Aug. 3, 1954 A. HASBROUCK ET AL 2,685,166

EXHAUST COLLECTOR SYSTEM

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2 Sheets-Sheet 1

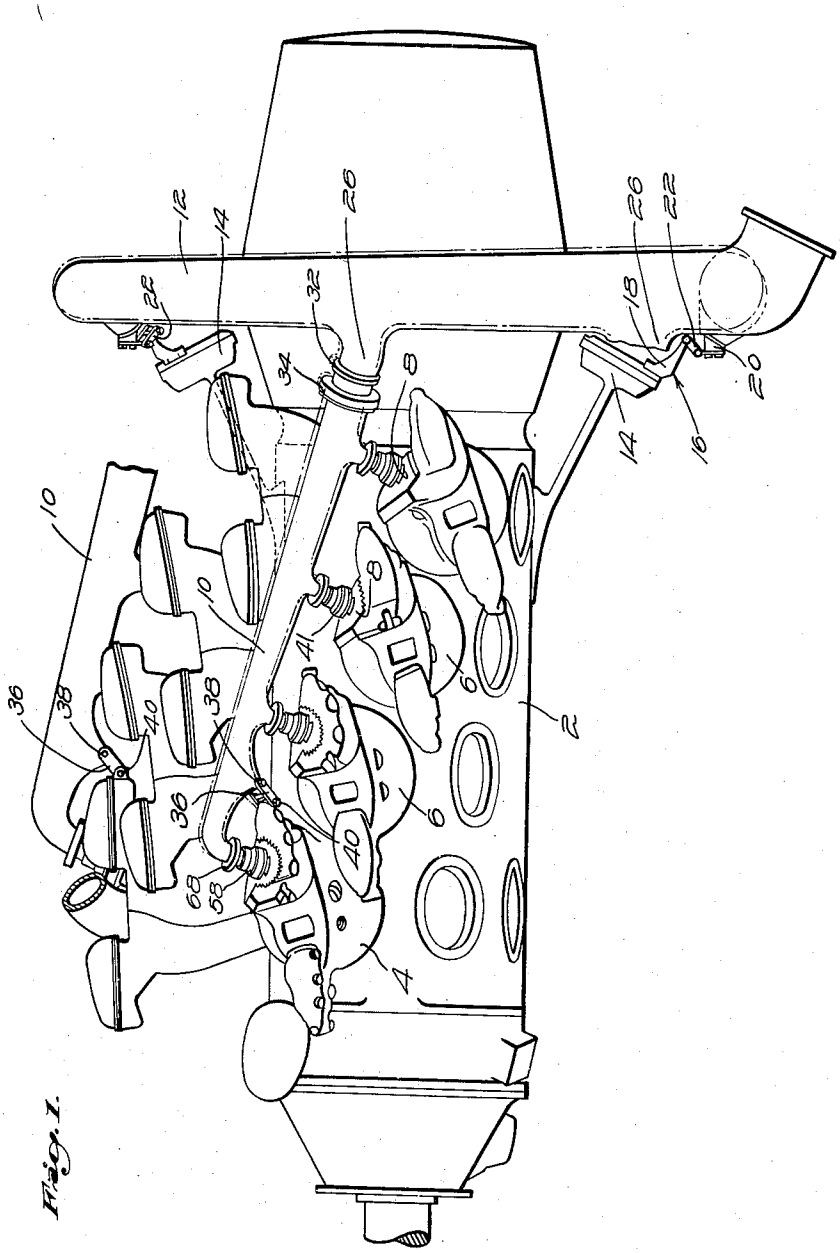


Fig. 1.

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Fig. 2.

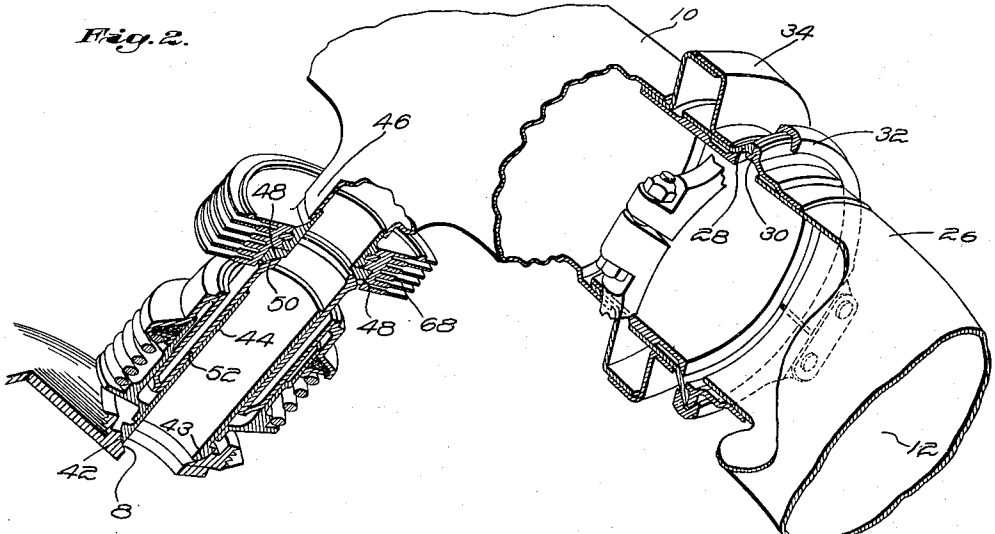



Fig. 3.

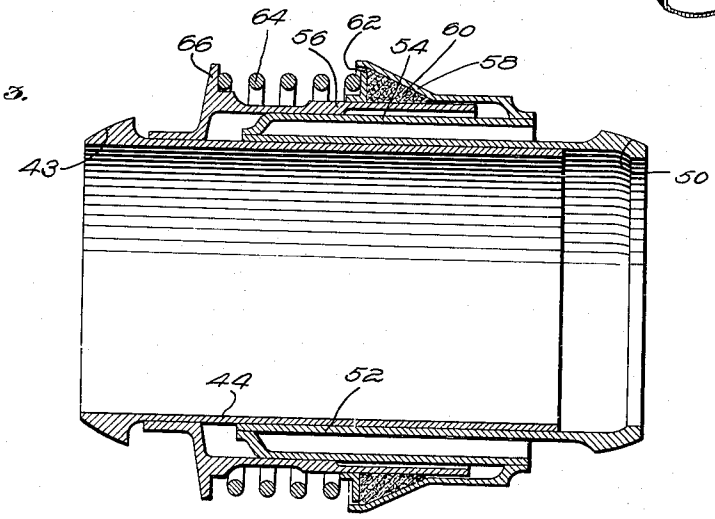
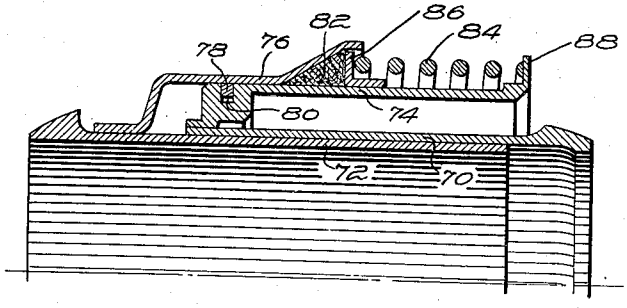



Fig. 4.

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# UNITED STATES PATENT OFFICE

2,685,166

## EXHAUST COLLECTOR SYSTEM

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3 Claims. (Cl. 60—29)

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This invention relates to exhaust collectors for use primarily in a multiple row, multiple bank engine.

In compounded engines or in engines in which the exhaust gas is collected under pressure for use for example in a thrust nozzle or turbine, the exhaust collector system must be heavy enough to withstand the pressures developed in the system at the temperatures of the exhausted gas. Such rugged, heavy construction reduces the flexibility of the collector to such an extent that provision must be made for thermal expansion of the parts of this invention. A feature of this invention is an arrangement for mounting the exhaust system on an engine such that thermal expansion in the exhaust system may occur without undue stresses on the system or on the parts of the engine to which the system is connected.

A feature of this invention is an exhaust collector extending around the engine and having exhaust manifolds extending over each bank of cylinders with the collector supported for axial and radial motion when it becomes heated so that the exhaust collector and the manifold may be free to expand as required without stressing the engine and without applying excessive stresses to the collector system itself.

One feature of the invention is the interconnection of the exhaust manifold to the individual cylinders by connecting ducts which can withstand the pressures thereon and still permit relative movement between the cylinders and manifold.

Other objects and advantages will be apparent from the specification and claims and from the accompanying drawings which illustrate an embodiment of the invention.

Fig. 1 is a diagrammatic elevation of a multiple row, multiple bank engine with the exhaust collector system connected thereto.

Fig. 2 is a perspective view of the connections between the collector and the manifold and between the manifold and the engine cylinder.

Fig. 3 is a sectional view through the duct between the engine cylinder and the manifold.

Fig. 4 is a modified construction of the duct of Fig. 3.

The invention is shown on a radial engine in which the crankcase 2 supports helically arranged banks 4 of engine cylinders 6 having exhaust ports 8 through which the exhaust gas from the cylinders is delivered to a series of manifolds 10, one for each bank with all of the manifolds connected to an exhaust collector 12 in the form of a ring extending around the engine crankcase and preferably located in one end of the engine.

The engine is supported by engine mounts 14 and the exhaust collector is supported from these mounts by means of a series of supports 16 each

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of which include a small bracket 18 on the engine mount, a cooperating bracket 20 on the collector 12 and a link 22 connecting the brackets and pivoted for relative movement with respect to each of the brackets. With the exhaust collector in the cold condition shown in full lines in Fig. 1, the linkages 22 extend at an angle to a strictly radial position so that when expansion of the exhaust collector occurs as it becomes heated while the engine is in operation, radial expansion of the collector ring 12 may take place with this expansion causing both radial and axial movement of the exhaust collector in the dot-dash line position of Fig. 1. It will be noted that the motion of the collector as it becomes heated is rearwardly for a purpose that will hereinafter appear. To accomplish this the links 22 are arranged so that the pivotal connection to the bracket 18 which is radially inward of the bracket 18 is also rearwardly with respect to the pivotal connection with bracket 20.

Each manifold 10 is connected to a lateral duct 26 on the collector ring 12 as by interengaging radially extending flanges 28 and 30 on the manifold 10 and collector 12, respectively, these flanges being engaged by and held in proper relation to each other by clamping ring 32. The manifold 10 adjacent to the collector 12 has a radial connection 34 which may be of any suitable construction to provide a small amount of angular flexibility between the manifold and the collector.

Each manifold is supported adjacent the forward end of the engine (the collector being at the rearward end of the engine) by a connecting link 36 which in the arrangement shown is pivoted on a pin 38 on the manifold and another pin 40 on one of the cylinder heads. When the engine and exhaust collector system are cold the link 36 extends at an angle to a direct radial position so that when heating of the exhaust collector system takes place the forward end of the manifold is free to move forwardly and at the same time to move outwardly an amount corresponding to the radial movement of the collector 12. The angle of the links 36 is preferably so related to the clamping rings 32 that the radial movement of the forward end of the manifold will be as nearly as possible equal to the radial movement of the rearward end of the manifold caused by the expansion of the collecting ring.

With the manifold expanding lengthwise and moving radially outward the connection 41 between the manifold and each exhaust port must provide for a measure of longitudinal expansion and also for pivotal motion with respect to both the manifold and the exhaust port. For this purpose the connection may be of the type shown in Figs. 2 and 3. In these figures, the exhaust port 8 has a spherical seat 42 to cooperate with a spherical surface 43 on a sleeve 44, and the standpipe 46 on the manifold has a spherical seat 48

engaging with a spherical surface 50 on a sleeve 52 fitting within and slidable with respect to sleeve 44.

As shown in Fig. 3, the sleeve 44 has a surrounding sleeve 54 connected to and affixed in spaced relation to the sleeve 44 which in turn is surrounded by a sleeve 56 slidable on the sleeve 54 and connected to the sleeve 52. A third sleeve 58 surrounds the sleeve 56 in spaced relation thereto and is connected to sleeve 54 and therefore to sleeve 44. Between sleeves 56 and 58 is packing 60 held in place by a ring 62 to which pressure is applied by a spring 64 extending between the ring 62 and a flange 66 on the sleeve 56. With this arrangement leakage between the sleeves 44 and 52 is prevented and the spring 64 also functions to hold the surfaces 43 and 50 in secure engagement with the cooperating surfaces 42 and 48. This arrangement of tubing permits the above described expansion of both the manifold and collector ring without transferring any bending stresses to the cylinder heads and also frees the manifolds and collector ring from any stresses thereon resulting from their thermal expansions. Each standpipe 46 may have associated therewith a heat transfer ring 68 to minimize the heat transfer between the engine cylinder and the manifold.

In the connector shown in Fig. 4, which is a modified form of coupling, the sleeve 70 corresponding to sleeve 44 surrounds a sleeve 72 and is slidable thereon. Sleeves 70 and 72 have spherical surfaces at opposite ends to engage respectively with the spherical seat 42 on the exhaust port 8 and the spherical seat 48 on the standpipe 46. Sleeve 70 has a surrounding sleeve 74 connected to and affixed in spaced relation to the sleeve 44. Sleeve 74 is in turn surrounded by a sleeve 76 which is slidable on sleeve 74 and connected to ring 72. A packing ring 78 in a groove 80 in ring 74 engages the inner surface of ring 76 for a seal. Between sleeves 74 and 76 is packing 82 held in place by a ring 84 to which pressure is applied by a spring 86 extending between ring 84 and a flange 88 on sleeve 74. The spring 84 also functions to hold the oppositely located spherical surfaces in contact with the exhaust port and standpipe by its tendency to elongate the assembled connector.

It is to be understood that the invention is not limited to the specific embodiment herein illustrated and described, but may be used in other ways without departure from its spirit as defined by the following claims.

I claim:

1. An exhaust collector system for a radial engine having a number of circumferential rows of cylinders with adjacent cylinders in successive rows arranged in banks extending in an axial direction with respect to the engine, said collector system including a collector ring surrounding the engine adjacent one end thereof, axially affixed manifolds connected to said collector ring, each manifold being in alignment with one of the banks of cylinders for collecting the exhaust gas from the cylinders in said bank, a connector connecting each cylinder to its manifold, each connector including means for permitting expansion of said connector, linkages connecting said collector ring to the engine to provide for radial expansion of said collector ring and also for a limited axial motion, and linkages connecting the ends of the manifolds remote from the ring to the engine to provide for radial outward movement



of the manifold comparable to the radial movement of the ring and longitudinal movement to compensate for the thermal expansion of the manifold.

2. In combination, a radial engine having a number of circumferential rows of cylinders with adjacent cylinders in successive rows arranged in banks, a collector ring surrounding the engine adjacent one end thereof, manifolds connected to said collector ring, each manifold being in alignment with one of the banks of cylinders for collecting the exhaust gas from the cylinders in said bank, each cylinder having an exhaust port, each manifold having an opening adjacent each exhaust port of its bank of cylinders, a connection between each exhaust port and the adjacent manifold opening, each connection including means for permitting expansion of said connection and angular movement of said connection with respect to its attached cylinder and manifold, linkages connecting said collector ring to the engine to provide for radial expansion of said collector ring and also for a limited axial motion, and linkages connecting the ends of the manifolds remote from the ring to the engine to provide for radial outward movement of the manifold comparable to the radial movement of the ring and longitudinal movement to compensate for the thermal expansion of the manifold.

3. In combination, a radial engine having rows of cylinders circumferentially spaced about an axis with adjacent cylinders in successive rows arranged in banks extending in a fore and aft direction with reference to the axis, a collector ring surrounding the engine, a manifold extending along each bank of cylinders, said manifolds being connected to said collector ring, connections from each manifold to the cylinders of its bank, each connection including means for permitting expansion of said connection, means including links connecting said collector ring to the engine to provide for thermal expansion of said collector ring with respect to said engine in a radial direction, said last named means also providing for axial movement of said collector ring in an aft direction during thermal expansion with reference to said engine, and means including links connecting the manifolds to said engine to provide for thermal expansion of said manifold in a forward direction with respect to said engine, said last named links also providing for radial movement of said manifold during thermal expansion with reference to said engine.

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