Sept. 13, 1960 A. W. POPE, JR 2,952,344

EXHAUST MANIFOLD SLIP JOINT CONSTRUCTIONS

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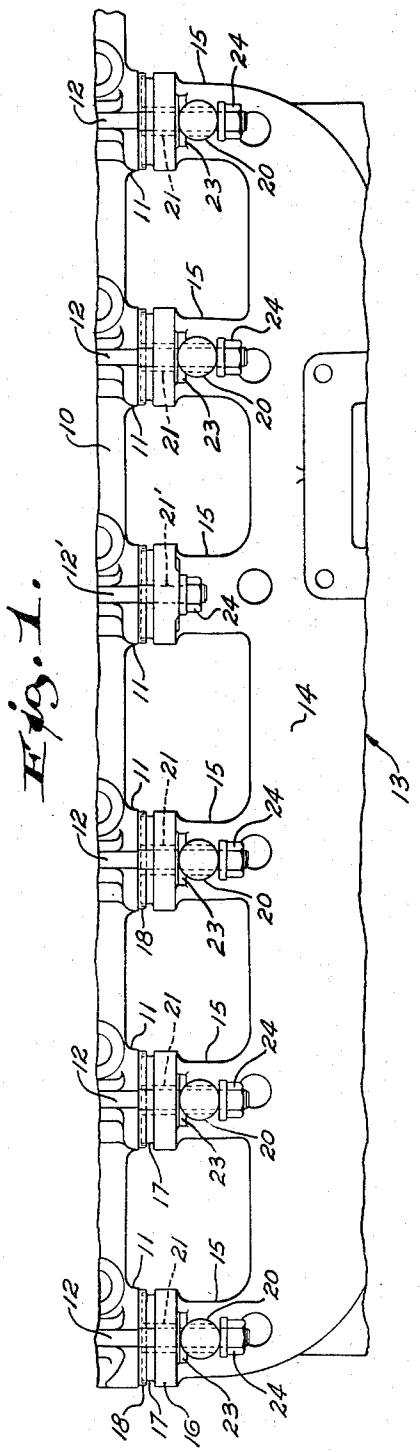


Fig. 1.

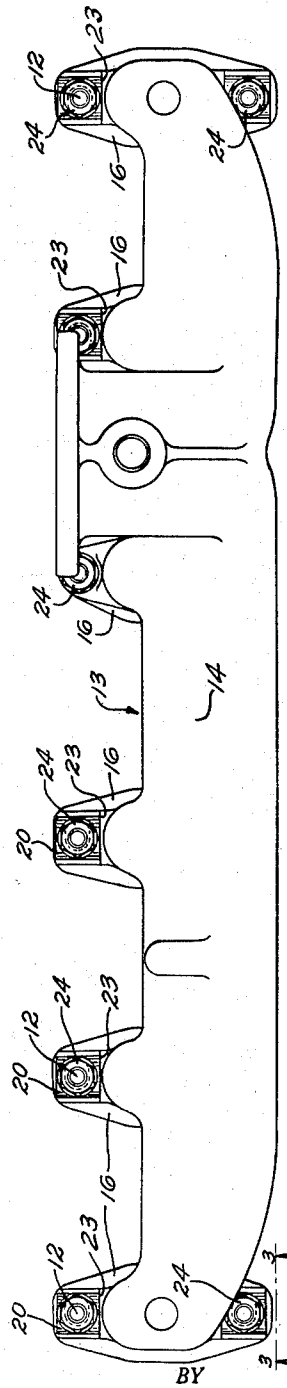


Fig. 2.

INVENTOR.
Arthur W. Pope Jr.
BY
Morsell & Morsell
ATTORNEYS

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Fig. 3.

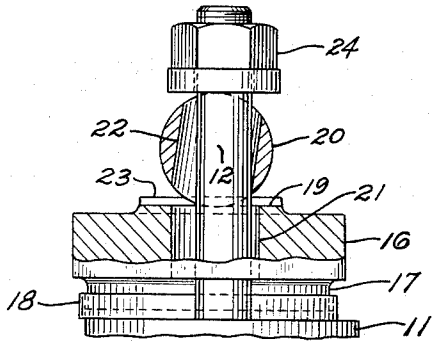


Fig. 4.

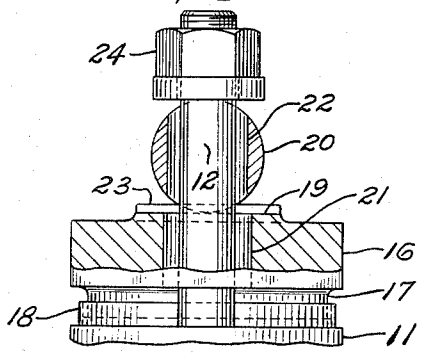
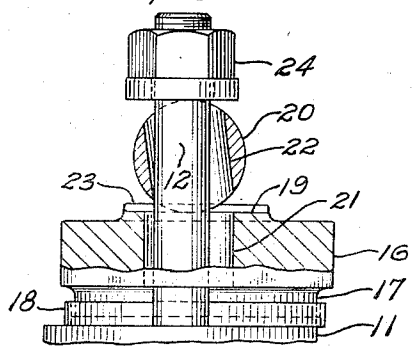


Fig. 5.



INVENTOR.
Arthur W. Pope Jr.
BY
Morsell & Morsell
ATTORNEYS.

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EXHAUST MANIFOLD SLIP JOINT CONSTRUCTIONS

Arthur W. Pope, Jr., Waukesha, Wis., assignor to Waukesha Motor Company, Waukesha, Wis., a corporation of Wisconsin

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4 Claims. (Cl. 189—36)

This invention relates to improvements in exhaust manifold slip joint constructions.

Exhaust manifolds have always presented an expansion problem because of the excessive heat from the exhaust gases therein as compared with the relatively cool cylinder block.

Heretofore it has been necessary for a manifold either to slip at the joint where it attaches to the relatively cool cylinder block or to compress the metal in the manifold in an amount corresponding to the relative expansion between the manifold and cylinder block, in which case if the endurance limit of the metal in the manifold is exceeded, it will crack. In small engines the differential expansion between the cylinder block and manifold is sufficiently small and the clamping pressure sufficiently low that it has been possible to use a one-piece manifold successfully. On larger engines it has heretofore been necessary to make the manifold in several sections with expansion joints between the sections. Expansion joints, however, are expensive and frequently develop leaks. On turbocharged diesel engines it is particularly important to have gas tight manifold joints in order to maintain full gas pressure for driving the turbine.

It is a general object of the present invention to provide an improved exhaust manifold slip joint construction which makes it practical to utilize one-piece manifolds in relatively large engines, such as diesel engines, without having cracking of the manifold result.

A more specific object of the invention is to provide a device as above described wherein there is an improved arrangement for clamping the port flanges of the manifold to the cylinder block, which arrangement reduces the sliding friction at each port to one-half the normal amount. This makes it possible to slip the joints between the manifold and cylinder block without loading the metal of the manifold runner above its endurance limit.

A further more specific object of the invention is to provide a construction as above described, wherein a novel roller arrangement is utilized between the manifold port flange clamping nuts and the flange to eliminate the sliding friction between said clamping nuts and the backs of the flanges, thereby leaving only the friction between the gaskets and cylinder block.

Other objects of the invention are to provide an improved exhaust manifold slip joint construction which is relatively simple and inexpensive, which is fool-proof in operation, and which is well adapted for the purpose described.

With the above and other objects in view, the invention consists of the improved exhaust manifold slip joint construction, and all of its parts and combinations, as set forth in the claims, and all equivalents thereof.

In the accompanying drawings, illustrating one complete embodiment of the preferred form of the invention, in which the same reference numerals designate the same parts in all of the views:

Fig. 1 is a fragmentary top view looking down on the exhaust manifold of an engine, parts being broken away;

Fig. 2 is a side elevational view of the exhaust manifold as it is positioned when assembled, the cylinder block being omitted;

Fig. 3 is a fragmentary view looking approximately as indicated by the line 3—3 of Fig. 2 showing a manifold port extension engaging within its gasket and showing an outer portion of a cylinder block exhaust port boss, part of the manifold flange and its roller being shown in cross-section, and the roller and slip joint being in the extreme hot position;

Fig. 4 is a similar view showing a midposition of the roller and associated parts; and

Fig. 5 is a similar view showing the extreme cold position of the roller and associated parts.

Referring more particularly to the drawings, the numeral **10** designates the cylinder block of an engine such as a diesel engine, said cylinder block having the usual outwardly projecting bosses **11** containing exhaust ports (not shown). Projecting outwardly from the cylinder block are the usual clamping bolts **12**. A one-piece exhaust manifold **13** comprises a runner section **14**, having the usual tubular branches **15**, terminating in vertically elongated port flanges **16**, the latter having tubular projections **17** each of which seats within a gasket **18** on the adjacent boss **11**. Each of the gaskets is generally cup-shaped in cross-section as is clear from Figs. 3, 4 and 5. There are openings in the port flange extensions **17** which communicate through registering openings in the gaskets with the exhaust ports of the cylinder block **10**, in the usual manner.

At each end of each of the port flanges **16**, the outer side has a flat bearing surface **19** on which a roller **20** is adapted to roll, there being an elongated opening **21** extending through the bearing surface at each end of each port flange for receiving one of the clamping bolts **12**. The rollers are made from suitable bar stock.

Each of said bolts extends loosely through an opening **22** in one of the rollers **20**, which opening is of substantially greater diameter than the diameter of the clamping bolt. As shown in Figs. 1 and 2, the inner end of each roller is guided by a shoulder **23** in order to maintain the axis of the roller at right angles to the direction of roller travel. A nut **24** on the outer end of each clamping bolt is tightened downwardly to maintain the clamped relationship between parts.

It is to be noted that one of the clamping bolts closest to the center, such as the bolt **12'**, is used without a roller and said bolt extends through a hole **21'** in the adjacent port flange which is not elongated as are the holes in the other port flanges.

When the manifold is not particularly hot the roller of Figs. 3, 4 and 5 will be in a mid position as in Fig. 4. When, however, the manifold is extremely hot, as when the engine is in operation, with the cylinder block maintained relatively cool, then the port flange shown in Figs. 3, 4 and 5 will tend to shift toward the left due to expansion of the runner **14**. This will cause the gasket **18** to slip toward the left as in Fig. 3, on the face of the boss **11** of the cylinder block, Fig. 4 showing the center or mid position of the gasket for comparison. If the nut **12** were bearing directly against the outer face of the port flange as was heretofore customary, there would also have to be slippage between said flange and nut with resulting friction. In other words, with prior constructions there was sliding friction both between the nut and port flange and between the gasket and cylinder block.

With the present invention where the rollers **20** are used, as the gasket slips from the position of Fig. 4 to the position of Fig. 3 during expansion, the roller will merely roll from the position of Fig. 4 to the position of Fig. 3, this being permitted by the large hole **22** in the roller, as illustrated. Due to this rolling action, friction on top

of the flange is practically eliminated so that there is only the friction between the gasket **18** and cylinder block bosses **11**. Thus, the sliding friction at each flange is reduced to one-half the normal amount. This makes it possible to slip the joints between the manifold and cylinder block without loading the metal of the manifold runner above its endurance limit. When the exhaust manifold cools down to an extreme cold position, the metal of the runner will contract and the gasket **18** will slip in the opposite direction to Fig. 3 or to the position shown in Fig. 5 where it overhangs the right-hand edge of the boss **11**. During such action, the roller **20** rolls to a reverse position from that of Fig. 3 to eliminate the usual friction between the nut **12** and the flange. When initially assembling the manifold the rollers are preferably turned to the cold position because the manifold is cold at the time. This, however, is not essential as each roller will eventually find its own proper position during the first heating and cooling cycle.

The bolt **12'**, where the roller is omitted and where there is a close-fitting bolt hole **21'**, is employed as close to the midpoint of the length of the manifold as is possible so that there will be a point near the center of the manifold where substantially no sliding action takes place. It is to be understood that each roller adapts itself to the proper position for expansion or contraction depending upon which side of the center of the manifold it is on.

It is obvious that due to the halving of the amount of sliding friction, a relatively large exhaust manifold such as is used in diesel engines can be made in one piece without danger of cracking during use. This eliminates the necessity of having large manifolds formed of multiple sections, with expansion joints between the sections, such expansion joints being undesirable in turbotype diesel engines because of the danger of leakage.

It is to be understood that the present invention is not to be limited to the exact details of construction shown and described, for obvious modifications will occur to persons skilled in the art.

What I claim is:

1. In a slip joint a first member having a joint surface and having a projecting bolt adjacent said surface, a second member having a joint surface on one side which is positioned against the joint surface of said first member for slipping movement and having a bearing face on its opposite side, there being an opening extending from said bearing face through said second member loosely receiving said bolt, clamping means on an outer portion of said bolt having a bearing face, and a roller rollably positioned between said bearing face of the clamping means and the bearing face of said second member and having a transverse hole through which said bolt loosely extends, said clamping means acting through said roller to clamp said first and second members together and said roller substantially eliminating friction between the clamping means and second member when slippage occurs at the joint.

2. In a slip joint a first member having a joint surface and having a projecting bolt adjacent said surface, a second member having a joint surface on one side which is positioned against the joint surface of said first member for slipping movement and having a bearing face on its opposite side, there being an opening extending from said bearing face through said second member loosely receiving said bolt, clamping means on an outer portion of said bolt having a bearing face, a roller rollably positioned between said bearing face of the clamping means and the bearing face of said second member and having a transverse hole through which said bolt loosely extends, said clamping means acting through said roller to clamp said first and second members together and said roller substantially eliminating friction between the clamping means and second member when slippage occurs at the joint, and shoulders extending transversely of said bearing faces on the port flanges engaging the ends of said rollers to guide the latter in rolling movement.

3. In a slip joint a first member having a joint surface and having a projecting bolt adjacent said surface, a second member having a joint surface on one side which is positioned against the joint surface of said first member for slipping movement and having a bearing face on its opposite side, there being an opening extending from said bearing face through said second member loosely receiving said bolt, a nut threaded on the outer end of said bolt, and a roller rollably positioned between said nut and bearing face and having a hole through which said bolt loosely extends, said nut acting through said roller to clamp said first and second members together and said roller substantially eliminating friction between the nut and second member during slippage at the joint.

4. In a slip joint a first member having a joint surface and having a projecting bolt adjacent said surface, a second member having a joint surface on one side which is positioned against the joint surface of said first member for slipping movement and having a bearing face on its opposite side, there being an opening extending from said bearing face through said second member receiving said bolt which is elongated in a direction to allow movement relative to the bolt during slipping movement at the joint, a nut threaded on the outer end of said bolt, and a roller rollably positioned between said nut and bearing face and having a hole of substantially larger diameter than the bolt through which said bolt loosely extends, said nut acting through said roller to clamp said first and second members together and said roller substantially eliminating friction between the nut and second member during slippage at the joint.

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