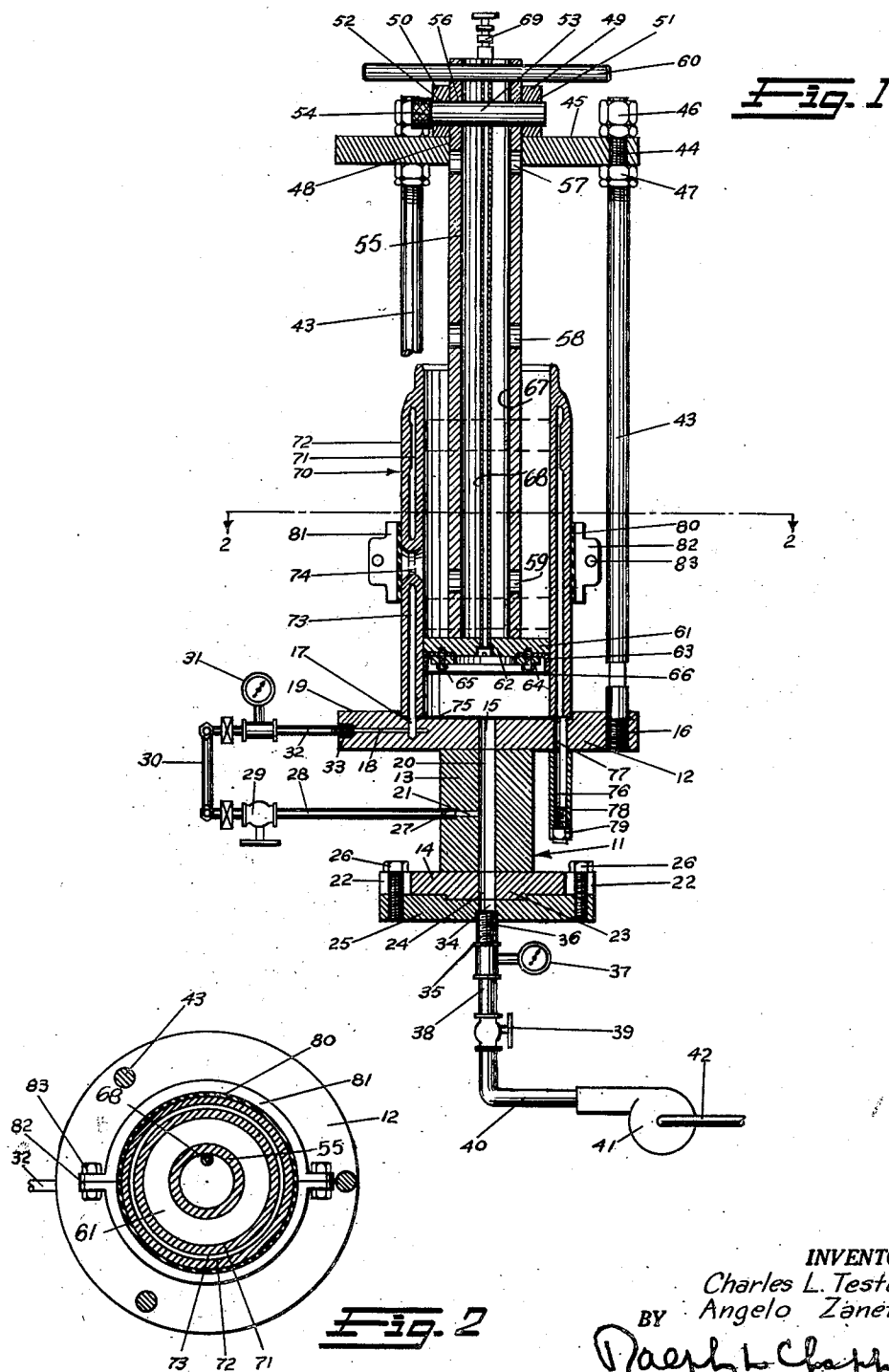


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FIXTURE FOR TESTING CYLINDERS

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FIXTURE FOR TESTING CYLINDERS

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The present invention concerns a fixture for testing cylinder liners and particularly concerns a fixture designed for subjecting Diesel-engine cylinder liners to hydraulic test for determining leaks.

In construction of Diesel engines it is common practice to produce a cylinder liner and the surrounding water jacket in a single piece by casting. Due to combustion of the fuel within the cylinder, the liner and jacket casting is subjected to extremely high pressures with resulting severe mechanical stresses and in addition is subjected to extremely high temperatures with resulting severe thermal stress. These and other stresses cause in the liner and jacket casting strains which tend to result in cracks. Such cracks occurring in the liner portion of the casting cause loss of compression and power as well as provide points of incipient failure of the entire cylinder with potential damage to the engine. The occurrence of such cracks in the water-jacket portion of the casting causes loss of cooling liquid with resultant overheating of the cylinder and provides points of incipient failure of the entire cylinder with potential damage to the engine.

It is therefore necessary that such cracks be detected upon occurrence and to this end it is customary to provide a periodic check with hydraulic fluid such as water under pressure when the engine is installed for use, and to provide a similar check when the engine is overhauled or repaired. A complete check involves four separate hydraulic tests to insure that all parts of the liner and jacket are examined. First a low-pressure test of the water jacket is required and this may be made at a pressure on the order of 100 lbs. per square inch. Three tests of the liner are also necessary to individually test the high-pressure portion of the combustion chamber defined generally by the piston at its point of maximum travel into the cylinder, the medium-pressure portion of the combustion chamber defined by the space between the exhaust ports and the outboard end of the cylinder and the low-pressure portion of the cylinder defined by the piston at its point of maximum withdrawal from the cylinder. The three latter tests are performed at pressures on the order of 1500 lbs. per square inch, 900 lbs. per square inch and 600 lbs. per square inch respectively.

Previous test fixtures involve a bedplate for supporting and sealing the lower end of the liner, a headplate for sealing the upper end of the liner, a piston disposed in the liner and sup-

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ported on a piston rod threaded through the headplate. Screwing of the piston rod in the headplate served to reciprocate the piston into desired position for testing, and water under pressure was introduced into the liner between the piston and the headplate. Such construction has the disadvantage of sealing the liner at both ends so that inspection of the interior of the liner during testing is impossible. It is therefore impossible to orient precisely the location of leaks on the inner liner surface and only a rough approximation of the general area of leakage can be estimated from the piston-rod position. A further disadvantage is that it is difficult to prevent leakage of fluid past the piston-rod threads in the headplate since this area is subjected to hydraulic fluid under pressure. A further disadvantage is that hydraulic pressure on the piston causes binding of the piston rod threads in the headplate so that it is necessary to slack off hydraulic pressure in order to turn the piston rod and effect adjustment of the piston in the cylinder. A further disadvantage is that separate fixtures are required to test the liner and the jacket, and in testing the liner it is necessary to loosen the headplate for each separate test since the sealing gaskets require changing for each test.

The present invention overcomes these difficulties by providing a fixture having a bedplate that supports and seals the bottom of the liner and a headplate that is spaced from the top end of the liner. A piston is disposed in the liner and mounted on a rod which is longitudinally adjustable relatively to the headplate. This is locked in its adjusted position by means of a transverse pin in the headplate which is insertable into a selected one of several holes in the piston rod to secure the piston in a selected position for performing the test. Water under pressure is forced into the space between the piston and bedplate in order to perform the test.

Thus by this invention the piston can be quickly and conveniently located and locked in a selected predetermined position for test, yet the inside of the liner between the piston and headplate is open for inspection during the test to identify the exact location of leaks. At the same time, the location of the gasket to seal the end of the liner is transferred from the moving parts of the headplate to the bedplate where there are no moving parts. Also, the fixture is designed so that both the liner and jacket can be tested, thus eliminating the need for separate fixtures.

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An object of the invention is to provide a fixture for hydraulic testing of a Diesel-engine cylinder liner and jacket for leaks.

A further object is to provide a fixture having a bedplate for sealing the lower end of the liner, and a piston that can be rapidly and conveniently located in predetermined position to define the area to be tested.

A further object is to provide a fixture in which the space inside the liner that is not filled with testing fluid is open for inspection during the test.

A further object is to provide a fixture in which the bedplate which seals the end of the cylinder is free of moving parts.

Further objects and advantages of this invention, as well as its construction, arrangement and operation, will be apparent from the following description and claims in connection with the accompanying drawing, in which,

Fig. 1 is a view showing a preferred embodiment of the present invention, and

Fig. 2 is a sectional view taken along line 2—2 of Figure 1.

Fig. 1 shows a preferred embodiment of the invention as comprising a pedestal 11 having a bedplate 12, a supporting column 13 and an anchor plate 14 secured together by welding to provide a rigid construction. Bedplate 12 is provided with a central bore 15, threaded peripheral openings 16 and drilled passages 17 and 18, disposed at right angles. An upstanding annular portion 19 is formed at the periphery of bedplate 12. Supporting column 13 is provided with a central bore 20 and a lateral bore 21 extending from the outside of column 13 to central bore 20. Anchor plate 14 is provided with peripheral slots 22, a centrally depending lug 23 and a central bore 24.

Pedestal 11 is adapted to be mounted upon a supporting member 25. Bolts 26 extend through slots 22 in anchor plate 14 and serve to secure the anchor plate to support 25.

Threaded into bore 21 at 27 is a hydraulic line 28 leading to a valve 29, the other end of which is connected by hydraulic line 30 with a pressure gauge 31. A hydraulic line 32 connects the other end of pressure gauge 31 with bore 18 by threaded connection 33.

A central bore 34 is provided in supporting plate 25. Threaded into bore 34 at 35 is one end of a hydraulic line 36 leading to a pressure gauge 37 and through a line 38 to a valve 39. Hydraulic line 40 connects valve 39 with a hydraulic pump 41, the other end of which is connected by line 42 to a source of hydraulic fluid (not shown).

Threaded into each peripheral opening 16 in bedplate 12 is the lower end of a staystud 43, the upper end of which is adapted to extend through a peripheral opening 44 in a headplate 45. Lock nuts 46 and 47 on each staystud 43 serve to anchor headplate 45 in fixed position. A central bore 48 is provided in headplate 45 and upwardly extending lugs 49 and 50 are provided on opposite sides of bore 48. Aligned transverse bores 51 and 52 are provided in lugs 49 and 50 and are adapted to receive slidably a transverse pin 53 having a knurled head 54.

Disposed for vertical reciprocation in bore 48 of headplate 45 is a piston rod 55 provided with the transverse openings 56, 57, 58 and 59, any one of which can be aligned with bores 51 and 52 of lugs 49 and 50, so that transverse pin 53 is engaged through the lugs and piston rod to lock the latter against reciprocation and in predetermined position. Secured transversely to the

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upper end of piston rod 55, is a handle 60 designed to afford a grip for an operator in effecting manual reciprocation of piston rod 55 when locking pin 53 is removed.

Secured to the lower end of piston rod 55 is a piston 61 provided with a centrally depending boss 62. A leather cup 63 is secured to the lower face of piston 61 and held in place by locking ring 64 and locking bolts 65. Leather cup 63 is provided with an annular sealing flange 66 adapted for sealing contact with the inner surface of a liner to be tested.

Piston rod 55 is provided with a central bore 67. Disposed within bore 67 is a bleed line 68 provided at its upper end with a bleed valve 69. Bleed line 68 is arranged to open into the lower face of piston 61 and at its upper end is arranged to open into the atmosphere at the upper end of piston rod 55.

A Diesel-engine cylinder liner and water jacket assembly to be tested is shown at 70. Assembly 70 comprises a cylinder liner 71 and a water jacket 72 integral therewith. Liner 71 and jacket 72 can be formed in a single piece by casting if desired. Water jacket 72 defines a space 73 surrounding liner 71 and adapted for the circulation of cooling fluid. Exhaust ports 74 are arranged peripherally around assembly 70.

Liner assembly 70 is adapted to be mounted upon bedplate 12 and a gasket 75 seated within annulus 19 is arranged to seal the lower end of liner assembly 70. Studs 76 integral with liner assembly 70 are designed to depend from the lower end of the liner assembly through openings 77 in bedplate 12. A spacing collar 78 is arranged to be disposed about the lower end of each stud 76 and a lock nut 79 is threaded on the lower extremity of each stud 76 to secure the liner assembly 70 in sealing engagement with bedplate 12. When pocked in position on bedplate 12, the cooling fluid space 73 of the liner assembly is in alignment with bore 17 in bedplate 12.

Exhaust ports 74 are adapted to be sealed by peripheral strip 80 secured around the outside of liner assembly 70 and locked in sealing engagement with assembly 70 by a pair of split collars 81 having lugs 82 which are secured together by means of bolts 83.

Operation of the device is as follows. To prepare the fixture for making a test, locking pin 53 is withdrawn, and by means of handle 60 piston rod 55 is manually raised until opening 59 is aligned with bores 51 and 52 in lugs 49 and 50. Locking pin 54 is then inserted in place to secure piston rod 55 against movement. In this position, piston 62 is at its maximum point of withdrawal from bedplate 12. Sealing gasket 75 is then placed on bedplate 12 within centering annulus 19, and a liner assembly 70 to be tested is placed in the fixture with the combustion chamber end thereof resting on gasket 75, and liner studs 76 depending through bedplate 12. Each stud 76 may then be fitted with a spacing collar 78 and nuts 79. Nuts 79 are then tightened to seat firmly liner assembly 70 in place and to insure that the lower end of the liner is hydraulically sealed against bedplate 12 by gasket 75. Pin 53 is then removed and piston rod 55 is lowered by handle 60 until opening 56 therein is aligned with bores 51 and 52 in lugs 49 and 50 in the position shown in Fig. 1. Pin 53 is then inserted to lock piston rod 55 against movement. When so adjusted, piston 61 will be disposed within liner assembly 70 in the position defining the high-pressure portion of the combustion chamber and

the position of the piston 61 corresponds to the position of the Diesel-engine piston in actual operation in its position of maximum travel into the cylinder.

The fixture is further conditioned for making a test by starting water pump 41 and opening valve 39 to flood the fixture with water. Trapped air within liner 72 between bedplate 12 and piston 61 is evacuated through line 68 by opening bleed valve 69. Spurting of water through bleed valve 69 indicates that trapped air has been completely evacuated. Presence of air within a fixture is undesirable since it forms a compressible cushion that distorts the value indicated on pressure gauges 31 and 37.

To make a low-pressure test of water jacket 72, valve 39 is regulated until pressure gauge 37 indicates about 150 lbs. per square inch. Valve 29 is next regulated until gauge 31 indicates a pressure corresponding to that used in the water jacket in actual operation. For a jacket of the type shown, a satisfactory pressure is about 100 lbs. per square inch. Water under the latter pressure flows through line 28 to valve 29 and on through line 36 and gauge 31, into line 32 and passages 18 and 17, to fill the cooling space 73 defined between liner 71 and jacket 72. Valve 29 is then closed.

After the cooling space 73 is filled with water the pressure can be maintained for a period of about five minutes. If there is no leak in liner assembly 70, the pressure indicated by gauge 31 remains constant. Should a low pressure leak be present, however, it can be detected by a drop in the pressure indicated by gauge 31 and the precise location of the leak can be ascertained by a visual inspection of the outside of jacket 72 and the inside of liner 71. Since both of these areas are completely open for visual inspection except for the small space defined below piston 61 inside of liner 71, it is seen that the exact location of any leak can be easily detected.

The inside of the liner 71, below piston 61 which defines the area of high-pressure combustion, can next be tested. Valve 29 is closed and valve 39 regulated until pressure gauge 37 indicates a pressure corresponding to that encountered in actual use. A pressure of about 1500 lbs. per square inch is satisfactory for the type of liner shown. Valve 39 is closed to maintain this pressure for a period of about five minutes and any leakage is detected by a drop in the pressure indicated on gauge 37. Although the area being tested is not open for visual inspection, any leaks which occur are localized in the area below piston 61 and can be exactly located by subsequent inspection. Absence of leaks is indicated by steady reading of gauge 37.

To test the liner assembly for medium pressure leaks thrust pin 53 is removed and piston rod 55 raised by handle 60, or under the influence of water pressure under piston 61, until opening 57 therein is aligned with bores 51 and 52 in lugs 49 and 50. Thrust pin 53 can be replaced to lock piston rod 55 against movement. This position is indicated by dotted lines in Fig. 1 in which piston 61 defines the area of medium pressure combustion. Valve 39 is regulated until pressure gauge 37 indicates a pressure corresponding to that encountered in actual use. For the liner assembly illustrated, a pressure of about 900 lbs. per square inch is satisfactory and valve 39 can be closed to maintain this pressure for a period of about five minutes. As in the previous test, any leakage is indicated by a drop in pressure in-

dicated by gauge 37, and since the area being tested is localized below piston 61, the exact area of leaks can be found by subsequent inspection. Absence of leaks will be reflected from steady reading of gauge 37.

To test the liner assembly for low-pressure leaks, thrust pin 53 can be withdrawn and piston rod 55 raised until opening 58 is aligned with bores 51 and 52 of lugs 49 and 50. Pin 53 is then reinserted to lock piston rod 55 against movement. In this position which is indicated by dotted lines for Fig. 1, piston 61 defines the low-pressure area of combustion. Ports 74 are hydraulically sealed by gasket 80 and clamps 81. Valve 39 is regulated until gauge 37 indicates a pressure corresponding to that encountered in actual use. For the liner illustrated, a pressure of about 600 lbs. per square inch is satisfactory and can be maintained for about five minutes with valve 39 closed. As in the previous tests, leakage is shown by a drop in pressure indicated by gauge 37, and the exact area of leakage can be determined by subsequent inspection.

Testing pressures, time intervals, and other factors can be varied to suit the requirements of the particular shell or liner being tested. If desired, automatic instruments can be incorporated in the fixture to make records of the pressures, time intervals and other factors involved.

While the embodiment of the invention described above has been designed for use particularly for testing the integral liner and jacket assembly of Diesel-engine cylinders, the construction can be modified for testing a liner individually or for testing any open ended shell construction or similar arrangement.

Modifications and changes can be made in this invention without departing from the spirit and scope thereof as set forth in the appended claims.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

What is claimed is:

1. A fixture adapted for testing for leaks in a cylinder liner and jacket of a Diesel engine, said fixture comprising a sealing member adapted for sealing one end of the liner, a head member spaced from said sealing member and adapted to be spaced from the open end of the liner, a piston rod mounted for reciprocation relative to said head member, a piston on said rod adjacent said sealing member and adapted to be disposed in a plurality of predetermined positions within the liner in sealing engagement with the inner wall of the liner, locking means for securing said piston against movement in said predetermined positions comprising a sliding pin supported in said head member and adapted to be removably engaged in a corresponding plurality of transverse slots in said piston rod, means for introducing liquid under pressure into the space defined by the sealing member, piston and liner, a pressure gauge to indicate leakage from said space, a bleeding valve providing an outlet for gas trapped in said space, means for introducing liquid under pressure into the jacket, and a pressure gauge for indicating leakage from said jacket, the space defined by said piston, wall of the liner and open end of the liner being open for inspection during test.

2. A fixture adapted for testing for leaks in a

tube, said fixture comprising a sealing member adapted for sealing one end of the tube, a head member spaced from said sealing member and adapted to be spaced from the open end of the tube, a piston rod mounted for reciprocation relative to said head member, a piston on said rod adjacent said sealing member and adapted to be disposed in a plurality of predetermined positions within the tube in sealing engagement with the inner wall of the tube, locking means for securing said piston against movement in said predetermined positions comprising a sliding pin supported in said head member and adapted to be removably engaged in a corresponding plurality of transverse slots in said piston rod, means for introducing liquid under pressure into the space defined by the sealing member, piston and tube, a pressure gauge to indicate leakage from said space, a bleeding valve providing an outlet for gas trapped in said space, the space defined by said piston, wall of the tube and open end of the tube being open for inspection during test.

3. A fixture adapted for testing for leaks in a cylinder liner and jacket of a Diesel engine, said fixture comprising a sealing member adapted for sealing one end of the liner, a head member spaced from said sealing member and adapted to be spaced from the open end of the liner, a piston rod mounted for reciprocation relative to said head member, a piston on said rod adjacent said sealing member and adapted to be disposed in a plurality of predetermined positions within the liner in sealing engagement with the inner wall of the liner, locking means for securing said piston against movement in said predetermined positions, means for introducing fluid under pressure into the space defined by the sealing member, piston and liner, means to indicate leakage from said space, means for introducing liquid under pressure into the jacket, and means for indicating leakage from said jacket, the space de-

fined by said piston, wall of the liner and open end of the liner being open for inspection during test.

4. A fixture adapted for testing for leaks in a tube, said fixture comprising a sealing member adapted for sealing one end of the tube, a head member spaced from said sealing member and adapted to be spaced from the open end of the tube, a piston rod mounted for reciprocation relative to said head member, a piston on said rod adjacent said sealing member and adapted to be disposed in a plurality of predetermined positions within the tube in sealing engagement with the inner wall of the tube, locking means for securing said piston against movement in said predetermined positions comprising a sliding pin supported in said head member and adapted to be removably engaged in a corresponding plurality of transverse slots in said piston rod, means for introducing liquid under pressure into the space defined by the sealing member, piston and tube, and a pressure gauge to indicate leakage from said space.

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