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MANIFOLD STRUCTURE FOR INTERNAL-COMBUSTION ENGINES

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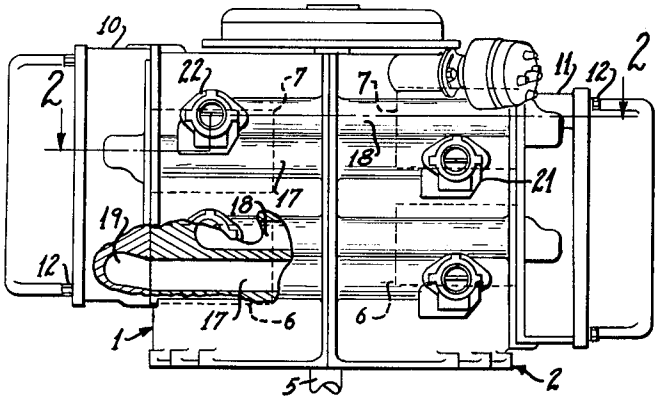


Fig. 1

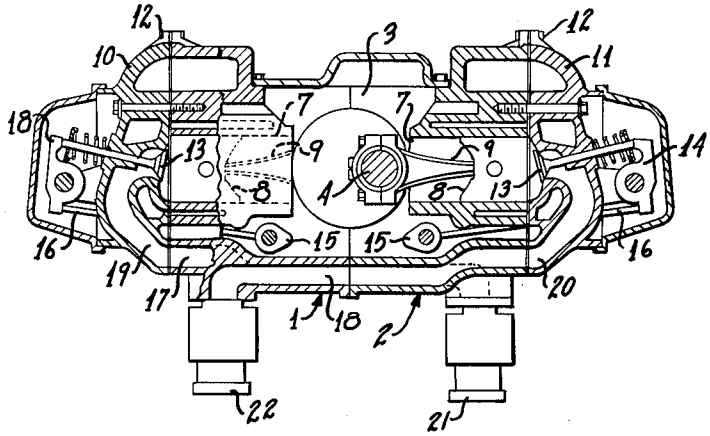


Fig. 2

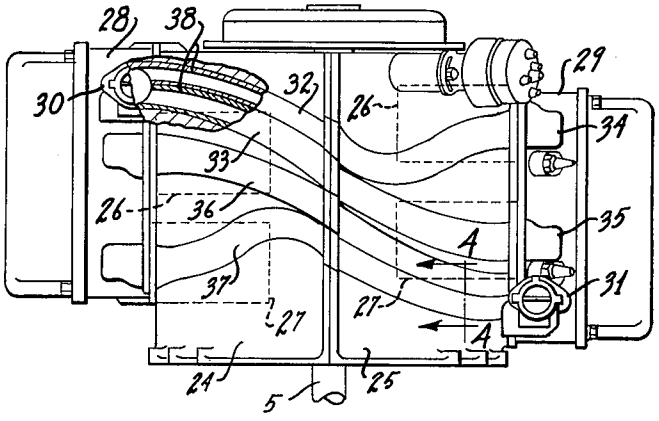


Fig. 3

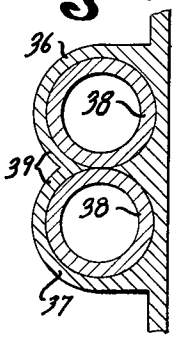


Fig. 4

INVENTOR.
ELMER C. KIEKHAEFER
BY
Andrus & Starke
Attorneys

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MANIFOLD STRUCTURE FOR INTERNAL-COMBUSTION ENGINES

Elmer Carl Kiekhaefer, Cedarburg, Wis., assignor, by mesne assignments, to Kiekhaefer Corporation, Chicago, Ill., a corporation of Delaware

Original application June 21, 1961, Ser. No. 118,563, now Patent No. 3,176,668, dated Apr. 6, 1965. Divided and this application July 29, 1964, Ser. No. 392,980
5 Claims. (Cl. 123—56)

This is a division of applicant's copending application Serial No. 118,563 filed on June 21, 1961, now Patent No. 3,176,668 entitled Manifold Structure for Internal-Combustion Engines.

This invention relates to a manifold structure for an internal-combustion engine and particularly to a tuned inlet manifold integrally cast within the cylinder and head of the internal-combustion engine.

Generally, the air intake manifold is manufactured as a separate component and releasably attached to the engine block with appropriate sealing gaskets therebetween to establish a hermetic joint. This is particularly true in internal-combustion engines where the exhaust and manifold system is tuned to a specific resonance to increase the efficiency of the system. The pulses which are present in the exhaust system are then also present at a negative pressure in the intake manifold. The negative pressure or vacuum developed within the intake manifold tends to destroy the gasket after long periods of use and disrupts the vacuum and the resultant air-fuel mixture.

A practical problem encountered in providing individual tuned intake systems has been the provision of equal lengths of conduit to each of the cylinders without the resulting manifold system including a great number projections in order to provide the proper length of the individual conduits.

The present invention is directed to an integrally cast manifold system having individual passageways for proper tuning to the desired operating speed and more particularly to an integrally cast manifold system for horizontally opposed cylinder engines.

In accordance with the present invention, the inlet manifold passageways are integrally cast into the side of the cylinder block assembly. The carburetor of each cylinder is mounted on the opposite end of the cylinder block assembly or the opposite cylinder head. The manifold passageways extend across the cylinder block assembly completely within the wall thereof. The width and length of the block of an opposed cylinder engine allows sufficient room for establishing the necessary and equal lengths of each of the manifold conduits by curving the passageway in the plane of the block wall and without projecting the passageways outwardly from the principal plane of the cylinder block. Consequently, the structure provides a compact and neat appearing structure which can be commerically employed.

In certain designs, straight passageways having their axes parallel to the axis of the cylinder bores can be employed. This permits simple casting production because the manifold passageways can be formed by the same cores as the cylinder bores and the water jackets. Therefore, the casting is not unduly expensive.

Preformed conduits of a material capable of withstanding the heat and pressure developed can also be cast within the cylinder block when die casting the block. The preformed conduits are secured within the mold and enclosed within a minimum amount of casting metal sufficient to maintain the conduits in captive relation within the block wall and thereby forming the tuned manifold system. The use of the preformed conduits eliminates the

necessity to core the passageways and practically increases the latitude in the configuration in which the individual conduits can be formed in order to provide equal length for the purposes of tuning the entire manifold system to the selected resonant frequency. Because the encircling casting metal need only hold the preformed conduit in place, a relatively light and strong construction can be employed.

The present invention thus provides an integrally formed tuned manifold system for an internal-combustion engine which is relatively low in cost and readily produced as a compact, pleasant appearing unit.

The drawings furnished herewith illustrate the best mode presently contemplated for carrying out the invention.

In the drawings:

FIG. 1 is a side elevational view of an opposed cylinder type engine;

FIG. 2 is a horizontal section taken on lines 2—2 of FIG. 1;

FIG. 3 is a side elevational view similar to FIG. 1 showing an alternative construction in accordance with the present invention; and

FIG. 4 is a vertical section taken on lines 4—4 of FIG. 3.

Referring to the drawings and particularly to FIGS. 1 and 2, an internal-combustion opposed cylinder engine is illustrated including a left cylinder block 1 and a right cylinder block 2 bolted or otherwise secured in back-to-back relation. A common crankcase 3 is defined by the adjoining portions of the cylinder blocks 1 and 2 rotatably housing a crankshaft 4 which extends downwardly as a drive shaft 5.

Each of the cylinder blocks 1 and 2 includes a pair of horizontally opposed cylinders 6 and 7 vertically spaced within the forward or outer portion thereof to form a four cylinder engine. The opposed cylinders 6 and the opposed cylinders 7 in the blocks 1 and 2 are vertically offset with pistons 8 slidably disposed one within each of the cylinders. Piston rods 9 connect the opposed pistons 8 to the common crankshaft 3.

Cylinder heads 10 and 11 are secured respectively to the ends of the cylinder blocks 1 and 2 as by bolts 12 in accordance with known construction. Each of the heads 10 and 11 includes a pair of valves 13 one for each of the cylinders 6 and 7. Valves 13 are operated through an engine-driven valve positioner or tappet unit 14 each of which is coupled to an engine-driven cam 15 by a rigid link 16. Cams 15 are driven in synchronism with the crankshaft 4 to properly open and close valves 13 for sequentially admitting a mixture of air and fuel to the corresponding cylinders 6 or 7 in timed relation with the movement of the corresponding pistons 8.

The lower opposed cylinders 6 and the upper opposed cylinders 7 are provided with similar inlet manifold systems and only upper opposed cylinders 7 are particularly described hereinafter. Corresponding elements for the cylinders 6 are similarly numbered for purposes of simplicity and clarity of description.

A pair of individual cylinder block manifold passageways 17 and 18 and a pair of related cylinder head manifold passageways 19 and 20 form individual continuous air-fuel charge passageways for introducing the air-fuel charge to the upper cylinders 7 from suitable carburetors 21 and 22.

The cylinder block manifold passageways 17 and 18 are integrally cast with the cylinder blocks 1 and 2 in vertically arranged side-by-side relation and extend from the associated carburetors 21 and 22 horizontally parallel to and aligned with the axis of the cylinders 7 and cylinder cooling jackets 23.

The lower passageways 17 and 18 are similarly located with respect to the lower opposed cylinder 6 as shown in FIG. 1. The parallel construction permits relatively simple casting of the manifold passageways 17 and 18 when casting the cylinder blocks 1 and 2.

In the embodiment of FIG. 1, individual carburetors 21 and 22 are provided for each of the opposed cylinders 7 and are properly connected by the individual passageways defined by passageways 17–20. The carburetors 21 and 22 are secured to the opposite cylinder blocks 1 and 2 in alignment with and immediately adjacent the end of the corresponding cylinder block manifold passageways 17 and 18.

Referring particularly to FIG. 2, the cylinder head manifold passageways 19 and 20 are integrally cast in the heads 10 and 11 as substantially U-shaped passages terminating in alignment with the corresponding opposed cylinders 7 at one end and with the cylinder block passageways 17 and 18 at the opposite end. The manifold passageways at the inlet end slant slightly upwardly in the left hand head 10 and downwardly in the right hand head 11 to align the inlet end of each passageway 19 and 20 with the adjacent end of passageways 17 and 18.

The complete inlet manifold passageways thus defined are similarly of a given length and diameter to tune the inlet manifold system to a predetermined resonance in accordance with the pulse frequency developed at a selected engine speed.

In the operation of the engine, the valves 13 are opened and closed to sequentially introduce air-fuel charges to the cylinders 6 and 7 from the corresponding carburetors 21 and 22. At each intake portion of the cycle, a back-pressure pulse wave is developed. The tuned manifold passageways, defined by the integrally cast passageways 17–20, correlate the introduction of the air-fuel charge into the cylinders 6 and 7 at the negative portion of the pulse wave when the engine is operating at the selected resonant speed. This produces maximum efficiency of the introduction of the air-fuel charge into the cylinders 6 and 7 at the desired speed.

The illustrated cylinder block passageways 17 and 18 are integrally cast completely within the side walls of the opposed cylinder blocks 1 and 2 to provide a compact and practical construction. The tuned passageways are generally straight and parallel to the axes of the cylinders 6 and 7 and may therefore be readily cast by the same cores which form the cylinders 6 and 7 and water jackets 23.

FIGS. 3 and 4 illustrate a similar opposed four-cylinder engine wherein the desired tuning demands inlet passageways longer than the width of the cylinder block structure.

In FIGS. 3 and 4, a pair of back-to-back cylinder blocks 24 and 25 also includes opposed upper cylinders 26 and opposed lower cylinders 27. Cylinder heads 28 and 29 close the opposite ends of blocks 24 and 25. A pair of carburetors 30 and 31 are mounted one each on the heads 28 and 29. Each carburetor 30 and 31 supplies a desired mixture to the pair of vertically arranged cylinders 26 and 27 in the opposite cylinder blocks 24 and 25.

The carburetor 30, which is shown secured to the head 28, is mounted adjacent the upper portion of the head. An upper cylinder manifold passageway 32 and a separate lower manifold passageway 33 are integrally cast in the side walls of cylinder blocks 24 and 25. Passageway 32 connects carburetor 30 to the upper cylinder 26 and passageway 33 connects carburetor 30 to the lower cylinder 27 in the block 25.

The upper cylinder manifold passageway 32 extends through the side walls of cylinder blocks 24 and 25 and initially curves downwardly through cylinder block 24 and the initial portion of the opposite cylinder block 25. Thereafter, passageway 32 curves upwardly defining a generally U-shaped passageway terminating in communication with a manifold passageway 34 in the head 29.

The curved configuration increases the length of the manifold passageway 32 to allow any desired tuning.

The lower cylinder manifold passageway 33 extends longitudinally and continuously downwardly from the carburetor 30 through the side walls of cylinder blocks 24 and 25 and terminates in communication with a manifold passageway 35 in the head 29 for the lower cylinder 33. Passageways 32 and 33 are formed in the same length and diameter to establish similar tuning of the cylinders 26 and 27 in the cylinder block 25.

The opposite carburetor 31 is secured to head 29 and is similarly connected by manifold passageways 36 and 37 to cylinders 26 and 27 in cylinder block 24.

Each of the manifold passageways 32, 33, 36 and 37 includes an inner metallic conduit 38 integrally connected and captured within the side walls of the cylinder blocks 24 and 25 by a relatively thin thickness of cast metal 39, as most clearly shown in FIG. 4. A minimum amount of cast metal 39 is needed to enclose and properly support the pre-formed conduits 38 and results in a light, strong cylinder block construction. The individual conduits 38 can be readily pre-formed to give the necessary configuration for establishing equal length of each manifold passageways while maintaining the passageways within the side walls of the cylinder blocks. The several pre-formed conduits 38 also eliminate expensive and complicated coring of the mold for casting of the cylinder blocks 24 and 25.

In operation, the illustrated embodiment of FIGS. 3 and 4 is the same as that of the embodiment of FIGS. 1 and 2 and no further description thereof is given.

Although the present invention has been described as a component part of an outboard motor, the invention is equally applicable to all other internal-combustion engines wherein the manifold system is to be tuned to a selected operating speed.

The present invention provides an improved opposed cylinder engine having a tuned intake manifold system integrally formed with the block structure in a compact and neat appearing assembly. The manifold passageway may be provided with a curved configuration to properly and similarly tune all cylinders without unsightly projections formed as a part of the engine structure and in an inexpensive manufacturing process.

Various modes of carrying out the invention are contemplated as being within the scope of the following claims particularly pointing out and distinctly claiming the subject matter which is regarded as the invention.

I claim:

1. In an internal-combustion engine a cast cylinder block, a head assembled with one end of said block and having a fuel inlet passage therein opening into a cylinder in said block, a cast housing member assembled with the other end of said block and providing a crank case therewith, a carburetor mounted on said cast housing member remote from said head and block in a direction generally axial of said head, pre-formed manifold liners integrally cast into the cylinder block and said cast housing member and defining an integrally cast manifold passageway in the wall of the housing member and the cylinder block for carrying the fuel charge from the carburetor to the inlet passage for the cylinder and being selected of a length and cross-section to tune the manifold system for a selected operating engine speed.

2. In an opposed cylinder engine having back-to-back opposed cylinders in a cast cylinder block unit, individual carburetors for the opposed cylinders and mounted adjacent the opposite cylinder, and a pair of pre-formed manifold tubular members integrally cast into the wall of the cylinder block unit and defining manifold passageways oppositely extending from the respective carburetor and being selected of a corresponding length and cross-section to tune the manifold system for a selected operating engine speed.

3. In an opposed cylinder engine having a multiple of in-line opposed cylinder pairs in a cast cylinder block unit, carburetors mounted as a part of the engine for supplying a fuel mixture to at least a pair of immediately adjacent non-opposed cylinders, said carburetors being mounted on the opposite end of the engine, and a pair of integrally cast manifold passageways communicating with each carburetor and being integrally cast into the side wall of the cylinder block unit, the pair of passageways extending longitudinally and laterally within the side wall of the block unit from the carburetor to the associated cylinders and being selected of a length and cross section to tune the manifold system for a selected operating engine speed.

4. In an opposed cylinder engine having a multiple of in-line opposed cylinder pairs in a cast cylinder block unit, carburetors mounted as a part of the engine for supplying a fuel mixture to at least a pair of immediately adjacent non-opposed cylinders, said carburetors being mounted in alignment with one of the associated cylinders and on the opposite end of the engine, a pair of integrally cast manifold passageways communicating with each carburetor and being cast in the side wall of the cylinder block unit, one of said passageways in each pair extending longitudinally and laterally in the general form of a U-shape to connect the carburetor to the aligned cylinder, and the second of said passageways in each pair extending longitudinally and laterally to connect the carburetor to the other of the cylinders, said passageways being selected of a length and cross section to tune the manifold system for a selected operating engine speed.

5. In an opposed cylinder engine having a multiple of in-line opposed cylinder pairs in a cast cylinder block unit, carburetors mounted as a part of the engine for supplying a fuel mixture to a pair of immediately adjacent non-opposed cylinders, said carburetors being mounted in alignment with one of the associated cylinders and on the opposite end of the engine, and a plurality of tubular members integrally cast into the cylinder block unit and defining manifold passageways connecting each carburetor with the proper cylinders, the pair of passageways extending longitudinally and laterally within the side wall of the block unit from the carburetor to the associated cylinders and being selected of a length and cross section to tune the manifold system for a selected operating engine speed.

References Cited by the Examiner

UNITED STATES PATENTS

1,190,252	7/1916	Fornaca	123—59
1,442,510	1/1923	Aitkin	123—56
1,903,607	4/1933	Moorhouse	123—52
2,506,250	5/1950	Taub	123—56
2,963,009	12/1960	Dolza	123—52 X

FOREIGN PATENTS

863,570 1/1953 Germany.

MARK NEWMAN, *Primary Examiner.*

FRED E. ENGELTHALER, *Examiner.*