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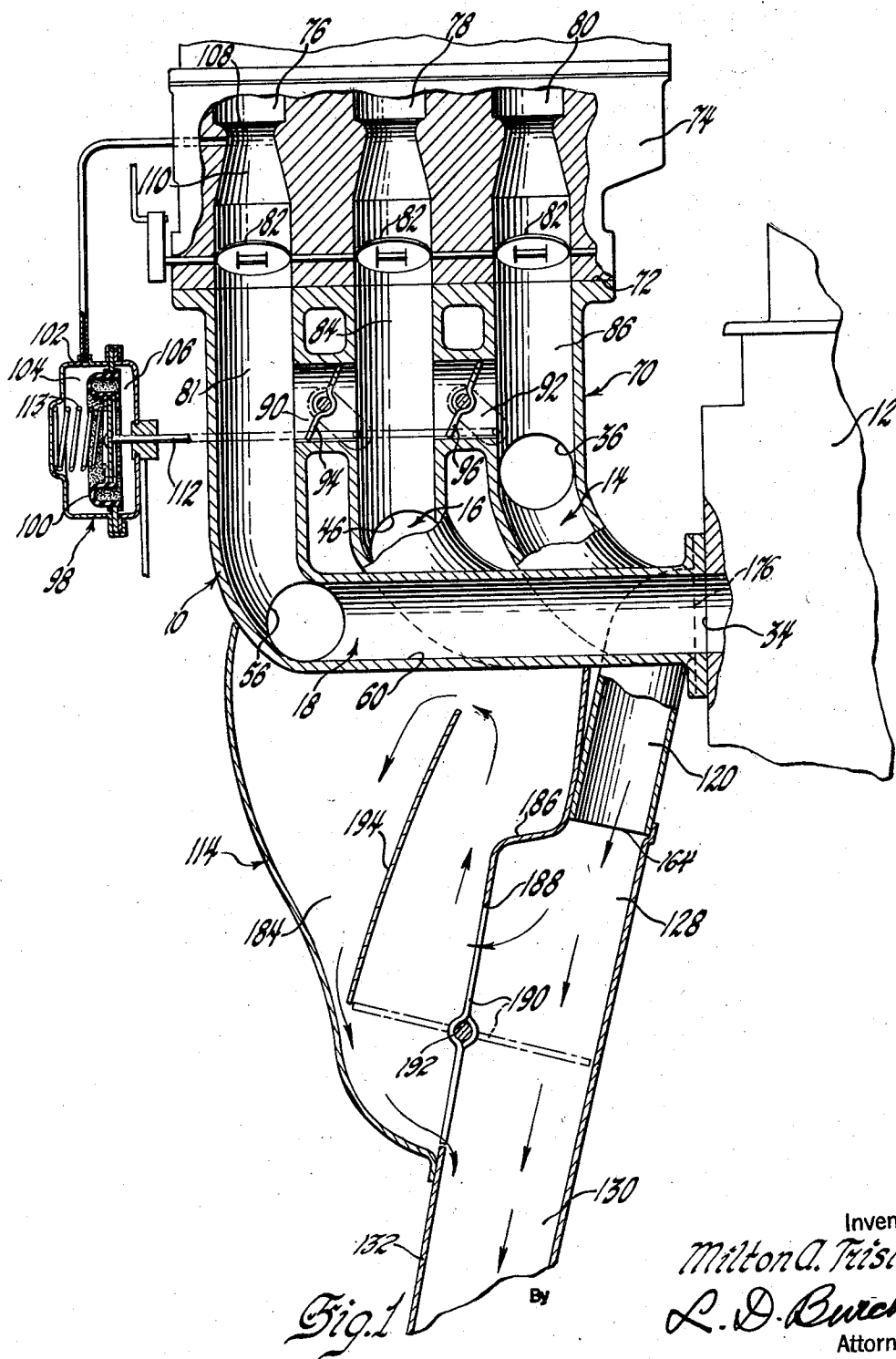
M. A. TRISLER

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ENGINE

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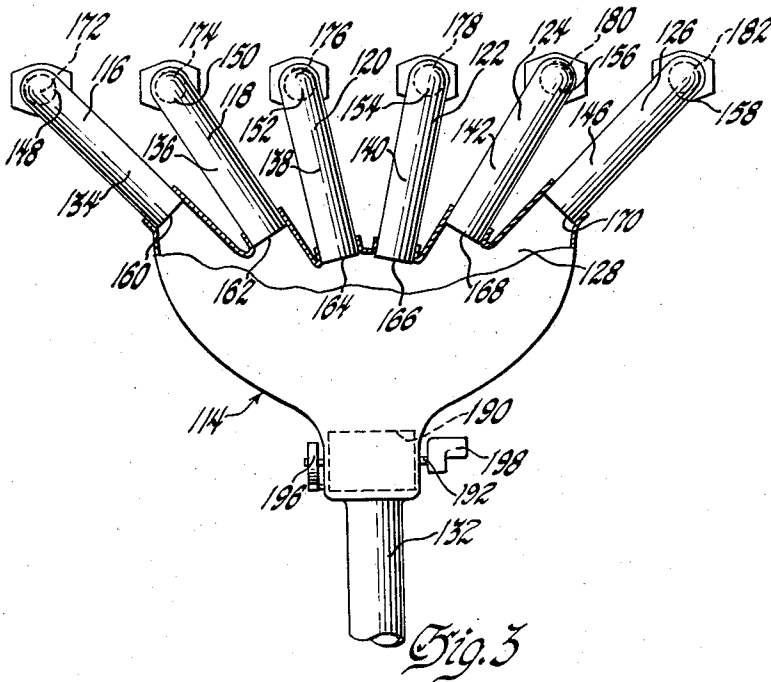
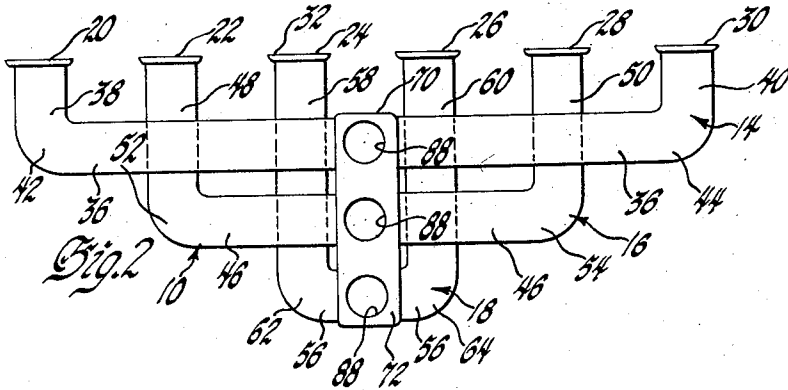
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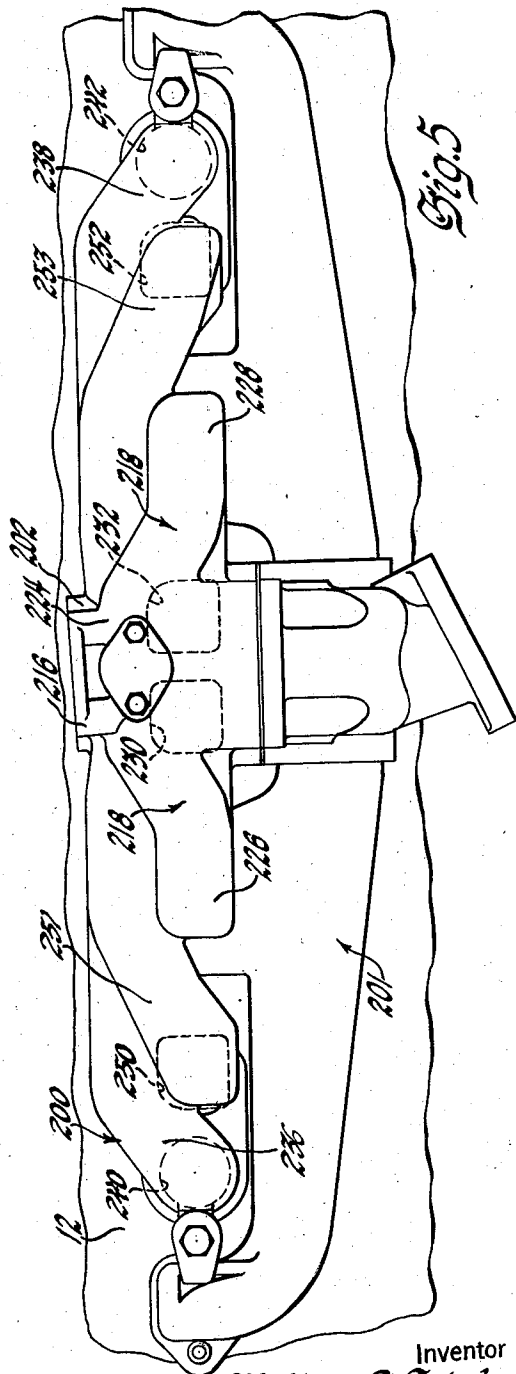
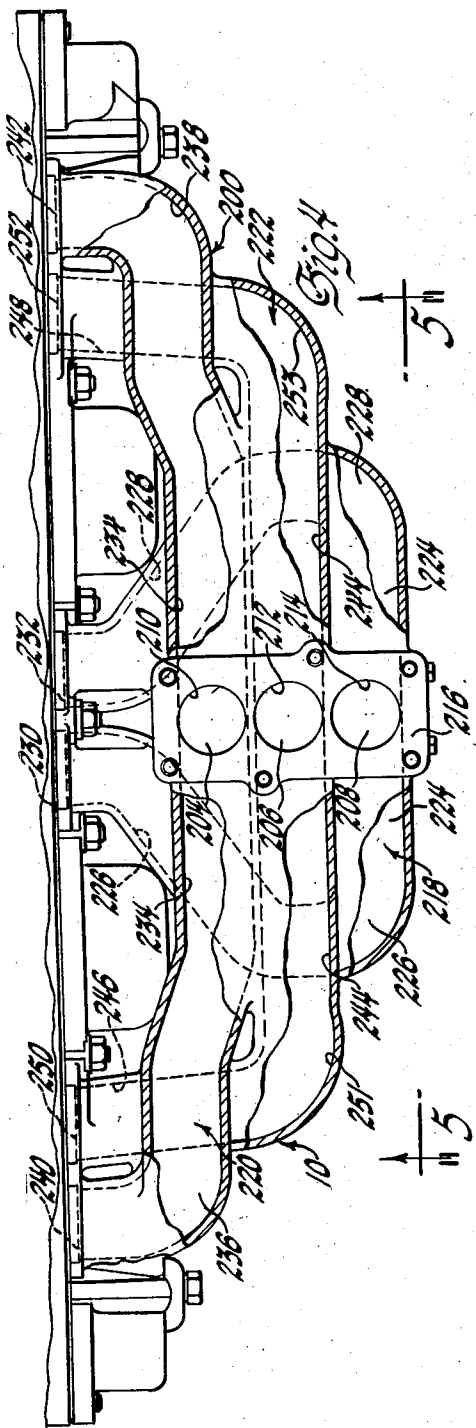
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ENGINE

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16 Claims. (Cl. 123—122)

The present invention relates to internal combustion engines and more particularly to the induction systems therefor.

At the present time spark ignited internal combustion engines employ carburetor means for forming a combustible charge and manifold means for delivering the combustible charge to the cylinders in the engine. The carburetor means may include one or more fuel mixing devices and the intake manifold may employ one or more distribution passages which interconnect the fuel mixing devices with the several cylinders in the engine. Heretofore, it has been extremely difficult, if not impossible, to place the carburetor means exactly equal distances from each of the cylinders. This has resulted in the distribution passages in the same intake manifold being of different lengths and/or different shapes. Every bend or turn in the distribution passages tends to produce a centrifugal separation of the air and fuel particles. Also the variations in the lengths of the passages and the number of turns therein produce sufficient variations in the flow resistances to cause a considerable variation in the volume of the fuel charges actually delivered to each of the individual cylinders. Since the air-fuel ratio of the entire charge delivered to the engine is normally determined by the cylinder receiving the leanest mixture, some of the cylinders will be receiving excessively rich mixtures. This not only produces a considerable amount of fuel wastage and accordingly, poor fuel economy, but in addition, it may be the cause of rough engine operation.

It is now proposed to provide an intake manifold that will deliver substantially identical charges to each of the cylinders during all conditions of engine operation. This is to be accomplished by employing an intake manifold having distribution passages all of which have substantially equal flow resistances. Each of these distribution passages may include a substantially straight center portion, a pair of substantially straight end portions, and a pair of elbows that interconnect the end portions with the center portion so that each distribution passage will be substantially U shaped. Thus each distribution passage will form a pair of ports in a side of the manifold so as to be substantially symmetrical about the center of the side. Although the lengths of the corresponding straight portions in the various distribution passages may differ, the total length of the straight portions and elbows in any one distribution passage will be substantially identical to the total length of the other passages.

If a fuel supply passage intersects the middle of each of the straight center portions, the distance from the fuel supply passage to the ports at the opposite ends of the passage will be equal. Since each distribution passage has the same general shape, the flow resistance to each of the cylinders will be equal. Thus it may be seen that the distribution passages will deliver substantially equal and identical charges to each cylinder.

In an intake manifold where one distribution passage feeds more than one cylinder, it has been extremely difficult to insure that the charges flowing in each distribu-

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tion passage will be equally spaced timewise. In other words, the opposite ends of every distribution passage will not feed cylinders that fire at equally spaced intervals.

It is now proposed to provide an intake manifold that will be economical to manufacture and in which each and every one of the distribution passages will have the opposite ends thereof connected to cylinders which fire at equally spaced time intervals. Thus during operation of the engine the direction of the flow of gases through a distribution passage will always have the maximum time to change. This will greatly decrease the amount of acceleration and deceleration required for each of the charges. In addition since the time intervals are equal, the distribution passage may be tuned to produce resonance at some engine speed.

During the operation of an engine the exhaust gases are discharged from the cylinders by means of exhaust valves that communicate with an exhaust system. The exhaust system normally includes some form of silencer or muffler and a considerable amount of piping. This presents a considerable amount of resistance to the flow of the exhaust gases. This in turn results in a "back pressure" being built up at the exhaust valves. This "back pressure" will prevent a complete exhausting of the exploded gases in the cylinder thus reducing the engine's efficiency.

It is now proposed to provide an exhaust manifold in which the back pressure present at the exhaust valves will be greatly reduced. This is to be accomplished by providing each exhaust port with a separate exhaust duct that discharges into a common chamber having an outlet for discharging the exhaust gases into a muffler. The exhaust ducts preferably have identical diameters and lengths so as to insure substantially the same flow resistance for each cylinder's exhaust. In addition, each of the exhaust ducts may be tuned to a particular frequency. Thus during some operating condition of the engine, each of the exhaust ducts will resonate as an open end chamber having a length equal to one-quarter wave length. During such operating condition, the flow of exhaust charges through the duct will produce a pressure antinode that will be located adjacent the exhaust valve. Thus the pressure at the exhaust valve may be considerably below atmospheric. This will greatly increase the flow of the exhaust gases from the combustion chamber into the exhaust system.

When a multiplicity of carburetors are employed to feed into a plurality of distribution passages, it may be desirable to have the air flowing through each distribution passage flow through a separate carburetor at light loads, however, the air flow at full throttle preferably flows through all of the carburetors. Thus if the various passages in the manifold are tuned to a frequency such that they will resonate during some comparatively light load condition, it would be desirable to employ a separate carburetor for each distribution passage during that condition but not at other or off resonant conditions. By allowing each distribution passage to draw from more than one carburetor, the flow resistance will be decreased and any impedance which might otherwise result from the resonant characteristics of the distribution passages will be prevented.

Accordingly, it is now proposed to provide an intake manifold having one or more balance passages that interconnects the distribution passages in the manifold so as to permit the gases to flow therethrough. A balance valve may be placed in the balance passages for controlling the flow of gases therethrough. The balance valve may be actuated by means which are responsive to the quantity of gases that are flowing through the induction system. In the present instance this means includes a pneumatic diaphragm which is interconnected with the throat of a

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venturi located in the induction system and connected to the balance valve. Thus when a large volume of air is flowing through the induction system, the diaphragm will open the valves and allow the air for the induction system to simultaneously flow through all of the carburetors. However, when the flow of air through the venturi is small, the valve will close thus substantially isolating the carburetors from each other. It may therefore be seen that when the engine is operating at full throttle-low speed, the balance valve will be closed and allow resonance; but at full throttle-heavy loads the balance valve will be open and there will be no resonance. The valve may be adjusted so that when in the closed position enough air may flow therethrough at low speeds to insure smooth operation of the engine.

Fig. 1 is a cross sectional view of an intake manifold and an exhaust manifold incorporating a preferred embodiment of the present invention.

Fig. 2 is a diagrammatic view of an intake manifold embodying the present invention.

Fig. 3 is a diagrammatic view of an exhaust manifold embodying the present invention.

Fig. 4 is a plan view of a modified intake manifold with portions thereof being broken away.

Fig. 5 is a side view of the modified intake manifold taken substantially along the plane of line 5—5 in Fig. 4.

Referring to the drawings in more detail, the present invention may be embodied in an intake manifold 10 suitable for installation on an internal combustion engine 12. Although the present invention is equally applicable to any type of engine having any number of cylinders, in the present instance the intake manifold 10 is adapted for installation on a six cylinder in-line engine and accordingly includes three distribution passages 14, 16 and 18. The opposite ends of these passages 14, 16 and 18 form six separate outlet ports 20, 22, 24, 26, 28 and 30 in one side 32 of the manifold 10. This side 32 of the manifold 10 may be secured to the engine 12 so the outlet ports will register with the intake ports 34 in the side of the engine 12. In the preferred embodiment the ports 34 are equally spaced along the sides of the engine 12 and manifold 10.

The first passage 14 of the three distribution passages includes a substantially straight center portion 36 which is disposed parallel to the side 32 of the manifold 10 and a pair of substantially straight end portions 38 and 40. A pair of substantially identical elbows 42 and 44 may interconnect each of the end portions 38 and 40 with the opposite ends of the center portion 36. The end portions 38 and 40 may then form a pair of outlet ports 20 and 30 in the side of the manifold. Since each of the elbows 42 and 44 and each of the end portions 38 and 40 are substantially identical, the end portions 38 and 40 will be angularly disposed with respect to the center portion 36 and the distribution passage 14 and the outlet ports 20 and 30 therefor will be symmetrical about the center of the side 32.

The second distribution passage 16 is similar to the first passage 14 as it also includes a substantially straight center portion 46 and a pair of straight end portions 48 and 50 which are interconnected with the center portion 46 by a set of elbows 52 and 54 that are identical to those in the first passage 14. The center portion 46 may be parallel to the first center portion 36 and the side 32 but spaced on the side of the center portion 36 farthest from the side 32 of the manifold 10. The end portions 48 and 50 in the second passage 16 may form a second pair of outlet ports 22 and 28 which are spaced inside of the first pair of outlet ports 20 and 30 formed by the first distribution passage 14. Although the end portions 48 and 50 and the center portion 46 of the second distribution passage 16 are not the same length as the corresponding parts of the first distribution passage 14, it should be noted that the total lengths of each distribution passage are substantially equal.

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The third distribution passage 18 is similar to the first two distribution passages 14 and 16 in that it also includes a substantially straight center portion 56 and a pair of straight end portions 58 and 60 interconnected therewith by means of elbows 62 and 64 similar to the first elbows. The center portion 56 may be parallel to the side 32 of the manifold 10 but outside of the other two center portions 46 and 56. The end portions 58 and 60 will form a third pair of outlet ports 24 and 26 which are disposed symmetrically about the center of the side 32 between the other ports. It should be noted that the center portion 56 of the third passage 18 is considerably shorter while the end portions 58 and 60 are considerably longer. Thus although the individual portions of the distribution passages 14, 16 and 18 are different, the over-all length of each passage is substantially the same.

A carburetor riser 70 may project upwardly from the center of the manifold 10 to form a mounting flange 72 on the top thereof. The flange 72 may be adapted to receive a carburetor 74 having fuel mixture passages 76, 78 and 80 therethrough. Throttle valves 82 may be provided in the passages 76, 78 and 80 for controlling the flow of gases therethrough. A plurality of supply passages 81, 84 and 86 may extend upwardly through the carburetor riser 70. The upper ends thereof may form openings 88 in the flange 72 which are adapted to register with the ends of the fuel mixture passages 76, 78 and 80. The lower end of each of the vertical supply passages 81, 84 and 86 may communicate with the center of one of the distribution passages 14, 16 and 18. Thus a combustible charge may be formed in the fuel mixture passages 76, 78 and 80 and delivered to each of the distribution passages 14, 16 and 18.

It may thus be seen that each of the distribution passages 14, 16 and 18 includes a substantially straight center portion 36, 46 and 56, a pair of straight end portions 38—40, 48—50 and 58—60, and a pair of elbows 42—44, 52—54 and 62—64 that interconnect the end portions with the center portions at identical angles. In order to permit the distribution passages 14, 16 and 18 to cross each other, the center portions of the passages may be at different elevations. In the present instance the third center portion 56 is lowest and the first center portion 36 is highest. Thus the third end portions 58 and 60 will extend under the other two center portions 36 and 46 while the first center portion 36 will extend over the other end portions 48, 50, 58 and 60. At the same time second passage 16 may extend over the third passage 18 and under the first 14. Each of the elbows 42, 44, 52, 54, 62 and 64 may be substantially identical so that the end portions 38, 40, 48, 50, 58 and 60 will be at substantially the same angle to the center portions 36, 46 and 56. In addition, although the lengths of the individual straight portions may vary the total length of the straight portions in each passage may still be a constant. Thus each of the distribution passages will be substantially U-shaped and although the distribution passages are of different proportions, they are all substantially the same length and they all include similar bends between the fuel supply passages 82, 84 and 86 in the carburetor riser 70 and the cylinders.

In order to provide a minimum resistance to the flow of air through the distribution passages 14, 16 and 18, it is desirable that the ports 20, 22, 24, 26, 28 and 30 formed by the opposite ends of each distribution passage be connected to cylinders which fire at equally spaced intervals. Thus if the cylinders are numbered consecutively 1, 2, 3, 4, 5 and 6 from one end to the other and the first passage may be connected to cylinders 1 and 6, the second passage may be connected to cylinders 2 and 5 and the third passage may be connected to cylinders 3 and 4, it may be advantageous to employ a firing order such as 1—5—3—6—2—4. Thus ports 20 and 30 of passage 14 will charge cylinders 1 and 6 and the interval from cylinder 1 to cylinder 6 is the same as the

internal from cylinder 6 to cylinder 1. It is apparent that the same situation exists for cylinders 2 and 5 which are fed by passage 16 and cylinders 3 and 4 which are fed by passage 18. This will allow the maximum and equal time intervals between the charging of each of the cylinders connected to any one distribution passage. By providing equal intervals the acceleration and deceleration of the charge during the reversal of its flow will be a minimum and accordingly, the flow resistance will not only be a minimum but it will also be substantially equal for each cylinder. Since the passages 14, 16 and 18 are all substantially the same shape, their natural frequencies will be the same. If desired they may be tuned so as to resonate at a particular engine speed. This will increase the ramming effect produced by the flowing of the charge. Thus there will be a tendency to greatly increase the volumetric efficiency and accordingly, the engine output at that speed. It is, of course, obvious that there are numerous other combinations which may be employed while still providing the same effect.

One or more balance passages 90 and 92 may be provided which extend horizontally through the riser 70 to interconnect the vertical fuel supply passages 81, 84 and 86. Therefore when a charge is drawn into one of the distribution passages 14, 16 or 18, it may be drawn from more than one carburetor by flowing through the balance passages 90 and 92. This will reduce the resistance to the flow of the charge into the cylinders. In addition, if there is any tendency for the resonant characteristics of the manifold to interfere with the flow of the charge, they will be destroyed by the open passages 90 and 92. Since the distribution passages may be tuned to resonate at some condition, the valves 94 and 96 may close the passages at that condition so as to take advantage of the resonance. At idle and near idle speeds the balance passages 90 and 92 should still allow a small amount of air to flow therethrough to insure a uniform charging of each cylinder. Thus if these valves 94 and 96 are closed during light loads, when the intake air is drawn into a distribution passage 14, 16 or 18 for one of the cylinders, all of the air for that cylinder will have to flow through only one carburetor except for a nominal flow past the valves 94 and 96. However, when the engine 12 is drawing the large volumes of air necessary for heavy load-high speed operation, it is desirable to allow the air to flow through all of the carburetors and thus greatly reduce the flow resistance. Accordingly, during heavy loads, the valves 94 and 96 may be opened so that the air is drawn through more than one of the carburetors at a time for materially reducing the flow resistance.

In order to automatically operate these valves 94 and 96, a control device 98 may be provided which is responsive to the volume of air flowing through the carburetor. In the present instance this control device includes a diaphragm 100 which is disposed inside a housing 102 to form two separate compartments 104 and 106. One of these compartments 104 may be vented to the atmosphere while the other compartment 106 is connected to the throat 108 of the venturi 110 in the carburetor. Since the amount of depression in air pressure in the throat 108 will increase with the volume of air flowing therethrough the pressure across the diaphragm 100 will be a function of the volume of flow. A push rod 112 may connect the diaphragm 100 to the valves 94 and 96 and a spring 113 may be provided to oppose the diaphragm 100. Thus during light loads the pressure drop in the throat 108 will be small and the spring 113 will retain the valves 94 and 96 in the closed position. However, when the volume of air drawn into the engine 12 increases with the speed and load, the pressure in the throat 108 of the venturi 110 will drop. This will expose one side of the diaphragm 100 to a vacuum and cause the spring 113 to be compressed so as to open the valves 94 and 96. This in turn will permit the charge to flow

freely between the passages 81, 84 and 86 in the carburetor riser 70.

In order to discharge the exhaust gases from the cylinders in the engine, an exhaust manifold 114 may be provided for collecting the exhaust gases. In the present instance this exhaust manifold 114 includes a plurality of exhaust ducts 116, 118, 120, 122, 124 and 126 each of which discharges into a common enlarged chamber 128. An outlet 130 may be provided in the manifold 114 for interconnecting the chamber 128 with the atmosphere by means of an exhaust system 132.

Each of the exhaust ducts is preferably of substantially identical size and shape so as to insure a substantially identical resistance to the discharge of exhaust gases for each cylinder. In the present instance each of the exhaust ducts includes substantially straight portions 134, 136, 138, 140, 142 and 146 and elbows 148, 150, 152, 154, 156 and 158. The elbows form ports 172, 174, 176, 178, 180 and 182 which are positioned to register with the exhaust ports in the side of the engine 12. The straight portions are angularly disposed so that the ends 160, 162, 164, 166, 168 and 170 discharge directly into the chamber 128 toward the outlet 130. Thus although the exhaust ports are varying distances from the chamber 128 they are all the same length. Since the chamber 128 is enlarged the resistance to the flow of gases through each duct will be substantially identical. In addition, it should be noted that the length of the exhaust ducts, i. e., the distances between the ends 160, 162, 164, 166, 168 and 170 and the ports 172, 174, 176, 178, 180 and 182 are equal and will make the frequencies of the ducts equal. The frequency thereof may thus be tuned to some engine operating condition. At this condition the ducts will resonate and cause a vacuum at the exhaust valves to occur and greatly increase the exhausting of the engine 12. The exhaust manifold 114 may be tuned to the same frequency as the intake manifold 10 so as to provide a very high output at one particular operating condition or the induction system and exhaust systems may be tuned to different frequencies so that they will resonate at different points thus providing a high engine output over a wider range.

To heat the charge flowing through the intake manifold 10, a second heating chamber 184 may be provided in the exhaust manifold 114. This heating chamber 184 is preferably disposed adjacent the first chamber 128 and separated therefrom by a common wall 186. The intake manifold 10 may be adapted to seat on top of the exhaust manifold 114 so that the bottom of the intake manifold 10 will form one wall of the second chamber 184. Thus the passages 14, 16 and 18 in the intake manifold 10 will be in heat exchanging relation with the contents of the second chamber 184. A portion of the common wall 186 between the first and second chambers 128 and 184 may have an opening 188 that interconnects the first and second chambers. A valve 190 may be mounted on a shaft 192 so as to be disposed in said opening 188 for rotating between a substantially vertical position and a substantially horizontal position. In the vertical position, the valve 190 will form a continuation of the wall 186 and close the opening 188. Thus the valve 190 will block the entrance of exhaust gases into the second chamber 184. As a result the exhaust gases will flow downwardly through the first chamber 128 directly into the exhaust pipe. In the other or horizontal position, a portion of the valve 190 will extend across the first chamber 128 and block the flow of exhaust gases through the first chamber 128. This will divide the opening 188 into two parts. The exhaust gases will then flow through the top of the opening 188 into the second chamber 184 and out through the bottom of the opening 188 back into the first chamber 128. A partition 194 may be disposed across the second chamber 184 so that the gases will

be deflected upwardly against the bottom of the intake manifold 10. The hot exhaust gases will then heat the intake manifold 10 and be deflected downwardly behind the partition 194 so as to flow underneath the valve 190 back into the exhaust system. A thermostatic spring 196 responsive to engine temperatures and a counterweight 198 may be provided for controlling the position of the valve 190.

When employing some valve arrangements, it may be desirable that the ports in the intake manifold be positioned in pairs instead of evenly spaced. Accordingly, as a modification, the intake manifold may comprise a casting 200 which may be disposed above the exhaust manifold 201. A carburetor riser 202 is formed in the middle of the manifold. The carburetor riser 202 may have three passages 204, 206 and 208 that extend therethrough so that the upper ends of the passages 204, 206 and 208 will form openings 210, 212 and 214 in the flange 216 while the lower ends of the passages 204, 206 and 208 will communicate with the distribution passages 218, 220 and 222. The first distribution passage 218 may include a generally straight center portion 224 and a pair of reversely curved or S-shaped end portions 226 and 228 so as to form a pair of adjacent outlet ports 230 and 232 in the middle of one side of the manifold. These ports 230 and 232 are positioned to register with the intake ports in the middle of the engine. The second distribution passage 220 may include a straight portion 234 and a pair of curved end portions 236 and 238 that are positioned to form a port 240 and 242 adjacent each end of the side. These ports 240 and 242 may register with the ports in the opposite ends of the engine. The third passage 222 may also include a substantially straight center portion 244, a pair of straight end portions 246 and 248 and a pair of elbows 251 and 253. The end portions 246 and 248 may form a second pair of ports 250 and 252 adjacent the end ports 240 and 242 for registering with intake ports in the engine.

The carburetor riser 202 may be disposed above the intake ports so that each of the center portions 224, 234 and 244 will be above the ports. The curved portions may then slope downwardly so that the end portions will be at the same elevation as the ports. This will permit the curved portions 226 and 228 of the first passage 218 to extend underneath the center portions 234 and 244 of the other two passages 220 and 222. At the same time the center portion 244 of the third passage 222 may extend over the other two passages 218 and 220. The second passage 220 may then extend over the first passage 218 and under the third one 222. This will permit the ports to be spaced in pairs.

It is to be understood that, although the invention has been described with specific reference to particular embodiments thereof, it is not to be so limited since changes and alterations therein may be made which are within the full intended scope of this invention as defined by the appended claims.

What is claimed is:

1. An intake manifold for an engine having a row of intake ports in one side thereof, said intake manifold comprising a member adapted to be secured to said side of said engine, a plurality of distribution passages extending through said member, each of said distribution passages having a center portion and a pair of end portions angularly disposed with respect to said center portion, the end portions of each of said distribution passages forming pairs of outlet ports in one side of said member, each of said pairs of outlet ports being disposed substantially symmetrically about the center of said side of said member and positioned to register with said intake ports, and a separate fuel supply passage for each of said distribution passages, each of said fuel supply

passages being connected directly to only one of said center portions.

2. An intake manifold for an engine having a row of intake ports in one side thereof, said manifold comprising a member adapted to be secured to said side of said engine, a plurality of distribution passages extending through said member, each of said distribution passages having a center portion and a pair of end portions angularly disposed with respect to said center portion, the end portions of each distribution passage forming pairs of outlet ports in one side of said member, each of said pairs of outlet ports being disposed substantially symmetrically about the center of said side of said member and positioned to register with said intake ports, a separate fuel supply passage for each of said distribution passages, each of said supply passages communicating directly with only one of said center portions, and balance ducts extending through said member for interconnecting said passage.

3. An intake manifold for an engine having a row of intake ports in one side thereof, said manifold comprising a member adapted to be secured to said side of said engine, a plurality of distribution passages extending through said member, each of said distribution passages being substantially the same length, each of said distribution passages having a center portion and a pair of substantially straight end portions that are angularly disposed with respect to said center portion, said end portions of each distribution passage forming pairs of outlet ports in one side of said member positioned to register with said intake ports, each of said pairs of ports being disposed substantially symmetrically about the center of said side of said member, a fuel supply passage communicating with each of said center portions, balance ducts extending through said member for interconnecting said passage, and valve means in said ducts for controlling the flow of fluids through said ducts.

4. An intake manifold for an engine having a row of intake ports in one side thereof, said manifold comprising a member adapted to be secured to said side of said engine, a plurality of distribution passages extending through said member for delivering a charge of combustible fuel mixture to said intake ports, each of said distribution passages being substantially the same length and including a substantially straight center portion and a pair of substantially straight end portions angularly disposed with respect to said center portions, the end portions of each distribution passage forming a pair of outlet ports in one side of said member to register with said intake ports, each of said pairs of outlet ports being disposed substantially symmetrically about the center of said side of said member, fuel supply passages communicating with each of said center portions for delivering said charge of combustible fuel mixture to said distribution passages, balance ducts extending through said member for interconnecting said passages, valve means disposed in said balance ducts for controlling the flow therethrough, and control means for actuating said valves, said control means being responsive to the volume of said charge flowing through said fuel supply passages for opening said valves as said flow increases.

5. An intake manifold for an engine having a row of intake ports in one side thereof, said manifold comprising a member adapted to be secured to said side of said engine, a plurality of distribution passages extending through said member, each of said distribution passages being substantially the same length and including a substantially straight center portion and a pair of substantially straight end portions angularly disposed with respect to said center portion and interconnected therewith by only one turn, the end portions of each distribution passage forming pairs of outlet ports in one

side of said member, each of said pairs of outlet ports being disposed substantially symmetrically about the center of said side of said member, a fuel supply passage communicating with each of said center portions, and heating means in said member for heating the walls of said passages adjacent the junction of said fuel supply passages and said distribution passages.

6. An intake manifold for an engine comprising a first distribution passage having a center portion substantially parallel to one side of said manifold, said distribution passage having end portions angularly disposed with respect to said center portion and forming port means in said side adjacent the center thereof, a second distribution passage having a center portion substantially parallel to said side, said second distribution passage including end portions angularly disposed with respect to said second center portion and forming a pair of ports adjacent the ends of said side which are symmetrically disposed about said center, a third distribution passage including a center portion disposed between said center portions and including end portions angularly disposed with respect to said third center portion, said third end portions forming a pair of ports which are positioned symmetrically about said center and disposed between said port means and said first pair of ports and a fuel supply passage communicating with each of said center portions.

7. An intake manifold for an engine comprising a first distribution passage having a center portion substantially parallel to one side of said manifold, said distribution passage having end portions angularly disposed with respect to said center portion and forming port means in said side adjacent the center thereof, a second distribution passage having a center portion substantially parallel to said side, said second distribution passage including end portions angularly disposed with respect to said second center portion and forming a pair of ports adjacent the ends of said side which are symmetrically disposed about said center, a third distribution passage including a center portion disposed between said center portions and also including end portions angularly disposed with respect to said third center portion, said third end portions forming another pair of ports which are positioned symmetrically about said center of said side and disposed between said port means and said first pair of ports, a fuel supply passage communicating with each of said center portions, and balance ducts extending through said manifold for interconnecting said passages.

8. An intake manifold for delivering a combustible charge to the cylinders of an engine, said manifold comprising a first distribution passage having a center portion substantially parallel to one side of said manifold, said distribution passage including end portions angularly disposed with respect to said center portion and forming port means in said side adjacent the center thereof, a second distribution passage having a center portion substantially parallel to said side, said second distribution passage including end portions angularly disposed with respect to said second center portion and forming a pair of ports adjacent the ends of said side which are symmetrically disposed about said center, a third distribution passage including a center portion disposed between said first and second center portions and also including end portions angularly disposed with respect to said third center portion, said end portions forming another pair of ports which are positioned symmetrically about said center of said side and disposed between said port means and said first pair of ports, a fuel supply passage communicating with each of said center portions, balance ducts extending through said manifold for interconnecting said passage, valve means in said balance ducts for controlling the flow through said ducts, and control means for actuating said valve means, said control means being responsive to the volume of said charge flowing through said passages.

9. An intake manifold for an engine comprising a first

distribution passage having a center portion substantially parallel to one side of said manifold, said distribution passage having end portions angularly disposed with respect to said center portion and forming port means in said side adjacent the center thereof, a second distribution passage having a center portion substantially parallel to said side, said second distribution passage including end portions angularly disposed with respect to said second center portion and forming a pair of ports adjacent the ends of said side which are symmetrically disposed about said center, a third distribution passage including a center portion disposed between said first and second center portions and end portions angularly disposed with respect to said third center portion, said third end portions forming a pair of ports which are disposed symmetrically about said center of said side and disposed between said port means and said first pair of ports, a fuel supply passage communicating with each of said center portions, heating means in said member adjacent the intersection of said supply passages and said distribution passages so as to be in heat exchanging relation therewith.

10. An exhaust manifold for an engine having a plurality of exhaust ports disposed in substantial alignment for discharging exhaust gases from said engine, said manifold comprising a plurality of substantially identical ducts, one end of each of said ducts being positioned to communicate with one of said exhaust ports for collecting the exhaust gases discharged therefrom, an enlarged chamber for collecting exhaust gases, a portion of said ducts angularly converging toward said chamber, the other ends of said ducts being disposed in said chamber for discharging said exhaust gases into said chamber, and outlet means communicating with said chamber for discharging said exhaust gases into the atmosphere.

11. An exhaust manifold for an engine having a plurality of exhaust ports disposed in substantial alignment for discharging exhaust gases from said engine, said manifold comprising a chamber for collecting said exhaust gases, an exhaust pipe communicating with said chamber for discharging said exhaust gases into the atmosphere, a plurality of substantially identical ducts, each of said ducts including a first portion and a second portion, said first portions being substantially identical and straight and angularly arranged with the open ends thereof being disposed in said chamber and directed toward said exhaust pipe, said second portions being substantially identical and including a bend, said second portions communicating with said first portions and the open ends thereof being positioned to register with one of said ports, said chamber having a cross section considerably larger than that of said ducts.

12. An exhaust manifold for collecting the exhaust gases discharged from the exhaust ports of an engine, said manifold comprising a first chamber, a second chamber adjacent said first chamber, exhaust ducts for communicating with said ports and positioned for discharging said exhaust gases into said first chamber, outlet means communicating with said first chamber for discharging said exhaust gases into the atmosphere, a valve member disposed between said chambers, said valve member when in one position forming one wall of said first chamber for diverting said exhaust gases directly into said outlet means, said valve member when in another position being adapted to first divert said exhaust gases from said first chamber into said second chamber and then back into said second chamber adjacent said outlet means.

13. An exhaust manifold for collecting the exhaust gases discharged from the exhaust ports of an engine, said manifold comprising a first chamber and a second chamber adjacent said first chamber, a plurality of substantially identical exhaust ducts communicating with said first chamber, an exhaust pipe communicating with said first chamber for discharging said exhaust gases into the atmosphere, a valve member disposed between said chamber, said valve member when in one position form-

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ing a portion of one wall of said first chamber for diverting said exhaust gases directly into said exhaust pipe, said valve member when in another position being adapted to divert said exhaust gases into said second chamber and then into said first chamber adjacent said exhaust pipe, and thermostatic control means responsive to engine temperatures for moving said valve member into the second of said positions when the temperature of said engine is below normal operating temperatures.

14. In an engine, the combination of an intake manifold and an exhaust manifold, said exhaust manifold including a first chamber and a second chamber, exhaust ducts discharging into said first chamber, outlet means communicating with said first chamber, and valve means when in one position being adapted to direct the flow of exhaust gases from said exhaust ducts into said outlet means and when in another position to divert the flow of said exhaust gases in said first chamber into said second chamber and then back into said first chamber adjacent said outlet means, said intake manifold comprising a plurality of distribution passages and fuel supply passages positioned to intersect said distribution passages in the middle thereof, the portion of said intake manifold disposed around the intersection of said passages forming one wall of said second chamber so as to place at least a portion of said passages in heat exchanging relation with the contents of said second chamber.

15. In an engine, the combination of an exhaust manifold and an intake manifold, said exhaust manifold including a first chamber for collecting said exhaust gases from said engine and discharging them through outlet

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means, a second chamber adjacent said first chamber, and valve means for diverting the flow of exhaust gases from said first chamber into said second chamber, said intake manifold including a plurality of substantially U-shaped distribution passages and fuel supply passages communicating with the centers of each of said distribution passages, the portion of said intake manifold adjacent said intersection of said passages forming one wall of said second chamber so as to place at least a portion of said passages in heat exchanging relation with the contents of said second chamber.

16. An induction and exhaust system for an engine, said system comprising an intake manifold having a plurality of distribution passages substantially identical with each other and an exhaust manifold having a plurality of exhaust ducts substantially identical with each other, each of said distribution passages being adapted to resonate under certain engine operating conditions and each of said exhaust ducts being adapted to resonate under certain engine operating conditions.

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