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TWO-STAGE MANIFOLD AND CARBURETOR

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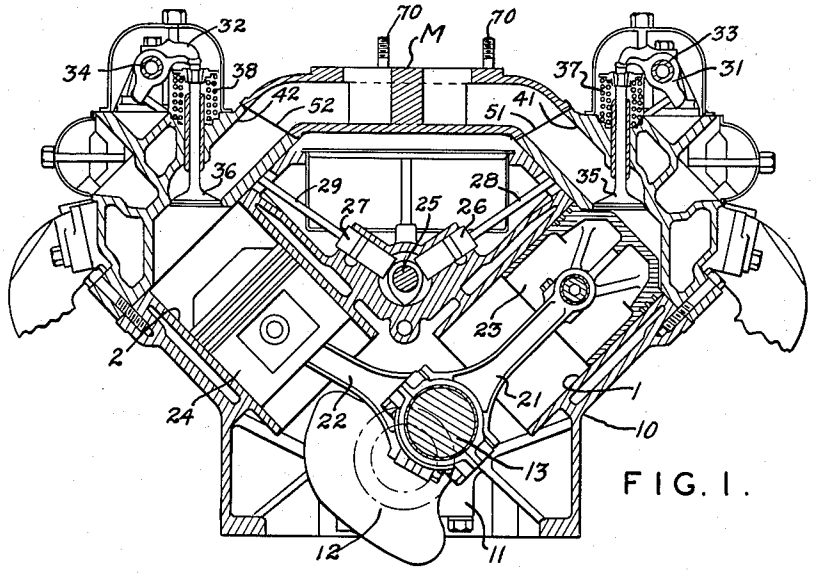


FIG. 1.

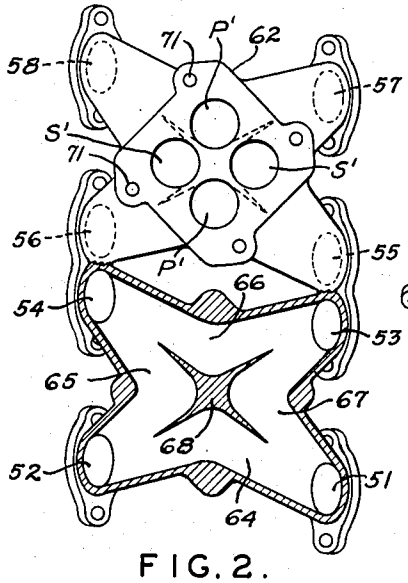


FIG. 2.

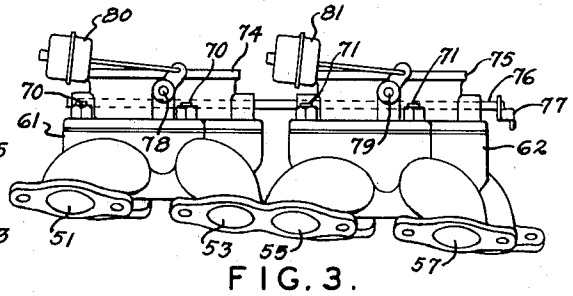


FIG. 3.

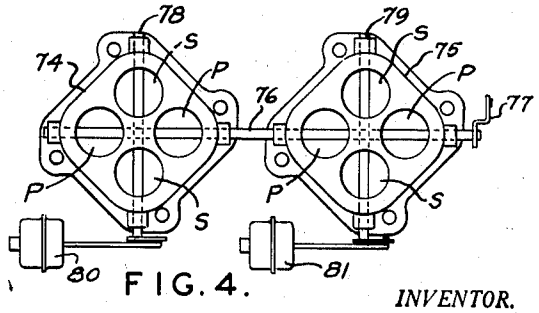


FIG. 4.

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TWO-STAGE MANIFOLD AND CARBURETOR

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7 Claims. (Cl. 123—52)

This invention relates to internal combustion piston engines having cylinders arranged in parallel rows and, more particularly, to an induction system for this type of engine providing dual manifolds for multi-barrel, multi-stage carburetion.

The most prevalent form of engines of the type above referred to is the V–8, which is fast becoming the standard in the motor car field. This invention will be described and illustrated as applied to this specific form, although it obviously can be adapted to most, if not all, known engines of this general type, regardless of the number of cylinders.

At the present time, the motor car manufacturers are extremely power conscious, and each year engine performance must be improved in order to meet the claims of competition. This improvement must be accomplished without basic engine changes, since this cost would be prohibitive. Thus, each succeeding model has made changes in the induction system, because this is regarded as the source of greatest possible gain in engine output. It is well understood in the art that better engine breathing characteristics yield better volumetric efficiency and higher torque, and cooler temperature of the charge increases the mechanical octane rating of the engine to permit an increase in compression ratio.

Of course, all of these benefits could be obtained with individual carburetors for each cylinder, but this presents such obvious technical difficulties that up to now it has been avoided.

A brief description of V–8 engines and present induction systems applied thereto is included here solely to form a background to better explain the advantages and objects of the present invention.

A V–8 engine has a cylinder block with opposite banks of cylinders, four in each bank, inclined with respect to one another at 90 degrees. Looking down at the top of such an engine, one of the banks of cylinders is slightly ahead of the other. This offset relation between the two banks is sufficient to permit connecting rods of opposite cylinders to be journaled side by side on the same crank pin of the crankshaft. The four crank pins of the crankshaft are displaced, so that the end throws of the crankshaft journaling connecting rods one and two and seven and eight, respectively, are exactly opposite. Likewise, the crank pins journaling connecting rods three and four and five and six are opposite but displaced 90 degrees with respect to the end cranks.

The cylinders are numbered, generally, from front to back, with the odd numbered cylinders 1—3—5—7 in the bank offset forwardly. Cylinders 2—4—6—8 are in the bank offset rearwardly.

Looking at the front of the engine, if the odd bank is on the right and the even on the left, then certain of the pistons will be in a position to fire each 90 degrees. For example, starting at the top dead center for number 1 cylinder, in the first position both 1 and 6 will be at at top dead center. Ninety degrees later, 5 and 8 will be

at top dead center. Ninety degrees later, 4 and 7 will be at top dead center, and ninety degrees later 2 and 3 will be at top dead center. With the above piston positions it is possible, by changing camshaft design for valve timing and ignition, to obtain several firing orders of the cylinders. There are three such systems employed. The one used by the greatest number of car manufacturers fires one cylinder in one bank, two cylinders in the other, one in the first, and then repeates on the second revolution, such as 1—8—4—3—6—5—7—2. The other two systems employed fire one cylinder in one bank and one in the other alternately, or one in one bank, one in the other, and two in the first bank, and then repeat for the second revolution of the crankshaft.

The reason for the adoption of such firing orders will become apparent from the following discussion relating to induction systems now generally employed. These systems are now standardized, and in all dual manifolds each contains passages interconnecting the two end cylinders in one bank and the two inner cylinders in the opposite bank, with an intake centrally located on top of the engine. Although the firing orders used may seem dissimilar when compared, actually these dissimilarities are primarily due to different systems of engine cylinder numbering. Without exception, firing orders are selected so that intake strokes in the respective manifolds are spaced 180 degrees.

Up until now, improvements in the induction system have been confined to increasing the number of intakes in the dual manifolds and applying, first, dual carburetors, and then four-barrel, multi-stage carburetors. One manufacturer has gone so far as to apply two four-barrel carburetors. No attempt has been made to improve the manifolding itself so as to obtain the equivalent of individual carburetion, although two four-barrel carburetors of the multi-stage type seems to offer this possibility.

The present invention is directed to an improvement in a manifold system to obtain all the advantages of individual carburetion by the use of two multi-stage, four-barrel type carburetors, and thereby eliminate the necessity of heat to aid in distribution of fuel through the manifold. In this invention, a dual manifold is used in which the individual system of passages connects the adjacent four cylinders at each end of the V–8 engine. Each manifold mounts a four-barrel, multi-stage carburetor with the barrels so arranged that each primary stage barrel operating singly will furnish the fuel mixture to a pair of intake ports in the engine in the low-speed range. When the secondary stage barrels come into operation, each intake port will be served by both a primary and a secondary, and adjacent intake ports wil be directly supplied from two secondaries and a primary stage barrel.

The close relationship between the intake ports and the carburetor means short, straight passages communicating directly between the carburetor and the inlet port, so that velocities through these passages will be substantially those at the intake port of the engine. This feature will contribute to good distribution throughout the low and medium range of engine speeds. At high engine speeds, all of the advantages of individual carburetion are attained, since each intake port communicates directly with a primary and a secondary stage barrel of the carburetor, and any two adjacent intake ports communicate directly with a primary and two secondary stage barrels of the carburetor, so that adequate capacity is immediately available to supply the intake ports, and this will be true with regular or irregular firing order in each group of four cylinders.

The accompanying drawings illustrate a construction operating in accordance with the principles of the invention above described.

In the drawings,

Fig. 1 is a vertical section of a V–8 engine taken along a line extending through No. 1 and No. 2 cylinders.

Fig. 2 is a top plan view of an intake manifold with parts broken away to illustrate the internal construction.

Fig. 3 is a side view of the manifold in Fig. 2 with throttle bodies for carburetors mounted thereon.

Fig. 4 is a top plan view of the throttle bodies shown in Fig. 3.

The engine shown in Fig. 1 is a conventional V–8 type with cylinders arranged in parallel rows inclined 90 degrees with respect to one another. Looking at the front of the engine as illustrated in Fig. 1, the crankshaft rotates clockwise, and the cylinders in the right bank are offset forwardly of those in the left bank. Those in the right bank will be referred to as one, three, five and seven. Those in the left bank will be referred to as two, four, six and eight.

The cylinder block **10** is a single casting containing all of the cylinders. Fig. 1 shows the cylinder **1** in the right bank, and cylinder **2** in the left bank. The cylinder block **10** has a series of main bearings **11**, only one of which is shown, which rotatably support the crankshaft **12**. According to general practice, the crankshaft **12** has four separate crank throws, each having a journal or crank pin **13**, one of which is shown in Fig. 1. Journaled on the crank pin **13** in side-by-side relation are a pair of connecting rods **21** and **22**, which are, in turn, connected with pistons **23** and **24**, respectively, reciprocating within the cylinders **1** and **2** during rotation of the crankshaft.

Mounted in suitable bearings between the cylinder banks is a camshaft **25** for operating the valves located in the cylinder heads. In this view, only two of the valves are shown, and both are intake valves.

The valve train for operating the valves includes tappets **26** and **27**, which reciprocate push rods **28** and **29** extending to rocker arms **31** and **32** journaled on the rocker shafts **33** and **34**. The opposite ends of the rocker arms contact the valve stems for operating the poppet valves **35** and **36**. Valve springs **37** and **38** resiliently urge the valves **35** and **36** toward their respective seats.

Each bank of cylinders has a plurality of intake ports—in this case, four in each bank. In Fig. 1 the intake port **41** controlled by the valve **35** supplies fuel mixture to cylinder **1**. The intake port **42** controlled by the valve **36** supplies fuel mixture to cylinder **2**. The intake ports, in turn, are supplied with fuel mixture through dual manifolds M, each of which has a separate carburetor.

The construction of the manifolds M illustrated in Figs. 2 and 3 is identical. The forward manifold has outlets **51**, **53** and **52**, **54** which connect directly with the intake ports in opposite banks of cylinders one to four. The rear manifold is provided with outlets **55** and **57** for cylinders three and five in the right bank, and **56** and **58** for cylinders six and eight in the left bank. Mounting pads **61** and **62** each have four inlets, P'—P' and S'—S', which correspond in size and spacing with the four mixture conduits or barrels of multi-stage carburetors.

Each manifold has star-shaped internal passages in the shape or arrangement of a quadrilateral. The passage **64** connects outlets **51** and **52**. The passage **65** connects outlets **52** and **54**. Passage **66** connects outlets **53** and **54**, and a fourth passage **67** connects outlets **51** and **53**. These passages are formed between the outside walls and a star-shaped partition **68**. One of the four inlets P'—S' shown in each of the mounting pads **61** and **62** communicates directly with each of the passages **64** to **67** approximately midway of its length.

Mounting pads **61** and **62** have vertical studs **70** and **71** for attachment of a carburetor on each mounting pad. The particular type of four-barrel carburetor contemplated is one such as shown in the co-pending application of James F. Armstrong, Serial No. 418,049, filed March 23, 1954. This particular carburetor, when modified by substitution of the throttle body such as disclosed and described hereinafter, can readily be adapted to use with these manifolds.

Fig. 3 illustrates two throttle bodies **74** and **75** secured to the manifolds M. A primary throttle shaft **76** extends through each throttle body **74** and **75** for operating the primary throttles P in each carburetor. A lever **77** secured to one end of the shaft **76** is provided for connection with the usual manual control.

The secondary throttles S in each throttle body are controlled by the throttle shafts **78** and **79** and operated by suction motors **80** and **81**, all in a manner completely disclosed in the said Armstrong application. As shown in Fig. 3, the secondary throttle shafts extend through the throttle body above the primary throttle shaft **76**. The primary throttle shaft mounts two primary throttles P in the throttle body **74**, and two in the throttle body **75**, so that all of the throttles P will open simultaneously and in synchronism. The secondary throttle shaft **78** mounts two secondary throttles S which will be operated in unison by the suction motor **80**. Likewise, the secondary throttle shaft **79** mounts two secondary throttles S, which will be operated simultaneously by the suction motor **81**. Throttle shafts **78** and **79** may be interconnected for purposes of synchronization, if desired.

The alternate arrangement of primary and secondary throttles in this invention differs from the usual side-by-side arrangement of primaries and secondaries in conventional four-barrel carburetors. There is no reason, however, why a carburetor such as shown by the Armstrong application, when provided with a throttle body of this design, would not be suitable for the purpose of this invention. Possibly some other slight changes would be necessary such as the relocation of the choke valve in that carburetor. Of course, other types of carburetors could be applied, if desired, such as a dual and two singles.

Each of the dual manifolds is completely independent, as is shown in the drawings, but it is contemplated that small balance holes may be provided between the two, if desired. These balance passages could readily be located between the outlets **53** and **55**, **54** and **56**.

During operation of the engine, fuel mixture will be supplied through the primary mixture conduits or valves of the carburetor intermediate the length of passages **64** and **66** in one manifold, and the corresponding position in the passages in the other. Thus, when the engine is operating on the primaries alone, fuel distribution to each intake port will be through short, direct passages of a capacity preferably matched to each carburetor barrel. When the secondary throttles are open and operating in connection with the primaries, fuel will be supplied to each of the intake ports by short, direct passages, preferably matched in size to the secondary barrels of the carburetor. The supply of fuel from the primary inlets P' to the primary passages and the secondary inlets S' to the secondary passages of the manifold give two-stage manifolding combined with two-stage carburetion. In addition, each group of four cylinders is continuously connected in a closed circuit. This closed circuit would negative the effect of pulsations in the flow on feul distribution because each pulsation would damp itself in a closed circuit, and would amount to a mere momentary change of pressure throughout the whole circuit, so that no reverse flow would occur. A pressure change of this kind would, therefore, have no effect on the directional flow of gases to the outlets of the manifold.

The short, direct passages from each of the primaries and each of the secondaries will communicate directly with the carburetor, so that velocities through the carburetor barrels and the intake manifolds will be substantially identical with the high velocities due to pulsations at the intake ports of the engine. The short, direct passages are such as to negative the effect of any accumulation of fuel on the manifold walls, and these two features acting together eliminate the necessity for heating except for de-icing purposes.

Another feature of this particular manifold arrangement is that each intake port communicates directly with a primary carburetor barrel and a secondary carburetor barrel, and, furthermore, each adjacent pair of intake ports communicates directly with three barrels of the carburetor. Where the firing orders are such as above described in this application, there will be a certain overlapping of intake strokes in the cylinders supplied by each manifold. Thus, in the front manifold the mixture will be simultaneously flowing from outlets 54—53 and then 52—51, since cylinders 4—3 and 2—1 fire in sequence. In the back manifold, mixture will be simultaneously flowing through outlets 56—55 and 55—57, since cylinders 6, 5 and 7 fire sequentially. Under ordinary conditions, it would be disadvantageous to interconnect these cylinders in the same manifold because the sequential firing means overlapping intake strokes where one cylinder tends to rob the other of fuel. This cannot take place, however, because, as pointed out, in each instance, each pair of intakes is connected directly with three barrels of the carburetor, so that there will be more than an adequate supply of fuel for both cylinders.

A construction has been described which will fulfill the objects of the invention above set forth, but it is contemplated that other structures will occur to those skilled in the art which are within the scope of the appended claims.

We claim:

1. The combination of an internal combustion piston engine of the type having cylinder intake ports arranged in parallel rows and a fuel induction system for said engine comprising star-shaped manifolds each having a plurality of outlets for connection with a group of adjacent engine intake ports located at the outer periphery of said star, and inlets for said manifolds centrally arranged with, and corresponding in number to, said outlets, each of said inlets being so disposed radially with respect to said outlets that each outlet is directly opposite two adjacent inlets.

2. The combination of an internal combustion piston engine of the type having cylinder intake ports arranged in parallel rows and a fuel induction system for said engine comprising star-shaped manifolds each having a plurality of outlets for connection with a group of adjacent engine intake ports located at the outer periphery of said star, and inlets for said manifolds centrally arranged with respect to and corresponding in number to said outlets, each of said inlets being so disposed radially with respect to said outlets that each outlet is directly opposite two adjacent inlets and each adjacent pair of outlets is in direct communication with more than two of said inlets.

3. The combination of an internal combustion piston engine of the V type having cylinder intake ports arranged in parallel rows and a fuel induction system for said engine comprising star-shaped manifolds each having a plurality of outlets for connection with a group of adjacent intake ports located at the outer periphery of said star, inlets for said manifolds centrally arranged with respect to and corresponding in number to said outlets, each of said inlets being so disposed radially with respect to said outlets that each outlet is directly opposite two adjacent inlets, and a multi-barrel, multi-stage carburetor for each of said star-shaped manifolds and primary and secondary mixture conduits in said carburetor directly connected to said two adjacent inlets.

4. The combination of an internal combustion piston engine of the V type having cylinder intake ports arranged in parallel rows and a fuel induction system for said engine comprising star-shaped manifolds each having a plurality of outlets for connection with a group of adjacent intake ports located at the outer periphery of said star, inlets for said manifolds centrally arranged with respect to and corresponding in number to said outlets, each of said inlets being so disposed radially with respect to said outlets that each outlet is directly opposite two adjacent inlets and each adjacent pair of outlets is in direct communication with more than two of said inlets, and a multi-barrel, multi-stage carburetor for each of said star-shaped manifolds with a plurality of primary and secondary mixture conduits arranged side by side in alternate relation in said carburetor and directly connected to said manifolds with said primary and secondary mixture conduits communicating directly with each of said manifold inlets so that each primary is connected with one of said inlets located between two of said outlets.

5. A fuel induction system for a V type engine comprising a star-shaped manifold having a plurality of outlets for connection with a group of adjacent intake ports in the engine located at the outer periphery of said star-shaped manifold, and inlets for said manifold centrally arranged with respect to and corresponding in number to said outlets, each of said inlets being so disposed radially with respect to said outlets that each outlet is directly opposite two adjacent inlets.

6. A fuel induction system for a V type engine comprising a star-shaped manifold having a plurality of outlets for connection with a group of adjacent engine intake ports located at the outer periphery of said star-shaped manifold, and inlets for said manifold centrally arranged with respect to and corresponding in number with said outlets, each of said inlets being so disposed radially with respect to said outlets that each said outlet is directly opposite two adjacent inlets, and each adjacent pair of outlets is in direct communication with more than two of said inlets.

7. The combination of an internal combustion piston engine of the type having cylinder intake ports arranged in parallel rows and a fuel induction system for said engine comprising a manifold for opposite pairs of intake ports in each bank of cylinders, a plurality of outlets in said manifold for connection with said group of adjacent intake ports, a plurality of passages in said manifold directly interconnecting each adjacent pair of outlets and arranged in the shape of a quadrilateral, and inlet openings in said manifold centrally arranged with respect to said outlets and each disposed intermediate the length of one of said passages.

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