March 5, 1957 A. M. BRENNEKE 2,783,748

CYLINDER BLOCK AND LINER CONSTRUCTION AND METHOD OF ASSEMBLING THE SAME

Filed April 19, 1954

Fig. 1.

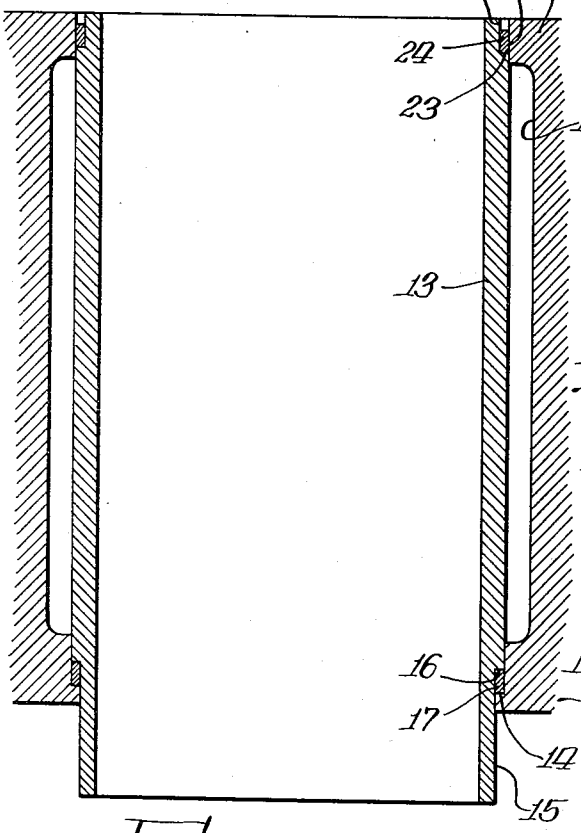


Fig. 3.

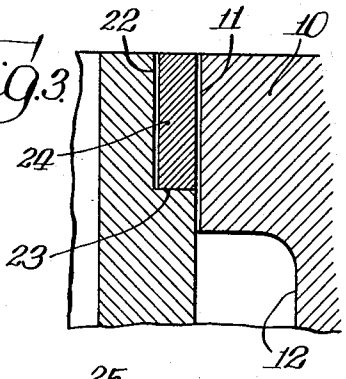


Fig. 4.

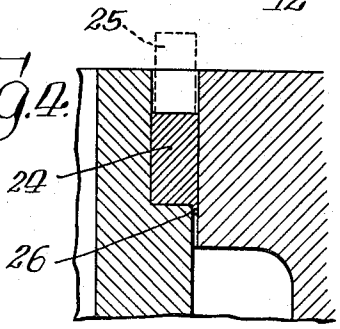


Fig. 6.

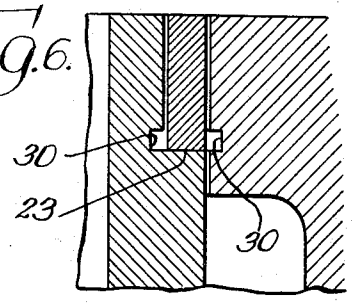


Fig. 2.

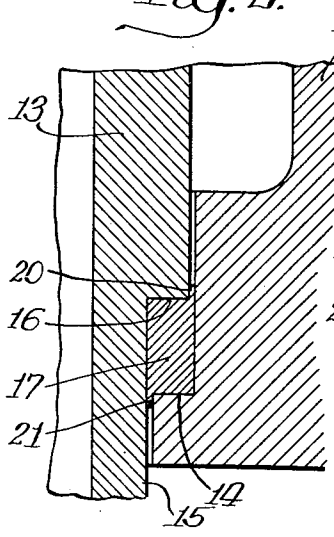


Fig. 5.

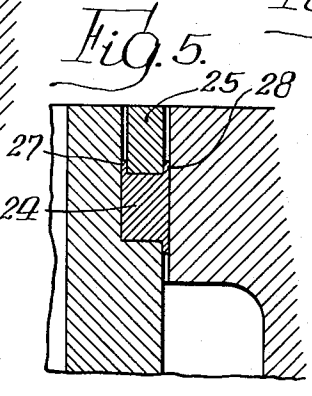
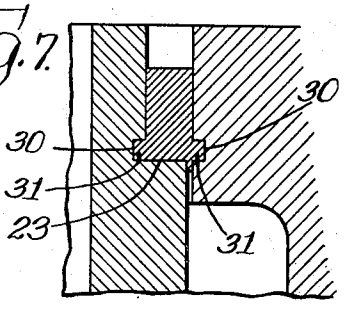


Fig. 7.



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CYLINDER BLOCK AND LINER CONSTRUCTION AND METHOD OF ASSEMBLING THE SAME

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10 Claims. (Cl. 123—41.83)

The invention relates generally to cylinder blocks and liners therefor, and more particularly to a cylinder block for an internal combustion engine having a so-called "wet" liner.

In internal combustion engines of the type where each cylinder is formed directly in the block, the metal of the entire block must be of proper type metallurgically to provide the desired wearing quality for the cylinder bore. In liquid-cooled engines, the block must also be carefully cast in order to provide cored water passages about the cylinder bore, with the proper wall thickness between the passages and the bore. These two factors increase the manufacturing cost of the cylinder block, and in addition there is another factor in such a block that affects the use thereof. Thus, when excessive wear of the cylinder bore occurs, the block must be rebored to permit the engine to operate properly, and such reboring requires replacement of the pistons and piston rings with pistons and rings that are oversize. Furthermore, the reboring reduces the thickness of the wall between the bore and the water passages and in some instances where the casting is not too carefully made, pockets or cracks in the wall develop which permit leakage.

With a wet liner, that is, one which provides the wall between the cylinder and the water passages, only the liner need be of such metallurgical structure as to provide the desired wearing quality for the cylinder. The block itself may therefore be cast of much softer metal which may be machined more rapidly and economically. Moreover, in the rough casting, the water passages open into the cylinder so that in making the casting the cores to form such passages may be better supported in the mold than in the old form where the water passages are separated from the bore. Baked sand cores may even be eliminated entirely. In operation, the liner is the only part which receives wear, and when excessive wear occurs, the liner may be replaced, permitting use after such replacement of standard size pistons and rings rather than oversize.

Wet liners, as heretofore generally constructed, have been supported at their upper ends in the cylinder block. Thus, an outwardly extending flange is provided at the upper end of the liner, and the upper face of the block is counterbored to receive the flange. Providing space for the flanges on the liners for adjacent cylinders increases the distance between the axes of the cylinders and hence increases the over all dimension of the block. The flange also increases the cost of the liner casting because of the increased material, the difficulty in making such a casting, and the increased machining cost. Furthermore, the upper end of the liner is subjected to the greatest temperature changes during operation of the engine since it forms part of the combustion chamber and, because the liner is supported by the block at that point, distortional difficulties may be encountered.

The general object of the invention is to provide a

cylinder block and liner construction in which the necessity for the flange at the top of the liner is eliminated and the maximum diameter of the liner is not substantially greater than it is throughout the major portion of its length and particularly the portion intermediate its ends.

A further important object is to provide a construction of this character, in which the liner is supported at or adjacent its lower end where temperature changes during operation are at a minimum.

Another object is to provide a cylinder block and liner construction having novel sealing means for preventing leakage between the liner and block from the water passages.

A still further object is to provide a novel method of assembling a liner in a block.

Other objects and advantages will become apparent from the following description taken in connection with the accompanying drawing, in which:

Fig. 1 is a longitudinal sectional view of a fragment of a cylinder block having mounted therein a liner, the block and liner embodying the features of the invention;

Fig. 2 is an enlarged fragmentary view of the right-hand side of the lower end portion of Fig. 1;

Fig. 3 is a fragmentary enlarged view of the upper right-hand portion of Fig. 1 showing the parts partially assembled;

Fig. 4 is a view similar to Fig. 3 but showing the completion of the assembly;

Fig. 5 is a view similar to Fig. 4 but showing a modified form of construction.

Fig. 6 is a view similar to Fig. 3 but showing another modified form of construction, with the parts partially assembled; and

Fig. 7 is a view similar to Fig. 6 but showing the parts of Fig. 6 completely assembled.

The invention herein disclosed, relating to a so-called "wet" liner for a cylinder of an internal combustion engine, contemplates a liner that is supported in the cylinder block at its lower end, rather than being hung from its upper end. By such manner of support it is possible to make a liner in which the usual supporting flange at the upper end is eliminated and the liner may be made in a form which can be machined from a straight cylindrical casting of substantially uniform outside diameter. With such a form, the casting may be manufactured at substantially less cost and also lends itself to ease in manufacture by the centrifugal casting method. Moreover, the machining of such a casting is substantially less costly than that required for the old form having a supporting flange at its upper end.

To illustrate one embodiment of the invention, I have shown in Fig. 1 a fragment of a cylinder block **10** having a cylinder bore **11** formed therein. The block is provided with a passage or cavity **12** for coolant, which ordinarily is water, and in the casting, the cavity **12** opens into the bore **11**. With a casting of this type, the cores to form the cavity **12** and the passages connecting such cavity may be readily supported from the core which froms the cylinder bore, thus insuring that the cavity **12** is properly placed within the casting.

Within the cylinder bore **11** is mounted the liner, indicated at **13**, which is adapted to be supported at its lower end and thus eliminates the necessity of a flange at its upper end. The liner thus may be formed from a substantially straight cylindrical casting. To support the liner in the manner stated, the lower end of the cylinder bore **11** is provided with an upwardly facing shoulder **14**, and a corresponding downwardly facing surface is formed on the liner **13** for support by the shoulder **14**. In the present instance, the lower end of the liner is reduced in

diameter as at 15 to provide a downwardly facing shoulder 16 above the shoulder 14 in the cylinder block.

The invention also contemplates means for rigidly holding the liner 13 within the bore 11 and for providing seals both below and above the coolant cavity 12 to prevent leakage of water therefrom. At the lower end such holding means and seal is provided between the shoulders 14 and 16 and is herein shown as a ring 17 of relatively soft metal which is compressed to form a tight seal with the surrounding surfaces of the liner and block and to rigidly hold the liner in place within the bore. The soft metal ring may be made of aluminum, lead, copper or other similar type of material.

To assemble the parts and obtain the holding effect as well as the sealing effect of the ring 17, such a ring is first placed on the liner and the liner is then lowered into the bore 11, the diameter of the liner being such as to provide a slight radial clearance in the bore so that the liner has an easy sliding fit therein. As the liner is lowered into position, the ring 17 is engaged between the shoulders 14 and 16. The initial axial dimension of the ring 17 is slightly greater than it is in its ultimate form, and the inside and outside diameters of the ring are such that a slight clearance is provided between the ring and liner on the one hand and the block and liner on the other hand.

The liner is then pressed downwardly with sufficient force to compress the ring 17 axially between the shoulders 14 and 16 and expand it radially both inwardly and outwardly into tight peripheral contact with both the liner and the block. Thus, the ring completely fills the space between the shoulders 14 and 16 and the liner on the inside and the block on the outside. It is also preferable to compress the ring sufficiently so that some of the metal therefrom will be forced both upwardly and downwardly from the main body of the ring into the radial clearance between the liner and the block. To illustrate this I have indicated at 20 a small part of the metal forced upwardly above the main body of the ring and at 21 a small part of the metal forced downwardly below such main body.

With such compression of the ring 17, a tight seal is effected between the liner and the block and the liner is held rigidly positioned within the block.

At the upper end of the block a similar type of seal is provided but of course such seal does not have to support the liner axially since axial support for the liner is provided by the shoulders 14 and 16 and the interposed ring 17 at the lower end. At the upper end above the cavity 12, the liner 13 has a reduced portion 22 to form an upwardly facing shoulder 23 forming an annular cavity between the upper end of the liner and the block. To effect a seal at this point, a soft metal ring 24 is inserted into the annular space between the reduced portion 22 of the liner and the cylinder bore, with the ring 24 having an inside and outside diameter such that it clears both the liner and the block as illustrated in Fig. 3.

A tool in the form of a hardened steel ring or plug 25, as illustrated in dotted lines in Fig. 4, is then placed on the top of the soft metal ring 24 and is forced downwardly with sufficient pressure to deform the ring 24 and cause it to fully expand radially into tight peripheral contact with both the liner and the block. Preferably sufficient force is exerted on the ring 24 to cause a portion of it to expand downwardly, as at 26, into the radial clearance between the main body of the liner and the plug. The plug 25 may then be removed and the ring 24 remains in tight sealing engagement with the liner and block, thus preventing any leakage of water from the cavity 12 upwardly around the liner. However, the seal effected by the ring 24 is not important since the usual gasket placed between the cylinder head and the block will prevent any leakage upwardly from the cavity 12. The ring 24, whether or not it effects a water-tight seal, assists in holding the liner against displacement relative to the block.

In the modified form of construction shown in Fig. 5, the plug 25 by which the ring 24 is compressed is shown as being depressed sufficiently so that its upper surface is substantially flush with the upper surface of the liner and block. The plug 35 may therefore be left in the annular cavity without removal and in that case, some of the metal from the ring 24 will be forced upwardly in the clearance between the liner and plug, as at 26 and between the liner and block as at 28. A tighter seal may thereby be effected.

In Figs. 6 and 7 I have illustrated a further modification of the construction of the upper end of the liner in order to give a tighter seal and to hold the soft metal ring against displacement relative to either the block or the liner as well as to hold the liner against axial displacement relative to the block. Thus, a radially extending groove 30 may be cut into either the liner or the block or both, preferably at or above the level of the shoulder 23. The soft metal ring is then compressed sufficiently so that not only does it engage peripherally with the liner and block but portions of the metal thereof are forced into the groove or grooves 30, as at 31, to completely fill the latter. The portions 31 then serve to key the liner against axial shifting movement relative to the block and a tighter seal is also effected.

With a liner held in place in the cylinder block in the manner hereinbefore described, it will be evident that by supporting the liner at its lower end, no outwardly extending flange is needed at its upper end. The liner is held accurately in place in the block since both the ring 17 and the ring 24 are compressed into tight peripheral engagement with both the liner and block. Moreover, a firm water-tight seal is provided at both ends to prevent leakage between the coolant cavity 12 and the interior of the cylinder. By supporting the liner at the lower end of the cylinder bore, the point of support is remote from the combustion chamber portion of the cylinder and hence is subjected to less variation in temperature than in the case of the old form where the support for the liner was at the upper end thereof. If in the present construction the variations in temperature at the upper end tend to produce distortions that might result in leakage around the upper ring 24, the gasket between the cylinder head and block is clamped therebetween with sufficient pressure to prevent any leakage above the liner. Thus, this method of sealing the liner to the block makes an assembled block structure which is much stronger than the conventional liner construction.

With this form of liner, it is obvious that the casting therefor may be made as a substantially straight cylinder, and the machining thereof is simplified since the outer diameter is substantially uniform for the major portion of the length of the liner and the reduced ends 15 and 22 may be formed by relatively simple turning operations.

I claim:

1. The combination of a cylinder block for an internal combustion engine, said block having a cylinder bore therein and a coolant cavity opening into and spaced from both ends of said bore, said bore having an upwardly facing shoulder adjacent its lower end below said cavity, a liner mounted in said bore and having a downwardly facing surface supported by said shoulder with the liner extending upwardly to the top of the block, and means interposed between said shoulder and said surface for securing the liner to the block and providing a seal therebetween.

2. The combination of a cylinder block for an internal combustion engine, having a cylinder bore therein and a coolant cavity opening into and spaced from both ends of said bore, said bore having an upwardly facing inwardly extending shoulder adjacent its lower end below said cavity, a liner mounted in said bore and having a downwardly facing surface supported by said shoulder

with the liner extending upwardly therefrom above said cavity and substantially to the top of said bore, said liner having a uniform outside diameter having a sliding fit with the diameter of said bore and extending from said surface at least to a point above said cavity, and means located between said surface of the liner and said shoulder of the bore and extending upwardly in the space between the liner and bore for securing the liner to the block and providing a seal therebetween.

3. The combination of a cylinder block for an internal combustion engine, having a cylinder bore therein and a coolant cavity opening into and spaced from both ends of said bore, said bore having an upwardly facing inwardly extending shoulder adjacent its lower end below said cavity, a liner mounted in said bore and having a downwardly facing shoulder adjacent its lower end and below said cavity and supported by the shoulder on the block, with the liner extending from said shoulders substantially to the top of said bore, and means located between said shoulders for securing the liner to the block and providing a seal therebetween.

4. The combination of a cylinder block for an internal combustion engine, having a cylinder bore therein and a coolant cavity opening into and spaced from both ends of said bore, said bore having an upwardly facing inwardly extending shoulder adjacent its lower end below said cavity, a liner mounted in said bore and having a downwardly facing shoulder adjacent its lower end and below said cavity and supported by the shoulder on the block, with the liner extending from said shoulder substantially to the top of said bore, and means located between said shoulders and extending upwardly and downwardly therefrom between said liner and bore for securing the liner to the block and providing a seal therebetween.

5. The combination of a cylinder block for an internal combustion engine, having a cylinder bore therein and a coolant cavity opening into and spaced from both ends of said bore, said bore having an upwardly facing inwardly extending shoulder adjacent its lower end below said cavity, a liner mounted in said bore and having a downwardly facing surface supported by said shoulder with the liner extending upwardly therefrom above said cavity and substantially to the top of said bore, the maximum outside diameter of said liner being not greater than the diameter of said bore, and means located both above and below said cavity providing a seal between the liner and the bore and securing the liner to the block.

6. The combination of a cylinder block for an internal combustion engine, having a cylinder bore therein and a coolant cavity opening into and spaced from both ends of said bore, said bore having an upwardly facing inwardly extending shoulder adjacent its lower end below said cavity, a liner mounted in said bore and having a downwardly facing shoulder below said cavity and facing the shoulder in the bore, said liner extending substantially to the top of the bore and having an upwardly facing shoulder adjacent its upper end above said cavity, the liner being of substantially uniform outside diameter between said shoulders, and a pair of rings of readily deformable metal, one compressed between the lower shoulder on the liner and the shoulder in the bore and the other compressed against the upper shoulder on the liner and between the bore and liner for securing the liner in the bore and providing seals therebetween above and below the cavity.

7. The combination of a cylinder block member for an internal combustion engine, having a cylinder bore therein and a coolant cavity opening into and spaced from both ends of said bore, said bore having an upwardly facing shoulder adjacent its lower end below said cavity, a cylindrical liner member of substantially uniform diameter throughout the major portion of its length fitting with said bore and having portions of reduced external diameter at its ends forming a downwardly facing shoulder adjacent the lower end and spaced above said shoulder of the block member and an upwardly facing shoulder adjacent its upper end above said cavity, at least one of said members having a radial groove located above said upwardly facing shoulder, a ring of readily deformable metal compressed between the upwardly facing shoulder in the bore and the downwardly facing shoulder on the liner member, and a second ring of similar metal compressed against the upper shoulder on the liner and into said radial groove, said rings securing the liner in the bore and providing seals therebetween above and below said cavity.

8. The combination of a cylinder block member for an internal combustion engine, having a cylinder bore therein and a coolant cavity opening into and spaced from both ends of said bore, said bore having an upwardly facing shoulder adjacent its lower end below said cavity, a liner member mounted in said bore and having a downwardly facing shoulder below said cavity and an upwardly facing shoulder adjacent its upper end above said cavity, and a pair of rings of readily deformable metal, one compressed between the lower shoulder and the liner member and the shoulder in the bore, at least one of said members having a radial groove located at the upper shoulder of the liner member, and the other of said rings being compressed against the upper shoulder on the liner member with some of the metal thereof forced into said groove to prevent axial displacement of the upper ring.

9. The combination of a cylinder block for an internal combustion engine, having a cylinder bore therein and a coolant cavity opening into and spaced from both ends of said bore, said bore having an upwardly facing inwardly extending shoulder adjacent its lower end below said cavity, a liner mounted in said bore and having a downwardly facing shoulder below said cavity and facing the shoulder in the bore, said liner extending substantially to the top of the bore and having an upwardly facing shoulder adjacent its upper end above said cavity, the liner being of substantially uniform outside diameter between said shoulders, the diameter of the liner being slightly less than the diameter of said bore, and a pair of rings of readily deformable metal, one compressed between the lower shoulder on the liner and the shoulder in the bore with parts of the metal forced into the space between the liner and the bore both above and below the main body of the ring, and the other compressed against the upper shoulder on the liner with a part of the metal forced downwardly into the space between the liner and the bore below said upper shoulder, said rings securing the liner in the bore and providing seals therebetween above and below said cavity.

10. The combination of a cylinder block for an internal combustion engine, having a cylinder bore therein and a collant cavity opening into and spaced from both ends of said bore, said bore having an upwardly facing inwardly extending shoulder adjacent its lower end below said cavity, a liner mounted in said bore and having a downwardly facing shoulder below said cavity and facing the shoulder in the bore, said liner extending substantially to the top of the bore and having an upwardly facing shoulder adjacent its upper end above said cavity, the liner being of substantially uniform outside diameter between said shoulders, a pair of rings of readily deformable metal, one compressed between the lower shoulder on the liner and the shoulder in the bore and the other compressed against the upper shoulder on the liner and between the bore and liner, and a ring of relatively hard metal bearing against said other ring and being slightly spaced from the bore and the liner so that parts of said other ring are forced into the spaces between the hard metal ring and the bore and between the hard metal ring and the liner, said pair of rings securing the liner in the bore and providing seals therebetween above and below the cavity.

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