburetors **24**. If desired, the vane portions **27** may be omitted to leave only the needle valve portions of the valves **26**. The fuel-air mixture is drawn through intake manifolds **36** provided with vanes **38** to distribute the mixture of reed-type check valves **40** and on into the crankcase **34**.

Each of the valves **40** includes a flanged, V-shaped body or insert **42** that is retained between upper half **44** and lower half **46** of the crankcase **34** by the intake manifold **36**. The body **42** is provided with passages **48** (FIG. 6) in each side through which the flow is controlled in one direction only by flexible reeds **50** anchored at their one end by rivets **52** with the free ends seating against tapered portion **54** of the body **42**. This permits the mixture to enter the crankcase **34** but prevents the backward flow on the downward stroke of the piston.

The crankcase **34** differs from usual crankcases in that the volume has been reduced to a minimum (slightly greater than the piston displacement) by filling pistons **12** and **14** and providing counterweight stuffers **56** (FIG. 3) forming part of the crankshaft **58**. The pistons **12** and **14** are attached to the crankshaft **58** by connecting rods **60** pivoting on wrist pins **62** (FIG. 2) and journals **64**.

On each down stroke of the pistons, the fuel-air mixture is compressed and discharged from the crankcase **34** through reed-type check valves **66** similar to valves **40** except that valves **66** permit only flow out of the crankcase. Each of the reeds **68** is anchored at one end to a V-shaped body **70** (FIG. 6) by a rivet **72** with the free end of the reed seated against the flanged portions of the body **70** and normally closing off opening **74**. The fuel-air mixture is discharged from the reed valves **66** into updraft passages **76** leading to a pressure tank or reservoir **78**, which, with the passages **76** and outlets **82**, define a supercharging chamber. The volume of the supercharging chamber is at least eight times the combined displacement of the pistons in their strokes. The ends of the reservoir **78** are closed by plates **79** (FIG. 5) held tightly in place by a through-bolt **81** and sealed by "O" rings **83**. As can be seen from FIG. 2, a smooth, tangential flow of fuel-air mixture is had around portion of the periphery of the reservoir **78** and out of the outlet ports **82** to intake valve passages **84** of engine head **86**. The intake passages **84** are provided with manually controlled butterfly-type throttle valves **88** (FIGS. 2 and 4) which provide easy starting and quickly responsive control.

Intake valves **90** and exhaust valves **92** (FIG. 2) are operated by an overhead cam and follower assembly **94** mounted in a camshaft housing **96** closed by a cover **98**. A camshaft **100** (FIG. 3) mounted in bearings in the housing **96** is provided with a sprocket **102**, which is driven by a sprocket **104** on the crankshaft **58** through a timing chain **106**. The chain and sprockets

are encased by a cover **108.** At the opposite end of the camshaft **100,** and operated thereby, is mounted the ignition breaker point assembly **110.** A fan **112** has a hub **114** rotatably mounted on a stub shaft **116** secured to the upper half of the crankcase **34.** A V-belt **118** drives the fan **112** from a pulley hub **120** on the crankshaft **58.** A fan housing **122** encloses the front end of the engine with an air passage **124** provided in the face of the cover. A starter **126** is mounted by a bracket **128** on the side of the engine **10.** The starter **126** cranks the engine **10** by way of a chain **130** and a sprocket **132.** A clutching mechanism **134** connects the sprocket **132** to the crankshaft **58.** The engine exhausts through ports **136** to exhaust lines **138.**

For lubrication, a supply of oil positioned in a sump portion **149** in the lower ends of the passages **76** (FIG. 2) is forced through line **150** to an overhead line **152** having small, downwardly directed nozzle holes in its bottom which mist the oil onto the camshaft **100,** rocker arms and valves. The oil goes through the valves to the cylinders and pistons and also lubricates the connecting rods and crankshaft. The nozzle holes in the line **152** are sufficiently small that the escape of oil therefrom has a negligible effect on the pressure in the supercharging chamber.

A cap covered, pressure tight inlet **151** is provided for supplying oil to the sump portion **149.**

There is, of course, only a slight leakage from the reservoir past the valves **90** and pistons **12,** but this is sufficient to permit easy starting after the engine has been stopped a few minutes. That is, the high supercharged pressure in the reservoir is reduced by the leakage when the engine is stopped for a few minutes to reduce the compression for starting. However, once the engine has been started, the pressure in the reservoir is built up to the normal supercharged pressure very rapidly, for the most part a small fraction of a minute. If desired, the reservoir may be provided with a pressure relief outlet having a normally closed, manually operable valve to relieve the reservoir pressure momentarily for easy starting of the engine.

OPERATION

On the downstroke of the pistons **12** and **14** the fuel-air mixture in the crankcase **34,** which is well stuffed, is highly compressed and is forced through the reed check valves **66** into the passages **76,** through the passages **76,** and directly to the outlets **82** by flowing tangentially around the inner periphery of the pressure tank **78** to the outlets. During this stroke, one of the intake valves **90** is open to one of the cylinders, and the fuel-air mixture flows past the associated throttle **88** and into that cylinder, the piston in the other cylinder making its power stroke. This charges the cylinder being supplied with the supercharged mixture and the valve **90** is closed near the end of the downward stroke. Then, during the upward stroke, the most recently fired cylinder **16** or **18** is exhausted and the supercharged mixture in the other cylinder is compressed, the upwardly moving pistons also drawing fuel-air mixture from the carburetors **24** through the inlet check valves **40** into the crankcase **34.** Then, on the next downstroke, the most recently charged cylinder is fired and the most recently exhausted cylinder is charged. The direct flow of the supercharged mixture from the passages **76** to the outlets **82** and the position of the throttles **88** substantially immediately adjacent the intake valves **90** make the engine quickly responsive to adjustments of the throttles which, of course, are keyed to each other so as to always be in positions identical to each other. The carburetor jets are automatically controlled by the pressure changes in the carburetor throats so as to supply fuel in proportion to the air being drawn into the crankcase. The oil is fed through the lines **150** and **152** by the supercharging pressure so that no oil pump is required, a pressure sealed cap (not shown) being provided for introducing the oil into the sump portion of the reservoir.

EMBODIMENTS OF FIGS. 7 AND 8

In FIGS. **7** and **8** an engine **210** forming an alternate embodiment of the invention has a radically cammed valve assembly **212.** The engine **210** is provided with supercharging passages **76'** directing the fuel-air mixture to a reservoir **78'** as in the first embodiment. For low speeds, those up to about 4,500 r.p.m., the fuel-air mixture is fed to the cylinders **214** by way of ports **216** and normally cammed intake valves **218** and is exhausted through valves **220** and ports **222.** Low speed throttle valves **224** and high speed throttle valves **225** in ports **216** and **226** are operated simultaneously by a common shaft **228** which is manually controlled. Pistons **230,** connecting rods **232** and piston rings **234** are of standard design and operation. As can be seen from the drawings, low speed outlet passages **236** from the reservoir **78'** are open whereas high speed passages **238** are closed by cylindrical valve sleeves **240,** thus preventing any flow of fuel-air mixture from entering the cylinder **214.** When the engine's speed starts to exceed 4,500 r.p.m., a wire **242** responsive to crankshaft speed automatically and gradually withdraws each valve sleeve **240** along its guide **244** against the force of a spring **246** to open the high speed passages **238** to the throttle **225** and the high speed intake valve **248.** This arrangement permits rapid speed change at the high level without starving the engine. The timings of the radically cammed, high speed intake valves **248** are advanced substantially over the timings of the low speed valves **218** as is well known in the art.

EMBODIMENT OF FIG. 9

A supercharged engine **300** forming an alternate embodiment of the invention includes a pair of pistons **302** in phase with one another and is like the engine of FIGS. **1–6** except as brought out hereinbelow. In the engine **300,** fuel-air mixture is drawn from a carburetor **304,** through intake check valves **306** and into a stuffed crankcase **308** on each upward stroke of the pistons, and is compressed and forced out of outlet check valves **310** as the pistons are moved downwardly. The supercharged mixture is moved upwardly through large volume reservoir passages **312** to a rotary, vane type pump **314** driven by and at the same speed as crankshaft **316.** The pump **314** has vanes **318** urged against cylindrical periphery **320** of chamber **322** by springs **323,** and further compresses the mixture and feeds it through passages **324** and past manually controlled butterfly valve-type throttles **326** to intake valves **328,** the two valves **328** being opened alternately, each on every other downstroke of the pistons. Camshaft assembly **348** has a camshaft driven in timed relationship by the crankshaft, and a distributor of an ignition system (not shown) is driven in synchronism with the crankshaft.

A groove **340** in the bottom of reservoir section **342** forms a sump for oil which is forced through line **344** to an overhead misting line **346** to lubricate camshaft assembly **348** and to be forced under pressure from a sump **350** through nozzles **352** into the cylinders and the crankcase.

Diaphragms **360**, which are mounted by a bracket **361** on an intake manifold **362** on which the carburetors **304** are mounted, are actuated by pressure from lines **364** opening into throats **366** of the carburetors to automatically maintain the proper fuel-air mixture through linkage **368** which adjusts shaft **370** on which butterfly valves **372** are keyed. The fuel is sucked up from jets **374**. The inlets of the lines **374** are just downstream from the movable upper edges of the butterfly valves so as to be most responsive to changes in pressure from the venturi effect.

EMBODIMENT OF FIG. 10

A supercharged engine **400** forming an alternate embodiment of the invention is similar to the engine **300** but has throttles **402** in throats **404** of carburetors **406**, which are manually operated in synchronism with operation of intake throttles **408** positioned very close to intake valves **410**. The throttle **402** keeps the mixture substantially uniform at all speeds. Linkage **412** interlocks the throttles **402** and **408**. Also, a rotary, vane-type pump **414** is positioned adjacent outlet check valve **416** and feeds into a large volume pressure tank or reservoir **418**, which supplies the highly supercharged mixture to manifold passages **520** in which the valves **408** are mounted. The throttles **408** control the speed and the valves **402** are moved in accordance with the throttles **408** to keep the fuel-air mixture desired.

What is claimed is:

1. In a supercharged engine,
a block having a plurality of cylinders,
a plurality of pistons movable in the cylinders,
crankshaft means driven by the pistons,
the pistons having a predetermined displacement volume when reciprocated,
a reservoir having a volume at least several times as great as said displacement volume of the pistons,
supply means including supercharging means for supplying a fuel-air mixture under pressure to the reservoir,
a plurality of short intake passages connecting the reservoir to the cylinders,
a plurality of intake valve means for connecting the passages to the cylinders,
a plurality of manually controlled throttle means in the passages positioned close to the intake valves for controlling the flow from the reservoir to the cylinders,
the supply means including carburetor means supplying the fuel-air mixture and control means for keeping the proportions of fuel and air supplied by the carburetor means substantially constant.

2. The supercharged engine of claim **1** including a crankcase and wherein the supply means includes first valving connecting the carburetor means to the crankcase and second valving connecting the crankcase to the reservoir.

3. The supercharged engine of claim **2** wherein the first and second valvings comprise check valves.

4. The supercharged engine of claim **2** including pump means for pumping supercharged fuel-air mixture from the crankcase into the reservoir.

5. The supercharged engine of claim **1** including an inlet to the reservoir directed toward the throttle means.

6. The supercharged engine of claim **5** wherein the reservoir has a curved surface tangential with the inlet and the throttle means.

7. The supercharged engine of claim **1** wherein the carburetor means includes an adjustable venturi, and means responsive to pressure in the venturi for adjusting the venturi.

8. The supercharged engine of claim **1** wherein the carburetor means includes adjustable needle valve means for controlling fuel flow, and means responsive to pressure in the throat of the carburetor means for adjusting the needle valve means.

9. The supercharged engine of claim **1** including a crankcase having an inlet opening and an outlet opening to the reservoir, and a valve insert including a valve body having ports and mounted in one of the openings and a plurality of reed valve members mounted on the valve body in normal positions closing the ports and movable by pressure to positions opening the ports.

10. The supercharged engine of claim **9** wherein the body is flanged and tapered with the flange fitting into a counterbored portion of said one of the openings.

11. The supercharged engine of claim **1** wherein the reservoir is mounted on the block and has fins for cooling the supercharged fuel-air mixture.

12. The supercharged engine of claim **1** including linkage means interlocking the manually controlled throttle means and the control means.

13. In a supercharged engine,
a block having cylinders,
pistons movable in the cylinders,
crankshaft means driven by the pistons,
the pistons having a predetermined displacement volume when a reservoir having a volume at least several times as great as said displacement volume of the pistons,
supply means including carburetor means and supercharging means for supplying a fuel-air mixture under pressure to the reservoir,
and intake valve means for connecting the reservoir to the cylinders,
the intake valve means including normally timed intake valves and radically timed intake valves.

14. The supercharged engine of claim **13** including valve means for permitting flow to the radically timed valves only at speeds greater than a predetermined speed.

15. The supercharged engine of claim **13** wherein the radically cammed valves comprises valve ports and valve members adapted to open and close the ports, the valve means including manifold passages leading to the valve ports and gate valves adapted to close the passages at a speed up to said predetermined speed.

16. In a supercharged engine, a block having cylinder means,
piston means movable in the cylinder means,
crankshaft means driven by the pistons means,
the piston means having a predetermined displacement volume when reciprocated,

a reservoir having a volume at least several times as great as said displacement volume of the piston means,
supply means including crankcase supercharging means for supplying a fuel-air mixture under pressure to the reservoir,
intake valve means for connecting the reservoir to the cylinder means,
an oil sump portion having oil therein exposed to the pressure of the fuel-air mixture in the reservoir,
and oil passage means leading from the oil sump portion to moving parts of the engine.

17. The supercharged engine of claim **16** including a camshaft housing, the oil passage means including a line from the sump portion to the camshaft housing and nozzle means connected to the line.

18. The supercharged engine of claim **17** including a second sump portion in the camshaft housing, a crankcase, and a second line leading from the second sump portion to the crankcase.

19. The supercharged engine of claim **18** including second nozzles connected to the second line and directed upwardly into the cylinder means.

20. In a supercharged engine,
a block having cylinders,
piston means movable in the cylinders,
crankshaft means driven by the piston means,
the piston means having a predetermined displacement volume when reciprocated,
a reservoir having a volume at least several times as great as said displacement volume of the piston means,
supply means including carburetor means and supercharging means for supplying a fuel-air mixture under pressure to the reservoir,
intake valve means for connecting the reservoir to the cylinder means,
a crankcase,
unidirectional valve means connecting the carburetor means to the crankcase,
and second stage supercharging means in series with the crankcase, to reservoir and the intake valve means.

21. The supercharged engine of claim **20** wherein the second stage supercharging means comprises a vane pump driven by the engine at a speed proportional to the speed of the crankshaft.

22. In a supercharged engine,
a block having a plurality of cylinders,
a plurality of pistons movable in the cylinders,
crankshaft means driven by the pistons,
a reservoir having a volume at least several times as great as said displacement volume of the pistons,
supply means including supercharging means for supplying a fuel-air mixture under pressure to the reservoir,
a plurality of short intake passages connecting the cylinders individually to the reservoir,
a plurality of intake valves for connecting the intake passages to the cylinders,
and a plurality of manually controlled interlocked throttles in the intake passages close to the valves for controlling flows of the fuel-air mixture individually in the passages.

23. The supercharged engine of claim **22** including a crankcase, a carburetor, first check valve means permitting flow from the carburetor to the crankcase, second check valve means permitting flow from the crankcase to the reservoir, and control means for adjusting the carburetor to keep the fuel-air mixture substantially constant over a wide range of air flow through the carburetor.

24. The supercharged engine of claim **23** wherein the control means comprises throttle means in the carburetor and mechanical linkage means interconnecting the throttles and the throttle means.

25. The supercharged engine of claim **23** wherein the control means comprises means responsive to rate of flow of air through the carburetor for adjusting the fuel flow.

26. In a four-stroke cycle supercharged engine,
a block having cylinder means,
piston means movable in the cylinder means,
crankshaft means driven by the piston means,
the piston means having a predetermined displacement volume when reciprocated,
a reservoir having a volume at least several times as great as said displacement volume of the piston means,
a crankcase,
supply means including crankcase supercharging means for supplying a fuel-air mixture under pressure to the reservoir,
short intake passage means connecting the reservoir to the cylinder means,
intake valve means for connecting the passage means to the cylinder means,
manually controlled throttle means in the passage means positioned close to the intake valve means for controlling the flow from the reservoir to the cylinder means,
the supply means including carburetor means supplying the fuel-air mixture to the crankcase and keeping the proportions of fuel and air supplied substantially constant,
first check valve means permitting flow from the carburetor means to the crankcase,
and second check valve means permitting flow from the crankcase to the reservoir.

27. The supercharged engine of claim **26** including a throttle in the carburetor means and mechanical linkage means interconnecting the throttle and the throttle means.

28. The supercharged engine of claim **26** wherein the carburetor means includes means responsive to rate of flow of air through the carburetor means for adjusting the fuel flow.

* * * * *

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,859,968 Dated January 14, 1975

Inventor(s) DONALD E. STINEBAUGH

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 2, line 5, change "One" to --On--

Col. 2, line 16, change "of" to --to--

Col. 2, line 43, change "portions" to --portion--

Col. 6, line 42 (claim 13) insert --reciprocated,--after "when" ;

commence new paragraph with "a reservoir... the pistons"

Col. 6, line 57 (claim 15) change "comprises" to --comprise--

Col. 6, line 66 (claim 16) change "pistons" to --piston--

Col. 7, line 42 (claim 20) change "to" to --the--

Signed and sealed this 18th day of March 1975.

(SEAL)
Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents
and Trademarks