June 5, 1945. P. E. MERCIER 2,377,708

EXHAUST MANIFOLD

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Fig. 3

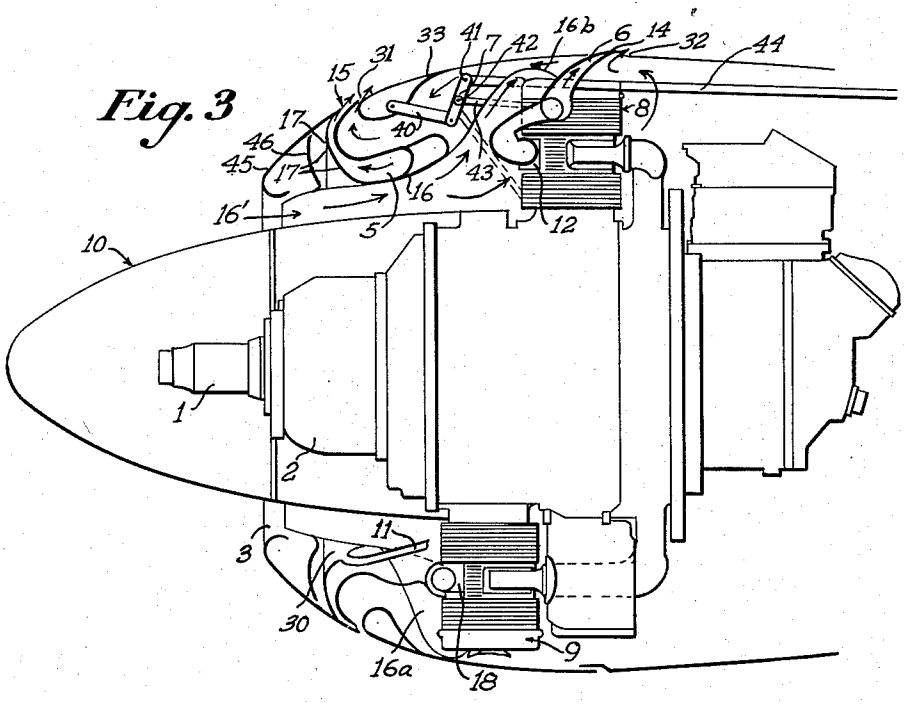


Fig. 2

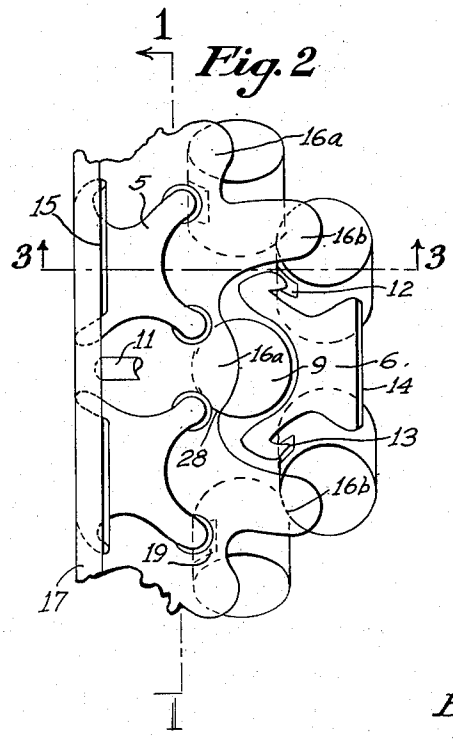
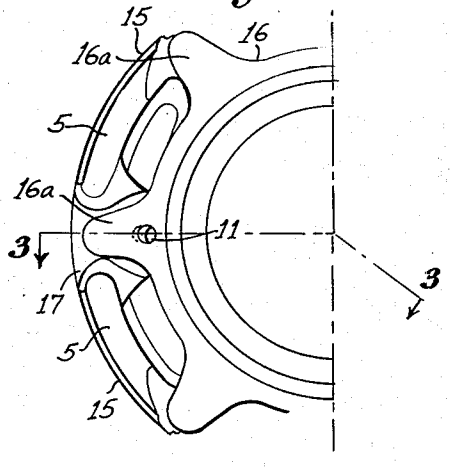


Fig. 1



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EXHAUST MANIFOLD

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Fig. 4

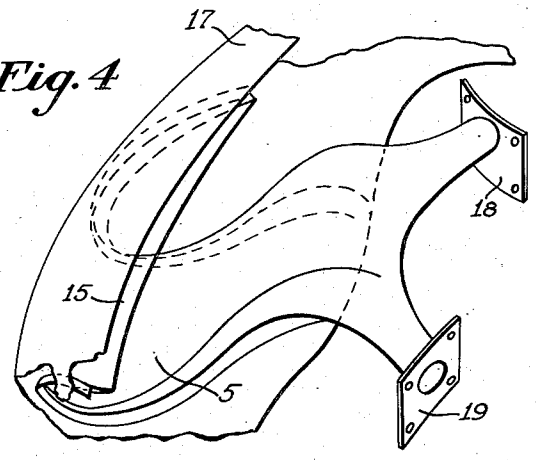


Fig. 5

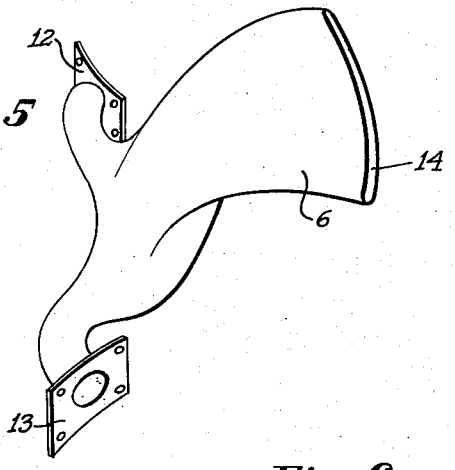
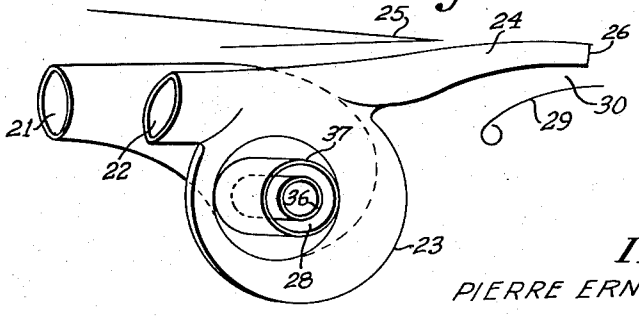


Fig. 6



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EXHAUST MANIFOLD

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Fig. 7

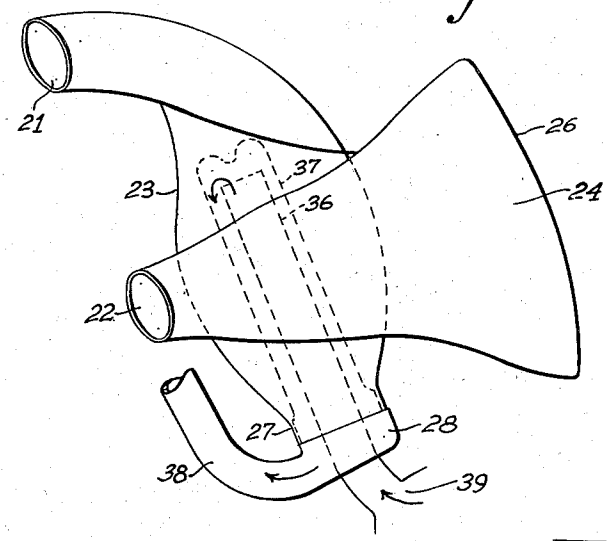


Fig. 8

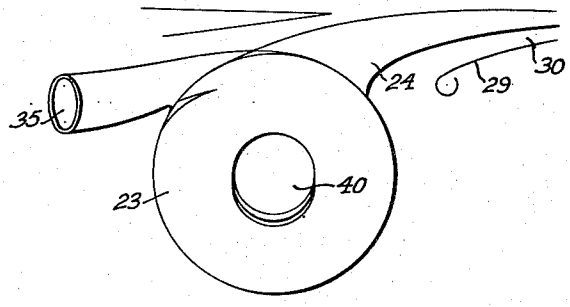
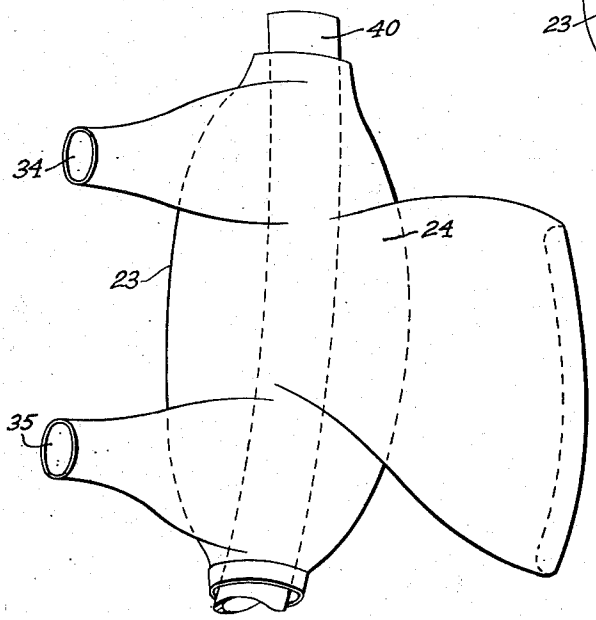


Fig. 9



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UNITED STATES PATENT OFFICE

2,377,708

EXHAUST MANIFOLD

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Application January 15, 1941, Serial No. 374,425
In France February 7, 1940

3 Claims. (Cl. 60—31)

The invention relates to exhaust manifolds for multicylindered airplane engines.

The main object of the invention is to group the exhausts of the engine cylinders in twos by providing an exhaust manifold common to each pair of cylinders.

Another object of the invention consists in providing a special form of such manifold combined with an exhaust pipe.

Still another object of the invention is to have forms of said manifold particularly adapted for use with a double-row radial engine.

The invention will be better understood by means of the attached drawings, in which:

Fig. 1 represents a half-view, taken along line 1—1 of Fig. 2 and looking in the direction of the arrows, of a double-row radial engine cowling without valve, by way of example, having exhaust members according to the invention.

Fig. 2 shows a bottom view of the same cowling.

Fig. 3 is a sectional view taken along line 3—3 of Fig. 1 and looking in the direction of the arrows.

Fig. 4 shows in perspective a manifold in accordance with the invention adapted to the front cylinders of a double-row radial engine.

Fig. 5 shows in perspective a manifold according to the invention adapted to the rear cylinders of a double-row radial engine.

Figs. 6 and 7 show respectively in lateral view and in perspective a variation of the manifold with a bulbous body form as connected to one of the cylinder pipes.

Figs. 8 and 9 in similar fashion show respectively, in a lateral view and in perspective, another variation in which the two cylinder pipes are connected to the side of the bulb-shaped portion of the manifold.

Assuming that the duration of the time of exhaust in an engine extends over more than 250° of the revolution of the crankshaft, it will be seen that without causing the end of an exhaust to coincide with the beginning of another, it is possible to have two cylinders exhaust into the same member if their exhaust times are separated approximately by one revolution of the crankshaft.

In multiple-row radial engines this is in general the case with two adjacent cylinders of the same radial row at nearly $1/n$ turn, n being the number of cylinders in a radial row.

In its most general aspect, the invention consists therefore in grouping the exhausts of such cylinders in twos.

In the particular case of double-row radial engines such a grouping would give rise to overlapping of exhaust members of both radial rows (on account of the overlapping arrangement of the cylinders of the two radial rows). The invention therefore provides for this case in having the exhausts of the front radial rows end in members common to each pair of adjacent cylinders in the form of a curved nozzle, the discharge slot of which is directed to the rear and permits a flow of insulating air between the gases and the cowling, while the exhausts of the cylinders of the rear radial row are arranged between the cylinders in common to each pair of said cylinders and by utilizing the flattening combined with the curvature and sheet of insulating air between the pipe and the motor cowling.

The preceding combination offers a great many advantages beside the increase of propulsive effect, on account of the fact that the exhaust manifolds are reduced as well as the exhaust members themselves, and lend themselves particularly well to the construction of a motor cowling with an efficient air circulation, provided with means for the removal of air arranged under the different gas exhaust evacuation slots.

Moreover, the exhaust members of the front radial row of cylinders, though being provided with discharge openings allotted to each pair of adjacent cylinders, may be assembled on a single crown forming the front tip of the cowling and permitting a device for the production of hot air to be readily established.

According to a variation applicable either to a double-row radial engine or to any multicylindered engine, the exhaust members common to two cylinders are characterized by a cavity of bulbous form, into which one or the two exhaust pipes enter tangentially, the discharge of the gases being assured along a gaseous sheet detaching itself tangentially from the bulb-shaped body and passing out to the rear of the surface of the motor fairing.

Among other things this arrangement offers the advantage of reduced space and allows of combining the exhausts of two adjacent cylinders, insuring at the level of the exhaust slot a more regular rate of flow of gas than in the case of individual pipes.

This more regular rate of flow promotes both the propulsive effect of the exhaust and the drive of the cooling air which is admitted under the evacuation rim of the gases leaving the device.

Of course, the invention lends itself to all sorts of variations of embodiment, and especially allows of the production of hot air (necessary, for example, for heating the carburetors), by means

of an inner tube, concentric with the bulb-shaped body, and provided with a simple or return circulation.

Now, with reference to Figs. 1, 2 and 3, a propeller shaft is shown at 1 (the hub of the propeller being removed); the reduction gear of the engine is seen at 2; one of the cylinders of the front radial row is marked 9; one of the cylinders of the rear row is marked 8.

One of the fixing flanges of the exhaust pipe, namely 18 serves to secure the same to cylinder 9, while the corresponding flange 12 serves to secure the exhaust pipe to cylinder 8.

The exhaust pipe common to each pair of rear cylinders is shown at 6 in Fig. 3; it is provided with a discharge slot 14. The pipe common to each pair of front cylinders is seen at 5 and is provided with a discharge slot 15. The sheets of air caused by the cooling of the motor and insulating the cowling from the exhaust gases pass through the outlets seen at 31 and 32, which can be adjusted by moving the fairing 33, controlled by articulated rods indicated diagrammatically at 7. To this end the fairing 33 is made movable relatively to the cowling and is secured to a plurality of links 40, one of which is shown in Fig. 3. Each link 40 is pivotally secured to a second link 41 mounted intermediate its ends on a pivot 42 supported on a bracket 43 fastened to the engine. Secured to the free end of each link 41 is an actuator rod 44. By moving the rods 44 forwardly or rearwardly, the fairing 33 may be moved rearwardly or forwardly with respect to the cowling, thus enabling the size of the openings 31 and 32 to be adjusted as desired. In Figure 3 of the drawings it is seen that one of the terminal ends of the fairing 33 lies adjacent the exhaust end of the pipe 6 (reference being made at this point to the upper half of Figure 3) while (reference being made to the lower half of the same figure) the fairing extends over the forward end portion of the cowling of the plane.

The members 5 are carried and joined together by means of the crown 17, which serves as a heating surface for the production of hot air admitted at the front nose 45 of the cowling through the slot 3. For this purpose, the nose 45 of the cowling and the crown 17 form an annular chamber 30 within which is disposed a laterally extending baffle 46 secured to the bell-shaped fairing 16. Cool air is admitted through the annular slot 3 and over the baffle 46 into contact with the crown 17 where it is heated by heat from the exhaust gases in the exhaust pipes 5. The heated air is conducted from the chamber 30 formed by the nose 45 and the crown 17 through a pipe 11 to the various points on the airplane where it may be needed.

A fairing 10, which is partly fixed and partly movable with the airplane propeller, cooperates with a rearwardly extending bell-shaped fairing 16 to form an air inlet 16' for supplying cooling air for the engine cylinders. To this end, the fairing 16 is provided with a plurality of rearwardly extending scoop-like members 16a and 16b which direct air from the inlet 16' to the tops of each of the cylinders in the two rows.

In operation, the rotating propeller (not shown) supplies cooling air through the inlet 16'. Part of the air admitted through the cooling inlet 16' passes over the cooling fins on the cylinders in both rows (Fig. 3) and is discharged through the discharge outlets 31, 32. Another part of the cooling air admitted through the inlet 16' is directed by the scoop like members 16a and 16b to the tops of the cylinders in both rows. From thence, part of it is discharged through the outlets 32 and another part moves forwardly and is discharged through the outlets 31.

Meanwhile, the exhaust gases from adjacent pairs of cylinders in the forward row are exhausted from exhaust pipes like the pipe 5 in Fig. 3, through the slot 15, the cooling air being discharged through the slots 31 between the exhaust gases and the cowling. In similar fashion, the exhaust gases from adjacent pairs of cylinders in the rear row are exhausted from exhaust pipes like the pipe 6 in Fig. 3, through the slot 14, the cooling air being discharged through the slots 32 between the exhaust gases and the cowling.

As indicated above, by employing a common exhaust manifold for each pair of adjacent cylinders, the number of exhaust manifolds and exhaust pipes is cut in half, while a more regular rate of flow of exhaust gases is obtained in the discharge slots than is possible in the case where an individual exhaust manifold is used for each cylinder. This more regular rate of flow of exhaust gases promotes both the propulsive effect of the exhaust and the drive of the cooling air which is discharged between the engine cowling and the exhaust gases.

In Figs. 4 and 5 we see, on a larger scale, the form of the double pipes in communication with each opposite cylinder exhaust flange of the same radial row. Fig. 4 refers to the front row, and Fig. 5 to the rear row of radial cylinders. The reference numbers 5, 15, 17, 18, 19 and 6, 12, 13 designate the same elements as in Figs. 1 to 3.

In Figs. 6 and 7, 21 and 22 designate two exhaust pipes fitted in any convenient manner with attaching flanges not shown, but similar to those shown at 18 and 19 or at 12 and 13 in Figs. 1 to 5, and which in the variation shown may evacuate the gases of any two cylinders of any engine. One of the exhaust pipes 21 enters a hollow bulb-shaped body 23 tangentially through one of the ends of the latter, while the the other, 22, has a pipe doubly bent with a surface common with the side of the bulb-shaped body, one wall of which is eliminated as well as that of the pipe in the portion of the surface in question.

The end 24 of the exhaust pipe enlarges fan-like at 26 as it becomes thinner, in order to terminate at its widest part along the discharge slot at the outside, while assuming the shape and the contour of the engine cowling 25. The bulging or bulb-shaped body is truncated at its end opposite the first exhaust pipe 21 (at 27), and an air heating device with baffles (28) is introduced into the interior of the bulb-shaped body at the level of said truncation. This device has two pipes, an interior open end pipe 36, and a concentric exterior one 37, respectively communicating with the pipe openings 38 and 39, allowing air to be heated to be drawn in from one pipe and fed to the engine from the other.

The outside cooling air flowing along the exterior surface of the exhaust member during the flight of the aircraft carrying the device flows around a deflector 29 and leaves at 30 under the lip of the pipe 24.

According to Figs. 8 and 9, the two exhaust pipes 34 and 35, similar to the pipes 21 and 22, enter tangentially and symmetrically of the hollow gland-shaped body 23 at its ends, and the exhaust pipe 24 is inserted symmetrically at the level of the greatest enlargement of the gland

between the two exhaust gas admission pipes. This pipe expands and becomes thinner, as indicated in the preceding variation. The cooling system at the end of the pipe is similar to that shown in Fig. 6.

The heating circuit may in this case be provided with the pipe **40** passing from one end to the other through the gland and arranged along its axis.

I claim:

1. In an airplane engine with several cylinders arranged radially in a double-row, common manifolds into each of which the exhaust pipes of the gases of two adjacent cylinders of the front row discharge, each manifold being associated with one pair of cylinders only and evacuating the gases in an exhaust pipe individual for said manifold, said pipe having a progressively flattened profile, so as to terminate in an elongated slot, and presenting a double curvature in the general direction of the evacuation of the gases with one portion curved substantially perpendicularly to the curvature of the other, and the arrangement being such that the gases are evacuated first toward the front of the engine and then guided to the discharge slot toward the rear, and a single crown on which are assembled all the exhaust members of the front radial row of cylinders.

2. In an airplane engine with several cylinders arranged radially in a double row, common manifolds into each of which discharge the exhaust passages of the gases of two adjacent cylinders of the front radial row, each manifold being associated with one pair cylinders only and evacuating the gases in an exhaust pipe individual for said manifold, said pipe having a progressively flattened profile, so as to terminate in an elongated slot, and presenting a double curvature in the direction of the evacuation of the gases with one portion curved substantially perpendicularly to the curvature of the other, and, the arrangement being such that the gases are evacuated first toward the front of the motor and then guided toward the discharge slot to the rear, and a single crown on which are assembled all the exhaust members of the front radial row, the interior of said crown forming a part of a circuit for air heated by contact with said members.

3. In an airplane, in combination with a double row, radial engine having a plurality of cylinders, a cowling for the engine, means forming in the front of said cowling an inlet for cooling air, means for directing air from said inlet to said engine cylinders, means forming in the cowling in front of said cylinders a first discharge outlet for cooling air, means forming in the cowling behind said first discharge outlet a second discharge outlet for cooling air, a first group of common exhaust manifolds for adjacent pairs of engine cylinders in the forward row, conduits for directing exhaust gases from each pair of cylinders to the manifold corresponding thereto, an exhaust conduit for each manifold, each of said exhaust conduits having a progressively flattened profile terminating in an exhaust outlet adjacent said first cooling air discharge outlet, and having curved portions for directing the exhaust gases in a forwardly direction and then in a rearwardly direction to said exhaust outlet, means including portions of said exhaust conduits for directing part of the heated cooling air to said discharge outlet such that it is discharged between the exhaust gases from said exhaust outlets and the engine cowling, common exhaust manifolds for adjacent pairs of engine cylinders in the rear row, conduits for directing exhaust gases from each pair of cylinders to the manifold corresponding thereto, an exhaust conduit for each manifold, each of said exhaust conduits having a progressively flattened profile terminating in an exhaust outlet disposed adjacent said second cooling air discharge outlet, and having a curved portion for directing the exhaust gases to said exhaust outlet, and means including portions of said last named exhaust conduits for directing another part of the cooling air to said second discharge outlet such that it is discharged between the exhaust gases from said last named exhaust outlets and the engine cowling.

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