Innovation, Sciences et Développement économique Canada
Office de la Propriété Intellectuelle du Canada

Innovation, Science and Economic Development Canada
Canadian Intellectual Property Office

CA 3080332 A1 2019/05/02

(21) 3 080 332

(12) DEMANDE DE BREVET CANADIEN
CANADIAN PATENT APPLICATION

(13) A1

(86) Date de dépôt PCT/PCT Filing Date: 2018/10/24
(87) Date publication PCT/PCT Publication Date: 2019/05/02
(85) Entrée phase nationale/National Entry: 2020/04/24
(86) N° demande PCT/PCT Application No.: US 2018/057218
(87) N° publication PCT/PCT Publication No.: 2019/084091
(30) Priorités/Priorities: 2017/10/26 (US62/577,423); 2017/10/27 (US62/577,965); 2017/12/13 (US62/598,045); 2018/01/12 (US62/616,601); 2018/05/31 (US62/678,460); 2018/07/12 (US62/697,072)

(51) Cl.Int./Int.Cl. *F01N 3/04* (2006.01), *F01N 13/00* (2010.01), *F01N 13/10* (2010.01), *F02F 1/42* (2006.01)

(71) Demandeur/Applicant:
500 GROUP, INC., US

(72) Inventeurs/Inventors:
TIRAMANI, PAOLO, US;
DENMAN, KYLE, US

(74) Agent: GOWLING WLG (CANADA) LLP

(54) Titre : COLLECTEUR D'ECHAPPEMENT A ANGLE DOUBLE
(54) Title: DUAL-ANGLE EXHAUST MANIFOLD

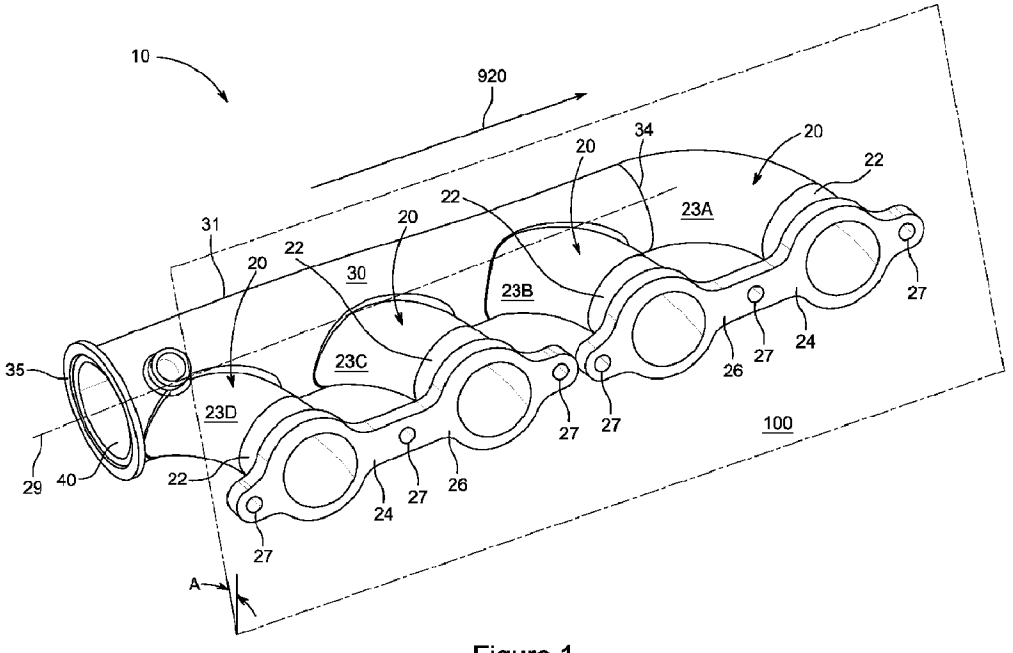


Figure 1

(57) Abrégé/Abstract:
An exhaust manifold for an internal combustion piston engine with a row of at least two cylinders inclined from the vertical. The exhaust manifold has plural exhaust stack assemblies and a manifold plenum with an outlet. Each of the plural exhaust stack

(21) 3 080 332

(13) A1

(57) Abrégé(suite)/Abstract(continued):
assemblies comprises a leader pipe and an exhaust connector, with a first end of each leader pipe being joined to a first end of the exhaust connector of the exhaust stack assembly, and a second end of each exhaust connector being joined to the manifold plenum. Each leader pipe is joined to a manifold flange that is adapted for joining to the internal combustion engine to receive exhaust gases from the cylinders of the engine.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

CORRECTED VERSION

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
02 May 2019 (02.05.2019)

WIPO | PCT

(10) International Publication Number
WO 2019/084091 A9

(51) International Patent Classification:
F01N 3/04 (2006.01) *F01N 13/10* (2010.01)
F01N 13/00 (2010.01) *F02F 1/42* (2006.01)

(21) International Application Number:
PCT/US2018/057218

(22) International Filing Date:
24 October 2018 (24.10.2018)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:

62/577,423	26 October 2017 (26.10.2017)	US
62/577,965	27 October 2017 (27.10.2017)	US
62/598,045	13 December 2017 (13.12.2017)	US
62/616,601	12 January 2018 (12.01.2018)	US
62/678,460	31 May 2018 (31.05.2018)	US
62/697,072	12 July 2018 (12.07.2018)	US

(71) Applicant: **500 GROUP, INC.** [US/US]; 400 S 4th Street, Las Vegas, NV 89101 (US).

(72) Inventors: **TIRAMANI, Paolo**; 3726 S Las Vegas Blvd, Las Vegas, NV 89103 (US). **DENMAN, Kyle**; 5327 Daywood Street, North Las Vegas, NV 89031 (US).

(74) Agent: **BAI, Mei** et al.; McCarter & English, LLP, One Canterbury Green, 201 Broad Street, Stanford, CT 06901 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP,

(54) Title: DUAL-ANGLE EXHAUST MANIFOLD

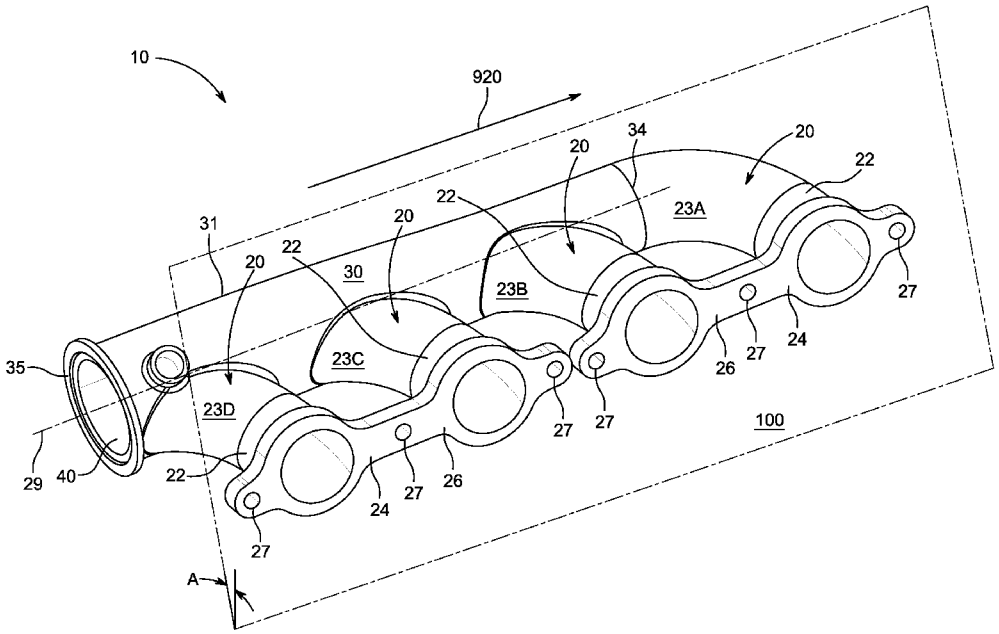


Figure 1

(57) Abstract: An exhaust manifold for an internal combustion piston engine with a row of at least two cylinders inclined from the vertical. The exhaust manifold has plural exhaust stack assemblies and a manifold plenum with an outlet. Each of the plural exhaust stack assemblies comprises a leader pipe and an exhaust connector, with a first end of each leader pipe being joined to a first end of the exhaust connector of the exhaust stack assembly, and a second end of each exhaust connector being joined to the manifold plenum. Each leader pipe is joined to a manifold flange that is adapted for joining to the internal combustion engine to receive exhaust gases from the cylinders of the engine.

WO 2019/084091 A9

[Continued on next page]

WO 2019/084091 A9

KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

Published:

— *with international search report (Art. 21(3))*

(48) Date of publication of this corrected version:
28 November 2019 (28.11.2019)

(15) Information about Correction:
see Notice of 28 November 2019 (28.11.2019)

TITLE

DUAL-ANGLE EXHAUST MANIFOLD

CROSS-REFERENCES TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application No. 62/577,423, filed October 26, 2017, U.S. Provisional Application No. 62/577,965, filed October 27, 2017, U.S. Provisional Application No. 62/598,045, filed December 13, 2017, U.S. Provisional Application No. 62/616,601 filed January 12, 2018, U.S. Provisional Application No. 62/678,460, filed May 31, 2018, and U.S. Provisional Application No. 62/697,072, filed July 12, 2018.

BACKGROUND OF THE INVENTION

Field of the Invention

[0002] This invention relates to systems for collecting the exhaust from internal combustion engines.

Description of the Related Art

[0003] Eight cylinder internal combustion engines are often designed with a "V-8" configuration; i.e., two banks of four cylinders rotating a common crankshaft, where each bank is inclined so as to form a "V". The exhaust gases from each

bank of cylinders may be directed by means of an exhaust manifold for discharge to the atmosphere, either directly or through other components.

[0004] The design of the exhaust manifold can impact engine power and efficiency.

SUMMARY OF THE INVENTION

[0005] The present invention provides a novel exhaust manifold designed to improve engine performance.

[0006] In one aspect, the present invention is directed to an exhaust manifold for an internal combustion piston engine that is adapted to be mounted with a row of at least two cylinders inclined from the vertical. The exhaust manifold features plural exhaust stack assemblies and a manifold plenum with an outlet, where each of the plural exhaust stack assemblies comprises a leader pipe and an exhaust connector, and a first end of each leader pipe joins a first end of an exhaust connector, a second end of each exhaust connector joins the manifold plenum, and a second end of each leader pipe joins a manifold flange that is adapted for joining to the internal combustion engine to receive exhaust gases from the cylinders of the engine. Notably, each leader pipe is joined to the manifold flange at a first angle in a vertical plane so that the plural exhaust stack assemblies are approximately horizontally oriented when joined to the internal combustion piston engine, and each leader pipe is joined to the manifold flange at a second angle in a horizontal plane inclined toward the outlet.

[0007] In another aspect, the present invention is directed to an exhaust manifold for an internal combustion piston engine with a row of at least two cylinders, where the exhaust manifold features plural exhaust stacks and a generally cylindrical manifold plenum having a generally cylindrical wall with a closed first end and a second end having an exhaust outlet. The diameter of the generally cylindrical manifold plenum changes from the first end to the second end to provide an increasing cylindrical volume from the first end to the second end. Notably, the diameter of the generally cylindrical manifold plenum changes

at a non-constant rate from the first end to the second end so that the wall of the manifold plenum generally conforms to an "S" shape in profile from the first end to the second end. A first end of each of the plural exhaust stacks is joined to the manifold plenum, and a second end of each of the plural exhaust stacks joins a manifold flange adapted for joining to the internal combustion engine to receive exhaust gases from the cylinders of the engine

[0008] These and other aspects of the present invention are described in the drawings annexed hereto, and in the description of the preferred embodiments and claims set forth below.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] Figure 1 is a schematic perspective view of the exhaust manifold of the present invention.

[0010] Figure 2 is a top view of the exhaust manifold of the present invention.

[0011] Figure 3 is a rear view of the exhaust manifold of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0012] In the embodiment of the present invention depicted in Figure 1, there is shown an exhaust manifold 10. In this disclosure, the direction toward the front of an engine to which exhaust manifold 10 is to be mounted is indicated by arrow 920, shown in Figures 1 and 2. Accordingly, references in this disclosure to the "forward" or "front" portion of any component or assemblage, and like references, refers to the portion of the component or assemblage oriented most closely to the head of arrow 920, and reference in this disclosure to the "rearward" or "rear" portion of any component or assemblage, and like references, refers to the portion of the component or assemblage oriented least closely to the head of arrow 920. Furthermore, references in this disclosure to the vertical direction, or like statements, refers to the orientation of a plane normal to the ground (the ground being coincident with the horizontal plane). In the case of

V-8 engines mounted in a conventional upright orientation, the vertical direction will coincide with a plane passing through the crankshaft centerline and equidistant from the cylinder banks. Exhaust manifold 10 depicted in Figure 1 can be secured to the left cylinder bank (facing forward) of an eight cylinder V-8 engine. In that circumstance, the exhaust manifold for the right cylinder bank (not shown) is a mirror image of manifold 10 but otherwise is identical in design, except that the overall length of the exhaust manifolds for the left and right cylinder banks optionally can differ, so as to adjust for V-configuration engines whose left and right cylinder bank discharge ports are offset (typically a consequence of utilizing crankshafts with crankpins arranged along the length of the crankshaft), and result in the rearward ends of each manifold plenum of the exhaust manifolds terminating approximately in the same vertical plane orthogonal to the crankshaft centerline.

[0013] Exhaust manifold 10 includes four exhaust stack assemblies 20 that are joined to manifold plenum 30. Exhaust stack assemblies 20 channel exhaust gases from left cylinder bank into manifold plenum 30, which collects and channels the collected gases to exhaust outlet 40, from which the collected gases are directed to energy recovery systems, such as exhaust gas turbines for compressing the intake air, and/or to pollution and/or noise control devices.

[0014] Exhaust stack assemblies 20 each comprises a leader pipe 22 and one of exhaust connectors 23A, 23B, 23C and 23D (generically referred to as exhaust connectors 23). The portions of leader pipes 22 proximate the engine are joined to manifold flanges 24. In particular, in the embodiment shown there are two manifold flanges 24, one of which is joined to the forward two leader pipes 22 and the other of which is joined to the rearward two leader pipes 22. Alternative designs in accordance with the present invention include individual flanges 24 joining respective individual leader pipes 22, as well as a single flange 24 joining all leader pipes 22. Each leader pipe 22 has a centerline 25 (see Figures 2 and 3) and has a generally circular diameter along the length of centerline 25.

[0015] Manifold flanges 24 include engine-side generally planar mating surfaces 26, which form a relatively gas-tight seal when fastened to an engine, and additionally, which define a plurality of apertures 27 that permit exhaust manifold 10 to be fastened (using nuts) to threaded studs extending from the cylinder bank of the engine. The portion of each stack assembly 20 distal from the engine is joined to manifold plenum 30.

[0016] The engine-side mating surfaces of manifold flanges 24 are oriented parallel to a plane 100, shown in Figures 1 and 3. An engine generally will have contact surfaces machined or formed on the engine in a region circumscribing the engine exhaust ports, in order to form a relatively gas-tight seal with appropriate portions of a manifold, which in this embodiment are the engine-side mating surfaces 26 of exhaust manifold 10. For V-8 engines, those contact surfaces generally are inclined from the vertical, for example at an angle V equal to one-half the angle subtended by the cylinder banks; thus, for a V-8 engine, the angle V from the vertical of plane 100 will be for example approximately 22.5°, 30° or 36°.

[0017] In the present invention, it is preferred that the centerline 25 of each leader pipe 22, as well as the centerlines of exhaust connectors 23, be inclined upwardly at an angle A from a line 28 orthogonal to plane 100, as shown in Figure 3, so that the exhaust stack assemblies 20 lie generally in a horizontal plane when exhaust manifold 10 is joined to an engine having an inclined cylinder bank. Thus in the rear view of Figure 3, the centerlines of exhaust connectors 23, as well as centerlines 25, collectively coincide so as to be located in that horizontal plane. In some V-8 engine cases, angle A will be approximately the same as angle V, although the ultimate choice for angle A depends on the orientation of the specific engine contact surfaces. Also, as can be seen in Figure 2, the centerline of each leader pipe 22 is inclined rearwardly at an angle B from line 28 orthogonal to plane 100. Inclining leader pipes 22 at angles A and B is for purposes of improving engine performance.

[0018] In the embodiment shown, the first exhaust connector 23A is a curved pipe of relatively uniform diameter, whereas the diameters of second, third and fourth exhaust connectors 23B, 23C and 23D increase with increasing distance from flanges 24, in order to permit the expansion of the exhaust gases along their length. This increase in diameter is for purposes of reducing cylinder backpressure and improving exhaust gas scavenging during the exhaust cycle. Leader pipes 22 are joined to flange fittings 24 via welding, brazing or by being integrally formed with flange fittings 24. Likewise, exhaust connectors 23 are joined to manifold plenum 30 via welding, brazing or by being integrally formed with manifold plenum 30, and leader pipes 22 are joined to exhaust connectors 23 via welding, brazing or by being integrally formed with connectors 23.

[0019] Manifold plenum 30 has a generally elongate cylindrical shape and a generally cylindrical wall 31, as shown in Figures 1 and 2. The forward end 34 of manifold plenum 30 is closed off by the first exhaust stack assembly 20 (containing exhaust connector 23A). The rearward end 35 of manifold plenum 30 defines exhaust outlet 40. Manifold plenum 30 is generally circular in cross-section, as shown in Figure 3. It is preferred that the diameter of manifold plenum 30 become greater along its length; i.e., from the forward end 34 of plenum 30 to the rearward end 35. This growth in diameter yields an expanding cylindrical volume from the forward end 34 to the rearward end 35, which serves to accommodate the introduction of additional exhaust gases from each successive cylinder along the length, as well as to permit the expansion of the exhaust gases.

[0020] It is particularly preferred that the rate of diameter growth of manifold plenum 30 not be constant along its length from forward end 34 to rearward end 35. Rather, it is particularly preferred that the growth in diameter of manifold plenum 30 start at zero at forward end 34, then grow at an increasing rate from forward end 34 up to approximately the mid-point between forward end 34 and rearward end 35, then grow at a decreasing rate from that mid-point up to rearward end 35, and again reach a zero growth rate at rear end 35. The result of changing the growth rate in this manner is to generally give an “S” shape to wall

31 in profile, from forward end 34 to rearward end 35, as can be seen in Figure 2. Put another way, the profile of wall 31 of manifold plenum 30 comes to be defined by an S-shaped curve rotated about the centerline 29 of plenum 30, as in Figure 2.

[0021] Although described with reference to use with a V-8 engine, the present invention has more general application, and can be utilized with any internal combustion piston engine having a row of two or more cylinders inclined from the vertical at an acute angle of approximately 45° or less, such as in-line inclined four, five and six cylinder engines, as well as V-4 engines, V-6 engines, V-12 engines, V-16 engines, etc. Manifold designs generally in accordance with the embodiment of exhaust manifold 10 disclosed herein are utilizable in some of the engine configurations disclosed in U.S. Provisional Patent Application No. 62/697,072 entitled "Customizable Engine Air Intake/Exhaust Systems" and filed July 12, 2018, and in U.S. Patent Application No. _____ [attorney docket no. 128245.10030] entitled "Customizable Engine Air Intake/Exhaust Systems," having the same inventors as the subject application and filed on the same date as the subject application.

[0022] As is more particularly disclosed in that provisional application and that utility patent application, an exhaust manifold having a design generally corresponding to exhaust manifold 10 as described herein can be paired with a second exhaust manifold of like design, or can be paired with a different exhaust manifold, such as one following the design disclosed in U.S. Provisional Application No. 62/678,460, entitled "Turbocharger Exhaust Manifold with Turbine Bypass Outlet," filed May 31, 2018, according to the particular engine configuration, and disclosed in U.S. Patent Application No. _____ [attorney docket no. 128245.10031], entitled "Turbocharger Exhaust Manifold with Turbine Bypass Outlet," having the same inventors as the subject application and filed on the same date as the subject application, again according to the particular engine configuration. The contents of U.S. Provisional Application No. 62/697,072, are hereby incorporated by reference as if fully set forth herein. The contents of U.S. Patent Application No. _____ [attorney docket no.

128245.10030] entitled "Customizable Engine Air Intake/Exhaust Systems," having the same inventors as the subject application and filed on the same date as the subject application, are hereby incorporated by reference as if fully set forth herein, including, as disclosed therein, the exhaust manifold design generally corresponding to exhaust manifold 10, and the different engine configurations and components disclosed therein utilizing or functioning in conjunction with such exhaust manifold design, found for example at paragraphs 53-70, 72-108, 110-154, 156-163 and Figures 1-26. The contents of U.S. Provisional Application No. 62/678,460 are hereby incorporated by reference as if fully set forth herein. The contents of U.S. Patent Application No. _____ [attorney docket no. 128245.10031], entitled "Turbocharger Exhaust Manifold with Turbine Bypass Outlet," having the same inventors as the subject application and filed on the same date as the subject application, are also hereby incorporated by reference as if fully set forth herein, including, as disclosed therein, the aforementioned manifold design that can be paired with an exhaust manifold having a design generally corresponding to exhaust manifold 10, such aforementioned manifold design found for example at paragraphs 14-48 and Figures 1-5 thereof.

[0023] The foregoing detailed description is for illustration only and is not to be deemed as limiting the inventions, which are defined in the appended claims.

WHAT IS CLAIMED IS:

1. An exhaust manifold for an internal combustion piston engine adapted to be mounted with a row of at least two cylinders inclined from the vertical, the exhaust manifold comprising:

plural exhaust stack assemblies;

a manifold plenum with an outlet;

each of the plural exhaust stack assemblies comprising a leader pipe and an exhaust connector, a first end of each leader pipe joined to a first end of the exhaust connector of the exhaust stack assembly, a second end of each exhaust connector joined to the manifold plenum;

a second end of each leader pipe joined to a manifold flange, the manifold flange adapted for joining to the internal combustion engine to receive exhaust gases from the cylinders of the engine;

each leader pipe joined to the manifold flange at a first angle in a vertical plane so that the plural exhaust stack assemblies are approximately horizontally oriented when joined to the internal combustion piston engine; and

each leader pipe joined to the manifold flange at a second angle in a horizontal plane inclined toward the outlet.

2. An exhaust manifold as in claim 1, wherein the surface of the manifold plenum is a generally axisymmetric solid of revolution defined by an S-shaped curve rotated about the axis of the manifold plenum.

3. An exhaust manifold for an internal combustion piston engine with a row of at least two cylinders, the exhaust manifold comprising:

plural exhaust stacks;

a generally cylindrical manifold plenum having a generally cylindrical wall with a closed first end and a second end having an exhaust outlet, the diameter of the generally cylindrical manifold plenum changing from the first end to the second end to provide an increasing cylindrical volume from the first end to the second end, the diameter of the generally cylindrical manifold plenum changing at

a non-constant rate from the first end to the second end so that the wall of the manifold plenum generally conforms to an "S" shape in profile from the first end to the second end;

a first end of each of the plural exhaust stacks joined to the manifold plenum; and

a second end of each of the plural exhaust stacks joined to a manifold flange adapted for joining to the internal combustion engine to receive exhaust gases from the cylinders of the engine.

4. An exhaust manifold as in claim 1, wherein the manifold plenum has a forward end distal from the outlet, and the second end of the exhaust connector of a first exhaust stack assembly of the plural exhaust stack assemblies is joined to the manifold plenum at the forward end, and the exhaust connector of the first exhaust stack assembly is a curved pipe of relatively uniform diameter.

5. An exhaust manifold as in claim 4, wherein the diameter of the exhaust connector of each of the other or others of the plural exhaust stack assemblies increases from the first end of the exhaust connector to the second end of the exhaust connector.

6. An exhaust manifold as in claim 3, wherein each of the plural exhaust stacks comprises a leader pipe and an exhaust connector, and wherein each leader pipe is joined to the respective exhaust connector of the exhaust stack, and the end of the exhaust connector distal from the leader pipe is joined to the manifold plenum.

7. An exhaust manifold as in claim 6, wherein the exhaust connector of a first exhaust stack of the plural exhaust stacks is joined to the manifold plenum at the first end of the manifold plenum, and the exhaust connector of the first exhaust stack is a curved pipe of relatively uniform diameter.

8. An exhaust manifold as in claim 7, wherein the diameter of the exhaust connector of each of the other or others of the plural exhaust stacks increases from the leader pipe to which it is joined to the manifold plenum.

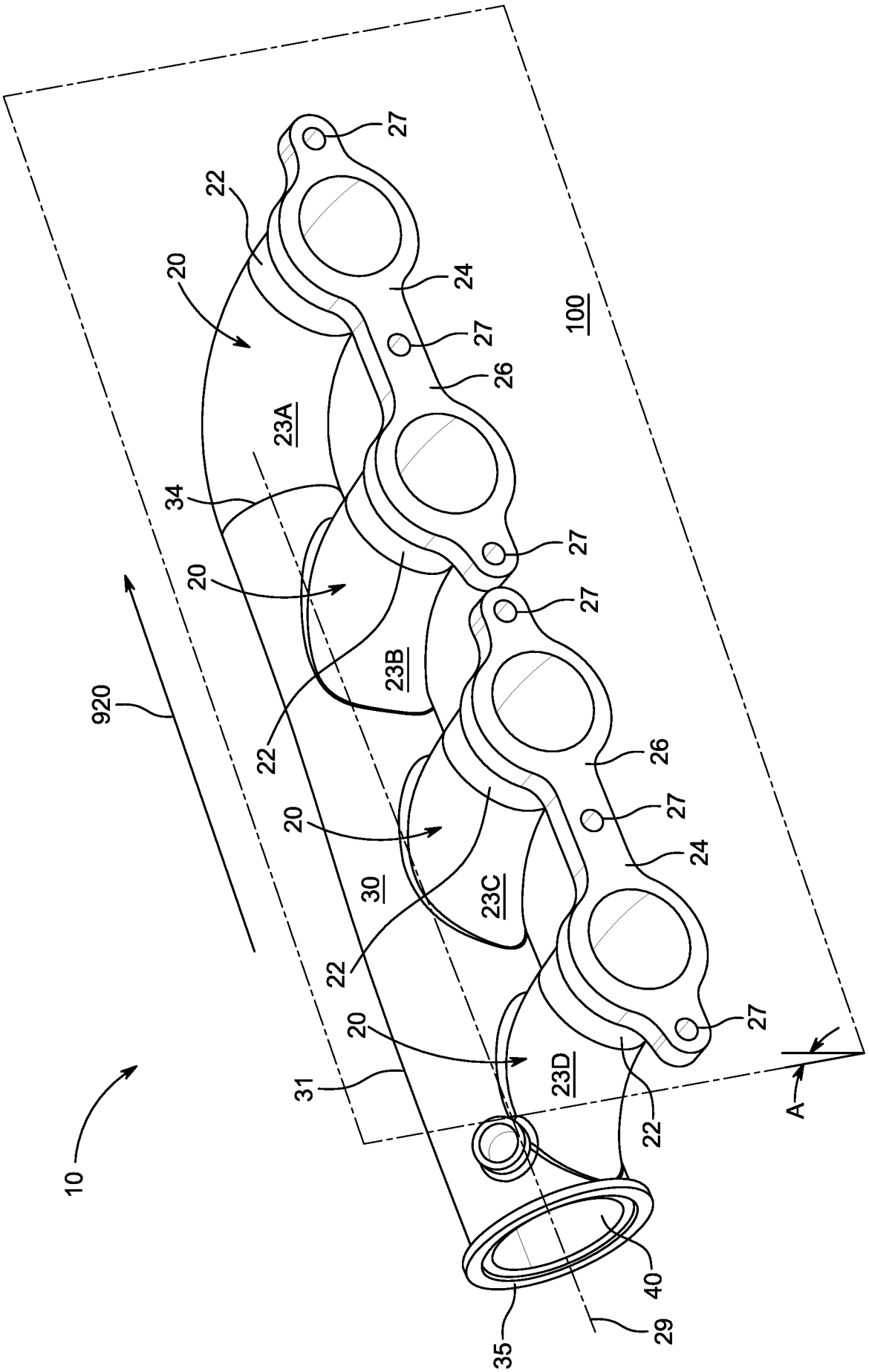


Figure 1

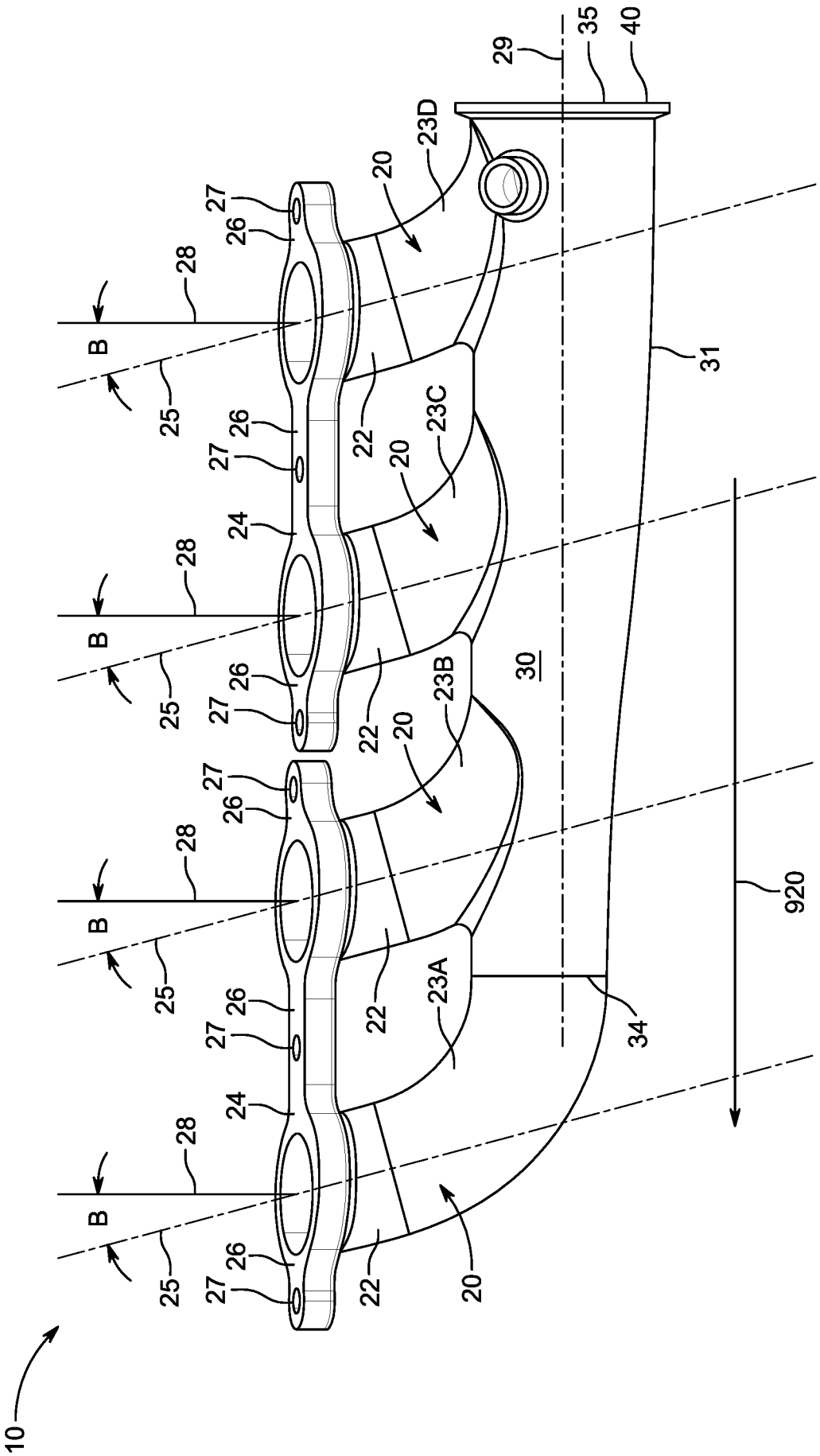


Figure 2

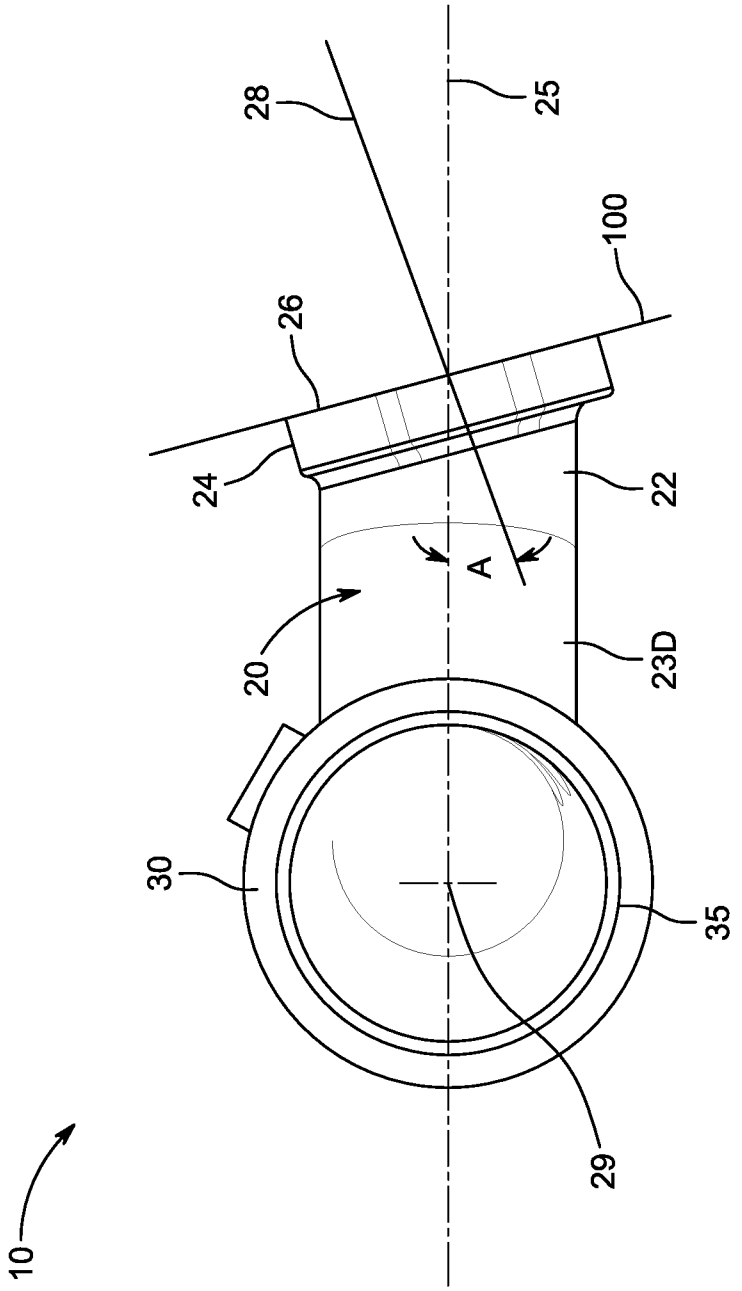


Figure 3