July 14, 1959 C. P. BOLLES, JR 2,894,497

MANIFOLD WITH VARIABLE LENGTH RAM PIPES

Filed Aug. 25, 1958 3 Sheets-Sheet 1

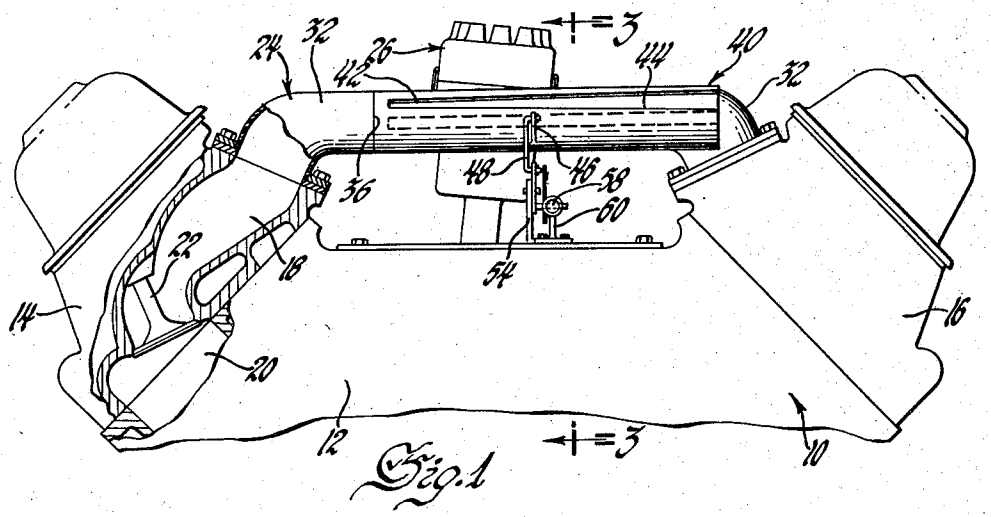


Fig. 1

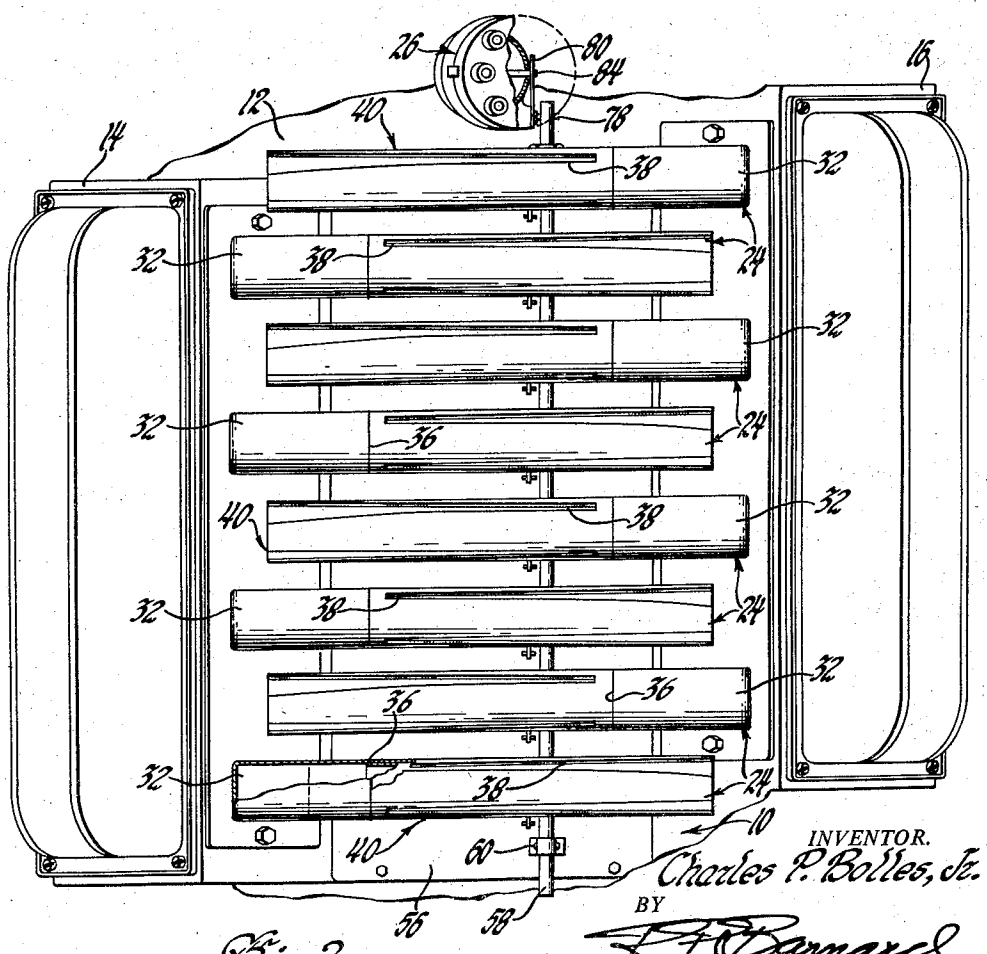


Fig. 2

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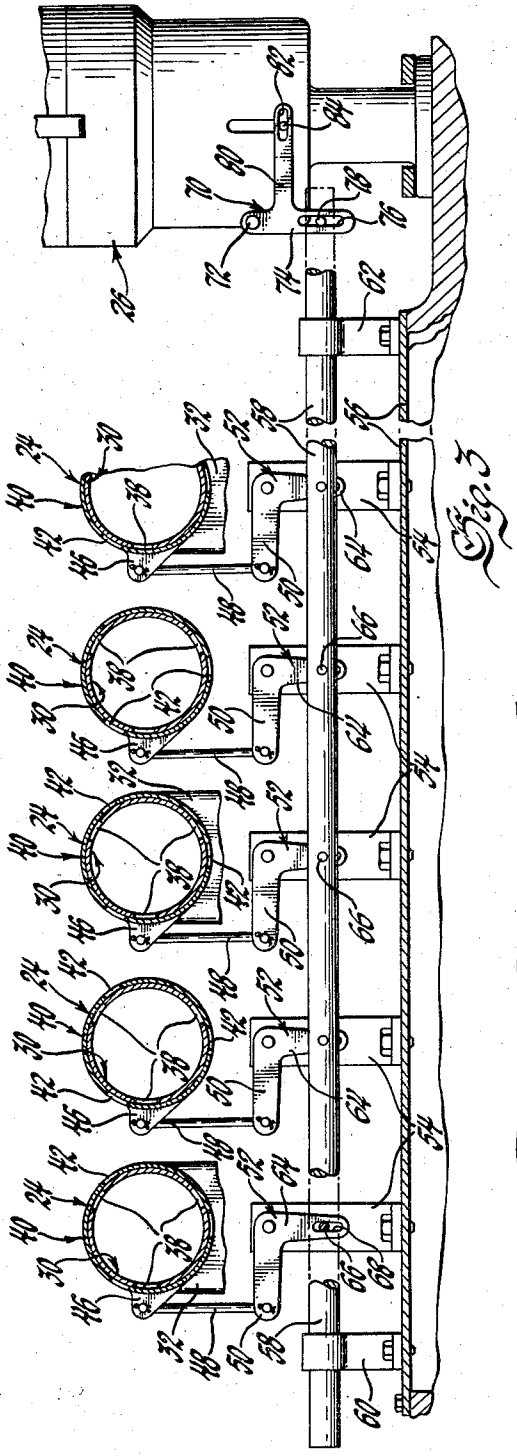


Fig. 3

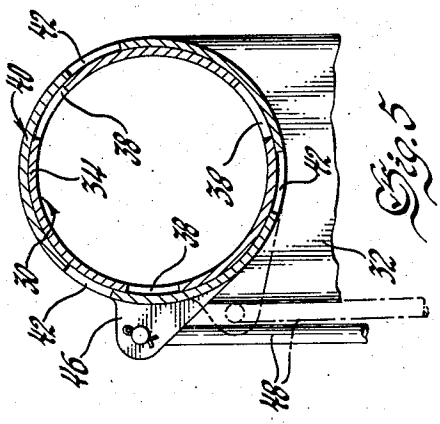


Fig. 5

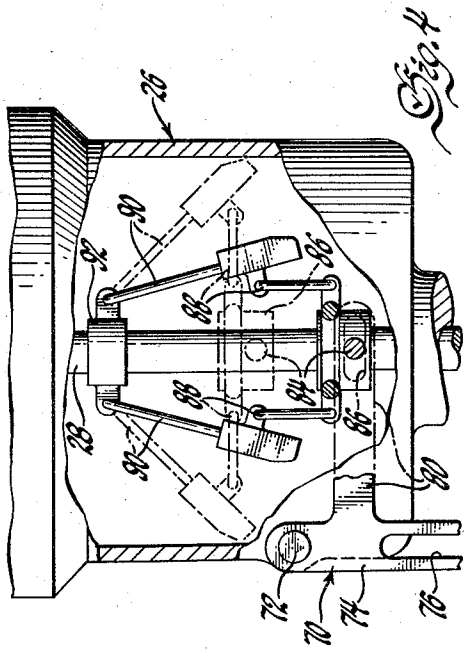


Fig. 4

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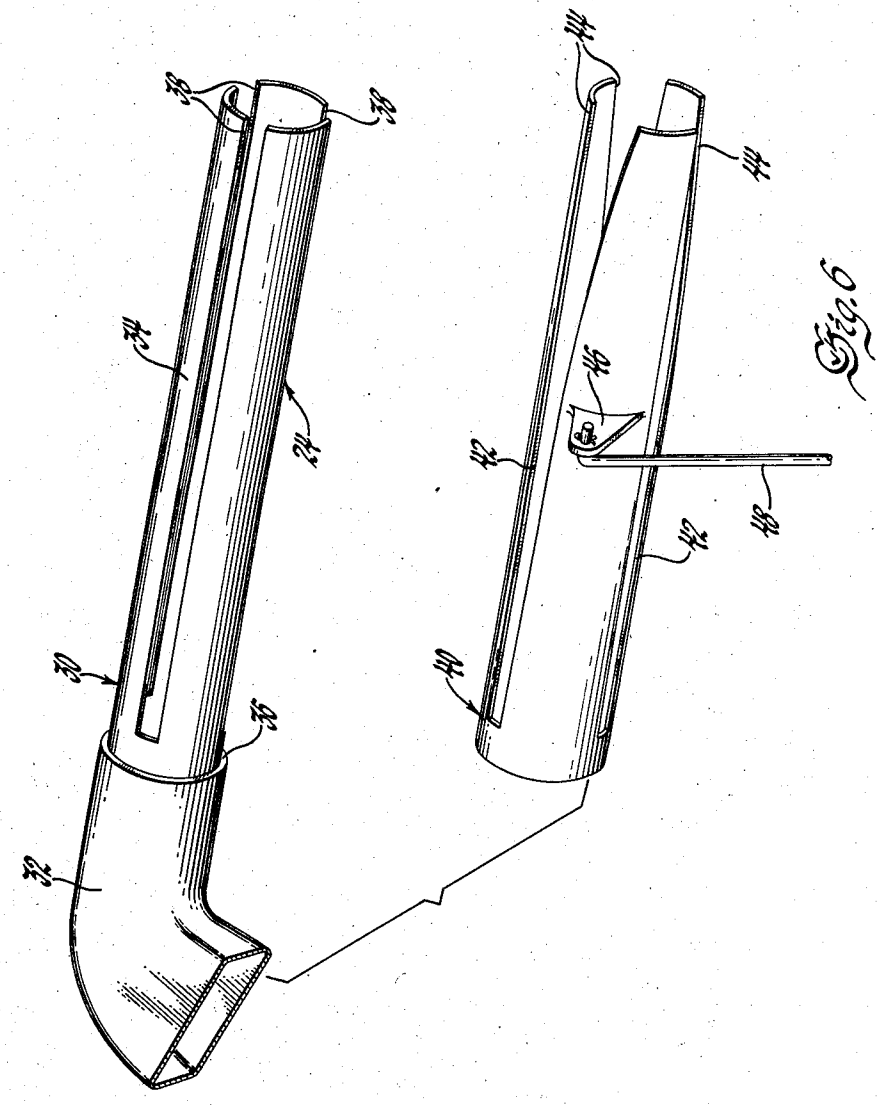


Fig. 6

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MANIFOLD WITH VARIABLE LENGTH RAM PIPES

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Application August 25, 1958, Serial No. 757,009

5 Claims. (Cl. 123—52)

This invention relates to an improved type of manifold for a fuel injection system. More specifically, the present invention is an improvement in the resonant type manifold shown in copending application Serial No. 608,935, Dolza, filed September 10, 1956.

As described in the aforenoted Dolza application, it has been found in utilizing a ram tube type manifold, it is possible to select the ram tube length in such a way as to obtain a resonant frequency with respect to the air being inducted into the engine cylinder. This selection of tube length heightens or emphasizes the ram effect and thereby occasions a supercharging effect whereby the volumetric efficiency is maximized at a given engine speed. While such resonance might occur at several different engine speeds, it is usually found that only one of these frequencies occurs at a speed compatible with maximum power output with a fixed length ram tube.

In the Dolza type construction, once having selected the appropriate ram tube length to achieve the resonant frequency at the desired engine speed, for practical purposes then resonance is not utilizable at any other engine speed. In the present invention a unique type ram tube manifold has been developed which enables the effective ram tube length to be varied under different operating conditions whereby increased volumetric efficiency is obtainable throughout the speed range of the engine or at least at a plurality of engine speeds.

Under low engine speed operating conditions, the frequency of cylinder inlet valve opening is low and correspondingly the frequency or pulsations of the air column within the ram pipes is low. At the same time the time between pulsations is relatively large. Accordingly, under the low speed operating conditions, a relatively long effective ram pipe length is desirable in achieving resonance and hence the supercharging effect noted. On the other hand, during high speed operating conditions, the frequency of inlet valve operation is high and with it the frequency of air column pulsations. In this instance, the time between such pulsations is rather short and correspondingly a shorter effective ram tube length is desirable to achieve a resonant condition.

The present invention, in facilitating variations in effective ram tube length corresponding with changes in engine speed insures a high volumetric efficiency at a plurality of engine speeds and hence contributes to an increased power output for the engine at all engine speeds.

Other objects and advantages of the present invention will be apparent from a perusal of the detailed description which follows.

In the drawings:

Figure 1 is a partially cross sectioned view of a V-type engine embodying the subject manifold;

Figure 2 is a plan view of the arrangement of Figure 1;

Figure 3 is a view along line 3—3 of Figure 1;

Figure 4 is an enlarged sectional view of the engine speed responsive mechanism for varying the ram pipe lengths;

Figure 5 is an enlarged sectional view through one of the ram pipes; and

Figure 6 is a perspective view of one of the ram pipes as disassembled.

For purposes of illustration the subject manifold arrangement has been shown as embodied on a V-type engine indicated generally at **10**. Engine **10** includes a cylinder block portion **12** as well as cylinder heads **14** and **16**. The cylinder heads each include a plurality of intake passages **18**, in this case four in each head, adapted to deliver a combustible charge to each of the engine cylinders **20**. The introduction of the combustible charge into each cylinder is controlled through inlet valves **22**. Each cylinder head intake passage **18** communicates with a ram pipe or air intake assembly indicated generally at **24**.

A distributor mechanism is shown generally at **26** and, as shown in Figure 4, includes a shaft **28** driven in proportion to engine speed by the engine cam shaft, not shown.

Since the ram pipes **24** are identically constructed it will suffice to merely describe the construction of one of such members. At the outset, it may be noted that the overall length of each ram pipe assembly may be varied by angularly inclining the ram pipe from a horizontal. In the form of the invention illustrated the ram pipes are generally horizontally disposed. However, if longer ram pipes are desired it is apparent that the ram pipes might be inclined upwardly from the horizontal in which event their overall length would be increased. The desirability for changing the overall length of the ram pipes might vary depending on the particular type of engine upon which the ram pipes are to be mounted.

As seen in Figure 6, each ram pipe assembly **24** includes a first tubular member **30** which terminates at one end in a curved section **32** adapted to register with intake passage **18**. The remainder of member **30** includes a portion **34** of somewhat reduced diameter and which construction provides a shoulder **36**. Tubular portion **34** includes a plurality of longitudinally extending slots **38**.

Each ram pipe assembly **24** also includes a sleeve member **40** adapted to be mounted upon the reduced diametral portion **34** of member **30** for rotation relative thereto. Sleeve member **40** seats against shoulder **36**. Sleeve **40** also includes a plurality of longitudinally extending slots **42** corresponding in number to the slots **38** in member **30**. While corresponding in number to the slots in member **30** sleeve slots **42** are of a slightly different configuration. Slots **42** differ in that they terminate at their outer or rightmost end, as viewed in Figure 6, in flared or tapered portions **44**.

It will be well at this juncture to consider the operative relationship between the fixed slots **38** and rotatable sleeve slots **42**. As already noted, under low engine speed operating conditions maximum ram pipe length is desired. Accordingly, under these conditions sleeve **40** should be so positioned with respect to member **30** that the sleeve slots **42** overlie the unslotted portions of the subadjacent portion **34**. In this way maximum effective ram pipe length is achieved. Thereafter as engine speed increases it is desired to progressively shorten the effective length of the ram pipe. To accomplish this end, sleeve **40** is rotated, by means to be subsequently considered, so that the flared ends **44** of sleeve slots **42** begin to progressively uncover fixed slots **38** in member **30**. Referring again to Figure 6, it will be apparent that, looking from the right end of the ram pipe assembly, the aforesaid operation will occur by rotating sleeve **40** in a counterclockwise direction. Thus as engine speed increases, the effective length of each ram pipe assembly is in effect reduced maintaining a resonant condition and

thereby assuring maximum volumetric efficiency for each engine speed.

Figure 5 represents a sectional view through a ram pipe assembly indicating the position of the respective slots **38** and **42** in which the latter are completely out of registry insuring maximum ram pipe length. It is apparent from this view that as the sleeve **40** is rotated in a counterclockwise direction the sleeve slots **42** will progressively move into registry with fixed slots **38** in member **30** shortening the effective length of the ram pipe.

Inasmuch as it is desired to maintain all of the ram pipe assemblies at the same effective lengths, it is possible to use a common actuating mechanism for rotating the sleeves **40** in unison. As already noted, it is desired to vary the effective ram pipe length inversely with engine speed. Accordingly, it has been found most convenient to utilize the engine distributor mechanism **26** as the means for providing a control force proportional to engine speed.

As best seen in Figures 3, 5 and 6, a tab member **46** is suitably formed on each ram pipe sleeve **40**. A link **48** is articulated at one end to tab **46**. The other end of link **48** is articulated to one arm **50** of a bell crank lever **52**. Bell crank lever **52** is pivotally supported intermediate its arms upon a bracket **54** in turn supported upon a plate **56** suitably mounted upon cylinder block **12**.

A control rod **58** is slidably mounted within a pair of longitudinally spaced supporting brackets **60** and **62** also supported upon plate **56**. The other arm **64** of bell crank lever **52** is articulated to control rod **58** through a pin **66** fixed to the control rod. Pin **66** coacts with a slot **68** formed in arm **64** of lever **52**. Since control rod **58** reciprocates in a longitudinal direction causing each bell crank lever **52** to rotate about its pivotal connection to bracket **54**, it is apparent that a pin and slot type of connection between the lever and control rod is necessary to prevent a binding action between the same.

To achieve a reciprocating movement of control rod **58** whereby ram pipe sleeves **40** will be rotated, supra, one end of the control rod is suitably connected to the distributor mechanism **26**. To this end, a bell crank lever **70** is pivotally supported at **72** upon the distributor **26**. Lever **70** includes an arm **74** having a slot **76** adapted to receive a pin **78** fixed to the control rod. The other arm **80** of lever **70** likewise includes a slot **82** adapted to receive a pin **84** fixed to a collar **86** slidably mounted upon distributor shaft **28**.

At this point it is apparent that as the bell crank lever **70** is rotated about its pivot **72** the longitudinal position of control rod **58** will vary and in turn vary the registry between ram pipe slots **38** and **42**. In order that the actuation of the bell crank lever **70** be controlled in accordance with engine speed, collar **86** is articulated through links **88** to a plurality of weighted arms **90** which are in turn articulated at their other ends to a collar **92** fixed to shaft **28** for rotation therewith. It is to be noted that shaft **28** rotates relative to collar **86**.

As best seen in Figure 4, as shaft **28** rotates with increased engine speed the weighted arms **90** will be thrown outwardly by centrifugal force. In so moving, arms **90** through links **88** cause collar **86** to be moved upwardly relative to shaft **28**. This movement of collar **86** in turn causes a counterclockwise rotation of bell crank lever **70** and through control rod **58** induces a similar counterclockwise rotation to levers **52** controlling the respective ram pipe sleeves **40**.

It will be seen that with the above described mechanism it is possible to vary effective ram pipe length inversely to engine speed and thereby maintain a high engine volumetric efficiency throughout the engine's speed range.

It is apparent that various structural modifications may be made in the illustrated embodiment of the subject invention within the intended scope of the hereinafter appended claims.

I claim:

1. A manifold for an internal combustion engine comprising a plurality of ram pipe devices for respectively supplying air to the individual cylinders of the engine, each of said ram pipe devices comprising a first tubular member mounted upon said engine and communicating at one end with an engine cylinder and open at the other end to atmosphere, a plurality of longitudinally extending slots formed throughout at least a part of the length of said member, a sleeve member rotatably supported upon said first member, said sleeve member including a corresponding number of slots adapted to coact with the slots in said first member, and engine speed responsive means operatively connected to said sleeve members to rotate the latter to progressively move said sleeve slots into registry with the slots in said first member to vary the effective length of each ram pipe device in accordance with engine speed.

2. A manifold for an internal combustion engine comprising a plurality of ram pipe devices for respectively supplying air to the individual cylinders of the engine, each of said ram pipe devices comprising a first tubular member mounted upon said engine and communicating at one end with an engine cylinder and open at the other end to atmosphere, a plurality of longitudinally extending slots formed throughout at least a part of the length of said member, said slots terminating at one end adjacent the atmospheric end of said member, a sleeve member rotatably supported upon said first member, said sleeve member including a corresponding number of slots adapted to coact with the slots in said first member, and engine speed responsive means operatively connected to said sleeve members to rotate the latter to progressively move said sleeve slot means into registry with the slot in said first member to reduce the effective length of each ram pipe device as engine speed increases.

3. A manifold as set forth in claim 2 in which said sleeve slots include a tapered side adapted to coact with a subadjacent slot in the tubular member to progressively uncover the latter slot as engine speed increases.

4. A manifold for an internal combustion engine, said engine including a plurality of cylinders, a cylinder head having a plurality of individual cylinder intake passages, said manifold comprising a plurality of ram pipe devices each adapted to supply air to said cylinder intake passages, each ram pipe device including a first tubular member mounted at one end upon said cylinder head and adapted to communicate with one of said cylinder intake passages, a sleeve member rotatably supported upon said first member, longitudinally extending slot means formed in each of said members, means for rotating said sleeve relative to said first member to vary the amount of registry between said slot means whereby the effective length of each ram pipe device is varied, and a common engine speed responsive device operatively connected to each of said sleeve rotating means to provide unison actuation of said sleeves to maintain all ram pipe devices at substantially the same effective length.

5. A manifold as set forth in claim 4 in which the common engine speed responsive device comprises a pivotally mounted lever disposed adjacent each rotatable sleeve, link means articulated between each sleeve and lever, a common control rod articulated to each lever, and a mechanism operable in proportion to engine speed connected to said rod whereby said sleeves are moved in unison to vary the effective lengths of said ram pipe devices.

No references cited.