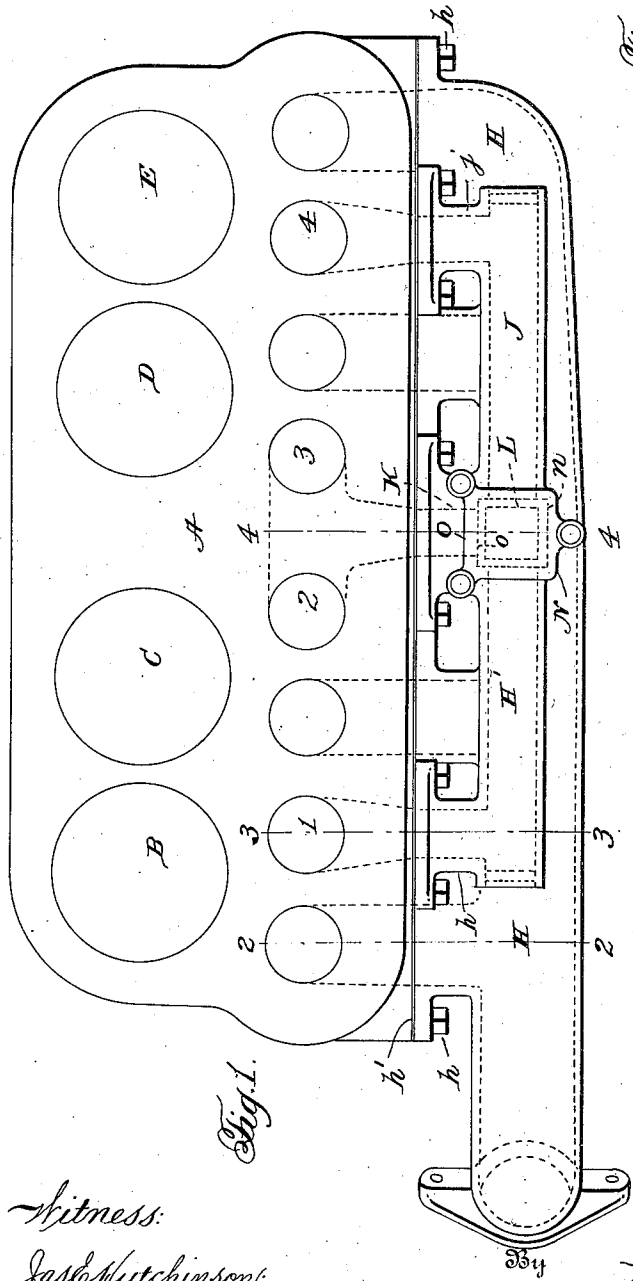
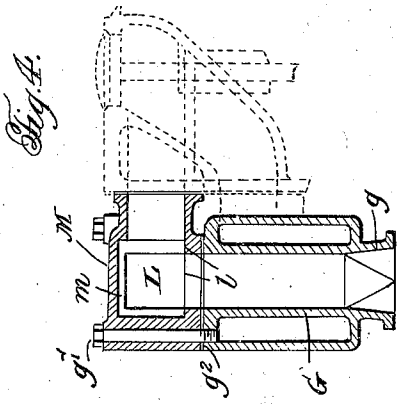
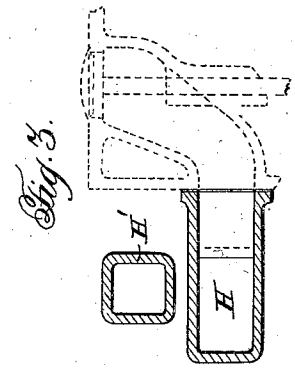
March 29, 1932. J. W. SWAN 1,851,601

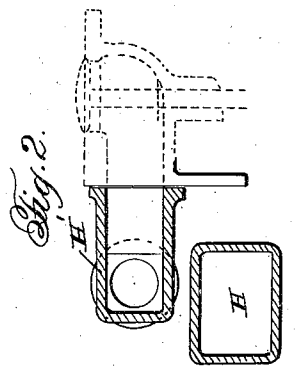
MANIFOLDING FOUR-CYLINDER ENGINE

Original Filed April 27, 1925 2 Sheets-Sheet 1

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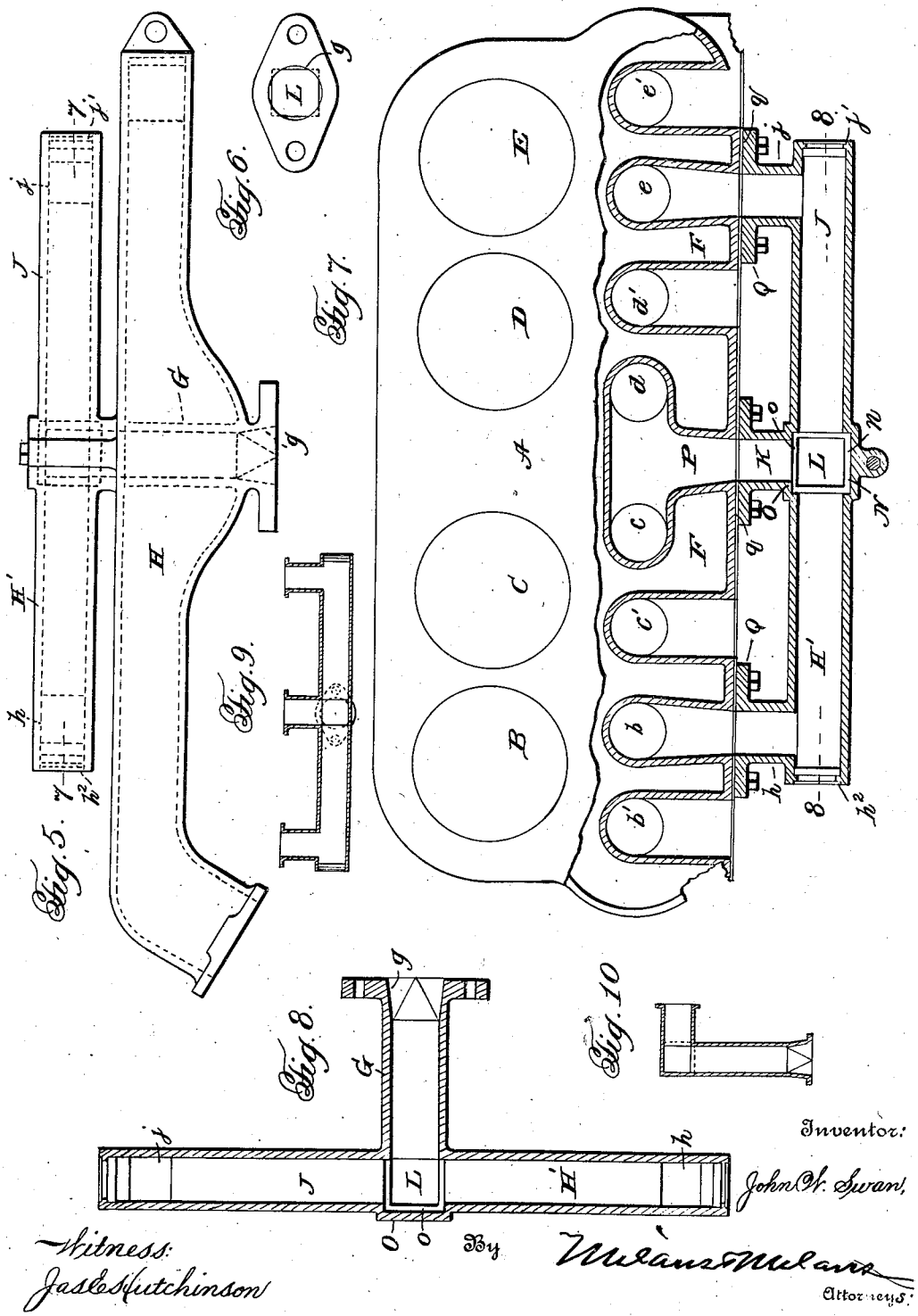
MANIFOLDING FOUR-CYLINDER ENGINE

Original Filed April 27, 1925 2 Sheets-Sheet 2



Patented Mar. 29, 1932 1,851,601

# UNITED STATES PATENT OFFICE

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## MANIFOLDING FOUR CYLINDER ENGINE

Application filed April 27, 1925, Serial No. 26,196. Renewed June 20, 1927.

This invention relates to a method (and means) of distributing an air and fuel mixture to the cylinders of an internal combustion engine.

The invention aims particularly at the uniform distribution of a mixture such as is known in the art as "a cold mixture", that is, a mixture under normal atmospheric temperature. However, the use of the invention is not so limited, inasmuch as it is capable of satisfactory performance in connection with mixtures of any temperature. A disadvantage of cold mixtures arises from the fact that such mixture contain particles of fuel in liquid state rendering uniformity of air and fuel ratios to the cylinders difficult of accomplishment. Such desired uniformity is obtained by the present invention.

Fundamentally, the underlying principle, method and means of attaining the above stated ends are fully set forth and claimed in my copending application, Serial No. 744,991, filed November 5, 1924. In so far as common or divisible subjects matter are concerned, the present application is a continuation of said application, and its parent application, Serial No. 501,314, filed September 17, 1921.

Whereas in my preceding application, Serial No. 747,991, the specific phase of the invention is devoted more particularly to six cylinder engines, the present embodiment of the invention is primarily constituted by an improved combination of the manifold as set forth in the earlier applications with a four cylinder type of engine.

Insofar as matter pertaining to the application or use of heat in carrying out the objects of my invention or improvements has been disclosed, but not claimed, in this application and/or in the Patent (of which this application is a continuation as to divisible subject matter), No. 1,536,044, patented April 28, 1925, filed November 25, 1924, and/or in its parent Patent No. 1,636,721, patented July 26, 1927, filed September 17, 1921, all claims referring to the application and/or use of heat as aforesaid for the purpose of aiding distribution or otherwise will be prosecuted in my co-pending application, Serial No. 208,291, filed July 25, 1927, for means for facilitating the delivery of fuel to an engine manifold, which application constitutes a continuation of this application as well as a division of the parent Patent No. 1,636,721, noted above.

An object of my basic invention has been to provide a manifold capable of securing uniform fuel distribution when applied to any type of engine, but in instances, such as the four cylinder type, now known to the industry, improvements have had to be conceived to enable the best use of the manifold in performing its intended functions. The present improvement is essentially of that nature, residing as it does, in the combining of a three-port manifold with a four ported engine in manner and form to overcome objectionable results flowing from successive passages of fuel mixture through a single branch of the manifold to adjacent cylinders, a pair of which must be in communication with one branch of the manifold.

In view of the foregoing, it may be stated that the novel features of the present invention reside largely in the manner in which the inlet ports to the cylinders are connected with the inlet manifold for the introduction of the fuel to the cylinders.

A practical and preferred embodiment of the invention is illustrated in the accompanying drawings forming part hereof and the details and association of elements will be clear from the specific description hereinafter contained when read in connection with such drawings.

In the drawings:

Figure 1 is a plan view, in fragmentary and diagrammatic manner, of a four cylinder engine operatively associated with my improved manifold;

Figures 2, 3 and 4 are vertical sectional views, respectively, on the lines 2—2, 3—3 and 4—4 of Figure 1;

Figure 5 is a front elevation of the manifold removed from the engine;

Figure 6 is a detail view looking at the bottom of the intake of the manifold;

Figure 7 is a horizontal sectional view on the line 7—7 of Fig. 5; and

Figure 8 is a longitudinal vertical sectional view on the line 8—8 of Fig. 7.

Another embodiment is illustrated in Figs. 9 and 10,—

Figure 9 is a horizontal section through the manifold, and

Figure 10 is a vertical section thereof.

Referring more particularly to the drawings wherein like reference letters designate corresponding parts in the several views, A represents the cylinder block or casting provided with the four cylinders, B, C, D and E, respectively provided with inlet ports, *b*, *c*, *d* and *e*, and the exhaust ports *b'*, *c'*, *d'* and *e'*. All of these ports are usually, and may or may not, be provided with the water jacket F as found convenient or desired in practice.

With any suitable carburetor or lead therefrom (not necessarily illustrated herein) the intake,—in this instance an uptake,—portion G of the manifold is adapted to extend in a vertical direction, the same being preferably in the nature of a square conduit rounding at its lower end *g* to register with the common circular opening of a carburetor outlet or a round pipe coupling the same with the manifold as will be obvious. The uptake passage of the conduit G passes directly through an exhaust manifold H coupled to the face of the engine by flanges and bolts *h*, with a suitable packing *h'* therebetween, and in registration with the several outlet ports, the conduit G being in this instance formed integrally with the exhaust manifold and has a vertical passageway therethrough so that the heating influence of exhaust gases will be imparted to the walls of the manifold and the consequent warming of the wall of the conduit G may overcome tendency of the fuel mixture or constituents thereof to adhere to the surface of said wall. The upper end of the conduit G and associated casting of the exhaust manifold is bolted as at *g'* to the bottom of the horizontal portion of the inlet manifold, now to be defined, a suitable packing $g^2$ being interposed between their adjacent flat faces. The horizontal portion of the manifold comprises three branches H, J and K all meeting at their inner ends at a common junction point which I have appropriately styled a distributing zone L. This zone opens through a square opening in the bottom of the horizontal portion of the manifold to the registering square bore of the inlet conduit G. It also opens and is in registration with the interiors of the three branches H, J and K, these branches being also preferably of square cross section, although it is here noted that the invention is not restricted to such square configuration or to a rectangular configuration which, however, has been found well suited for practical purposes, because, in instances, other shapes may be resorted to. The top M of the manifold immediately above the zone L is provided with a square recess *m* preferably somewhat larger than the square cross section of the uptake G, the end walls of the recess forming sharp angles with the top walls of the branches H, J and K so that any mixture reaching the dome will have to return into the air stream rather than have a tendency to run along the said top walls of the various branches. I have also found that results will be enhanced by forming the front wall N of the manifold with a recess *n* like the recess *m* having sharp angles with the front walls of the branches H and J, and the rear wall portions O of the manifold are formed with complemental recesses *o* formed by sharp angles with the rear walls of the branches H, J and K, all to the end that the mixture entering the distributing zone L or reaching the dome M will be directed back into the stream passing through the dome or to the uptake G rather than tend to adhere to and pass along the faces of the walls of the several branches.

As will be seen by reference to Figure 6 the branch H of the manifold extends at a right angle to the vertical conduit G and by a right angle turn *h* registers with the inlet port *b* of the cylinder B. The branch J is formed the same and occupies a similar relation to the inlet port *e* of the cylinder E. The intermediate or central branch K is also at right angles to the uptake G and leads to a siamesed pair of inlets *c* and *d* respectively belonging to the cylinders C and D, the siamesing of these particular ports as indicated at P being for purposes as will presently appear. The right angular relation of the parts H, J and K to the uptake G is accomplished by sharp corners in each instance as indicated at *l* to obviate the disadvantages of curved or rounded bends.

The outer ends of the branches H and J of the manifold have square recesses *h'* and *j'* formed therein projected outwardly a little beyond the adjacent wall of the turns *h* and *j*, the juncture therebetween being also a sharp right angle like the sharp angle of the inner wall of the branches H and J with the outlets *h* and *j* so that at every turn the fuel constituents and particularly the wet particles will always tend to reenter and mix with the stream rather than adhere to and follow wall surfaces as happens where turns and bends are formed on curved lines. The inlet manifold, in fashion similar to the securing of the exhaust manifold H to the engine, is attached to the side of the engine as through the medium of flanges and bolts Q, suitable packing *q* being interposed as will be readily understood.

In the foregoing description, it will be understood that I have provided a manifold comprising a vertical uptake and the three outlet branches all in communication with a distributing zone, the formation of said zone being symmetrical so that the same and the

forces acting therethrough will insure uniform distribution of the fuel in all (the three) directions determined by the outlet branches, thus favoring the fuel passing from the zone in one direction no more than the fuel is similarly favored when passing in either one of the other directions; also that at the ends of the manifold the same is so formed that the forces acting to distribute the mixture to the end cylinder will tend to restore the mixture to the character possessed by it prior to reaching the turn.

As previously observed herein, these basic matters are set forth in other applications, but as will be hereinafter particularly set forth in the claims, the present device possesses details of additional merit particularly as respects the association of the manifold with the ports of the four cylinder engines. In providing this combination I have maintained the usual firing order of the cylinders of the engine, for example, 1—3—4—2, or, 1—2—4—3, as the case may be, as indicated in Figure 1, where these numerals have been applied at the respective inlet ports of the cylinders B, C, D and E. However, I have provided a new arrangement incident to the siamesing of adjacent or middle inlet ports *c* and *d* and effecting registration thereof with the intermediate or central branch K of the manifold. Now, understanding the firing order to be, for example, as I have above outlined, so that the usual method of induction of the fuel is employed with reference to the sequence of the induction cycles, it will be noted that no two charges of mixture, in succession, will follow each other through the same branch of the manifold after passing the distributing zone. A change of direction at this zone from the intake or source of supply takes place each time a cylinder takes a charge, and as the influences at the zone when the change of direction takes place are such that the mixture will flow in substantially equal mixture constituents or ratios to each of the branches leading from this zone, it will be seen that equal distribution of the mixture charge to all of the cylinders will result.

To adopt this manifold to a four cylinder engine of the usual construction and to secure even distribution of the mixture, it is necessary to arrange the inlet ports to the cylinder valves so that the two center cylinders will take their charge from a common intake from the center branch of the manifold and the mixture will take a differing direction from the distributing zone each time there is an induction charge taken into the engine; thus, the order of induction of the cycles will be as related to the cylinders 1, 3, 4, 2 or 1, 2, 4, 3. An object of the invention is to construct the inlet ports in such a manner that the cylinders in their respective order will be provided with ports connecting with the inlet valves of the cylinders and arranged to admit of applying the manifold with these outlets. Thus No. 1 cylinder has an inlet port connection with No. 1 cylinder only. No. 2 and No. 3 have an inlet port connecting with these two cylinders, while No. 4 has a port corresponding in every way to the port in No. 1.

While I have herein disclosed the preferred embodiment of my invention, it will be understood by persons skilled in the art to which the invention relates that changes and alterations in details and association of parts may be availed of without departing from the spirit of the invention. For instance, I have shown in Figures 9 and 10 a variation, wherein the center or intermediate branch of the manifold has been dispensed with. At the junction with the uptake, this manifold may or may not be provided with the domed and recessed distributing zone, a zone without dome or recess being illustrated, the top wall of the manifold being flat throughout, which would serve quite well in some instances. This particular manifold could be coupled directly with the ports of four cylinder engines by siamesing opposite end pairs thereof. This form of manifold is, however, otherwise useful in connection with sub-manifolds for engines of other types as set forth in my copending application executed of even date herewith.

What I claim is:

1. The combination with a four cylinder engine having suitable inlet ports for the cylinders, of a manifold having three outlets operatively associated with said cylinder inlet ports to supply fuel mixture to the cylinders through their inlet ports in keeping with the induction cycles of the cylinders.

2. The combination with a four cylinder engine having suitable inlet ports therefor, of a manifold having three outlets operatively associated with said cylinder inlet ports to supply fuel mixture to the cylinders through their inlet ports in keeping with the induction cycles of the cylinders, the inlet ports to a pair of cylinders being in communication with one of the manifold outlets, and a common supply for the manifold, the outlet portions of the manifold and their relation to the inlet ports of the cylinders being such that the passage of the fuel mixture from the common supply to the cylinders will not be successively in any one direction with respect to the manifold outlets.

3. The combination with a four cylinder engine having suitable inlet ports, of a manifold having three outlets operatively associated with the inlet ports of said four cylinders, and means for supplying the manifold with a fuel mixture, the relation of the outlets, inlet ports and induction cycles of the cylinder being such that the distribution of the fuel towards the outlets from the mani-

fold will be successively in differing directions.

4. The method of distributing a fuel mixture to a four cylinder engine comprising the movement of the mixture to a distributing zone, subjecting the movement of the mixture to forces tending to uniformly distribute the mixture passing through said zone, and directing the mixture in three directions from said zone and in successively differing directions from the zone to supply the successive cylinders.

5. The method of distributing a fuel mixture to a four cylinder engine comprising the movement of the mixture from a common source in three different directions to the cylinder ports, and successively varying the direction of movement of the mixture so that the mixture will not pass in the same direction to immediately successive cylinder ports.

6. The method of distributing a fuel mixture to the cylinders of a four cylinder internal combustion engine comprising the movement of the mixture from a source of supply to a zone of distribution, and subjecting the movement of the mixture through said zone to forces tending to uniformly distribute the mixture in three successive directions transverse to the original direction and finally in each direction directing the mixture to one of the four cylinders of the engine.

7. The method of distributing a fuel mixture to the cylinders of a four cylinder internal combustion engine comprising the movement of the mixture from a source of supply to a zone of distribution, and subjecting the movement of the mixture through said zone to forces tending to uniformly distribute the mixture in three successive directions transverse to the original direction and finally in each direction directing the mixture to one of the four cylinders in two of the directions and to two of the cylinders in the third direction.

8. The method of distributing a fuel mixture to the cylinders of a four cylinder internal combustion engine comprising the movement of the mixture from a source of supply to a zone of distribution, and subjecting the movement of the mixture through said zone to forces tending to uniformly distribute the mixture in three successive directions transverse to the original direction and finally in each direction directing the mixture to one of the four cylinders in two of the directions and to two of the cylinders in the third direction but alternating the movements in said third direction to separately supply each cylinder of the pair with the movements in the other two directions to supply each of their corresponding cylinders.

9. The combination with a four cylinder engine having suitable inlet ports therefor, of which one port leads to a pair of cylinders between the firing of which one other cylinder fires, of a manifold having three outlets operatively associated with said cylinder inlet ports to supply fuel mixture to the cylinder through their inlet ports in keeping with the induction cycles of the cylinder, the inlet ports to a pair of cylinders communicating with one of the manifold outlets, and a common supply for the manifold, the outlet portions of the manifold and their relation to the inlet ports of the cylinders being such that the passage of the fuel mixture from the common supply to the cylinders will not be successively in any one direction with respect to the manifold outlets.

In testimony whereof I hereunto affix my signature.

JOHN W. SWAN.