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2,368,593

LUBRICATION INDICATOR

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2 Sheets-Sheet 1

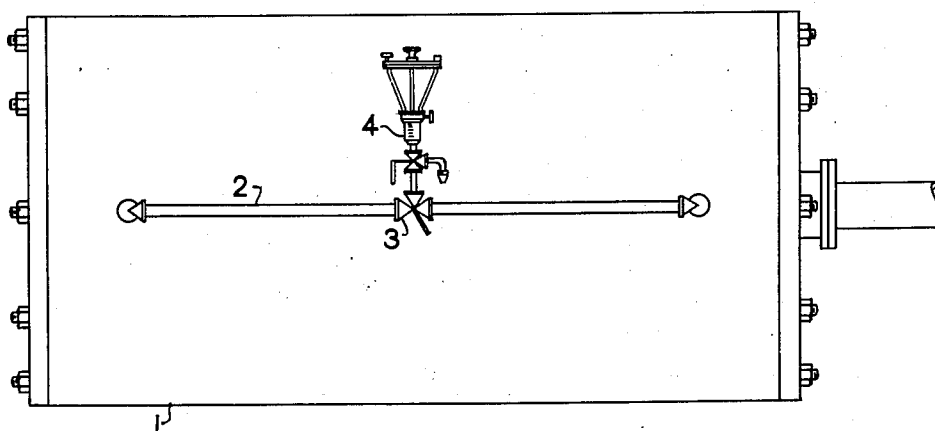


Fig. 1

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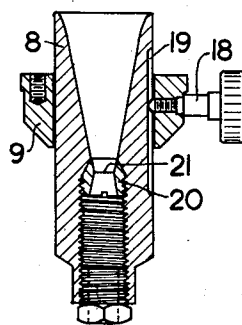
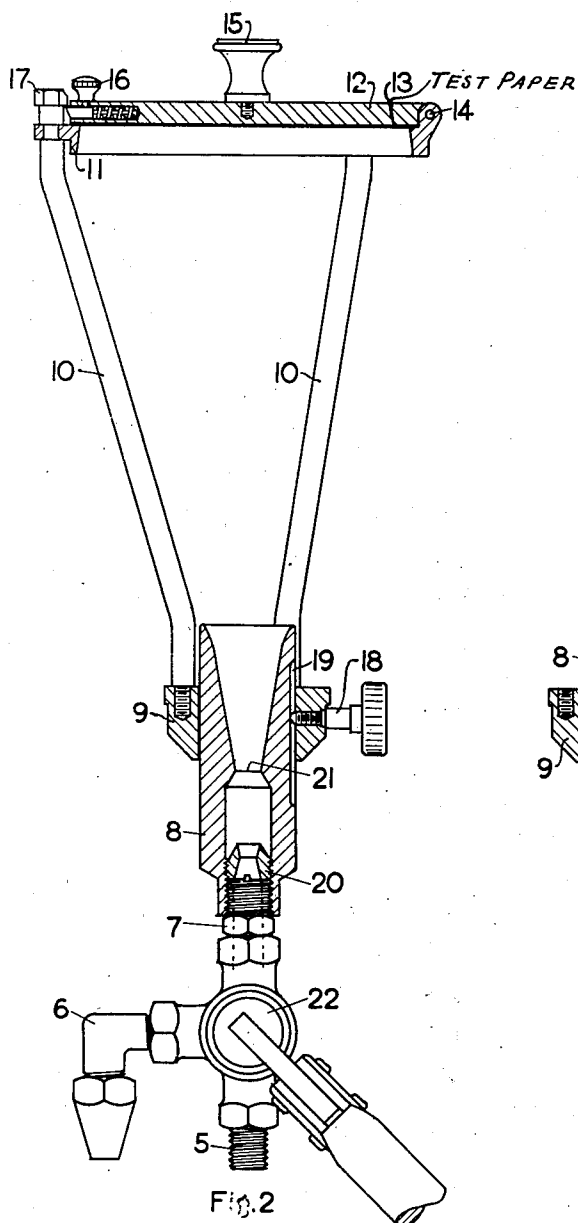
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2 Sheets-Sheet 2



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2,368,593

LUBRICATION INDICATOR

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8 Claims. (Cl. 73-64)

The present invention relates to an improved lubrication indicator and more particularly to a lubrication indicator suitable for determining the condition of lubrication of certain moving machine elements, especially with respect to the quality, quantity and distribution of lubricant and the presence of foreign bodies in lubricant supplied to such machine elements.

Specifically, the invention is drawn to apparatus suitable for determining the above data in the operation of machines, the operating elements of which are driven by or act upon fluids which also serve or may serve as carriers for a lubricant, as for example steam engines, air compressors and the like wherein the piston lubricant is at least partially carried and distributed by the steam or air.

It has been common practice in the past, in order to determine the conditions of lubrication in piston engines of the type noted above, to remove the cylinder cover and visually inspect the interior of the cylinder. This method not only results in undesirable interruption of the operation of the engine but is of little value in that only the fact that faulty lubrication is occurring, but not the cause of the same, is determinable. In the past there has also been a practice of impinging a stream of fluid from the piston upon a piece of paper which is hand held by the person making the determination, a deposit of lubricant, carrier fluid (in the case of steam pistons) and impurities being obtained upon the test paper by means of which an estimation as to the lubrication within the piston may be obtained. This method is unsatisfactory from the standpoints of danger to the operator and non-reproducibility of results. A further modification of this arrangement is described in U. S. Patents 700,682 and 700,683, wherein the test paper is rigidly supported by mechanical means and arranged to oscillate in front of an impingement jet. This arrangement is also unsatisfactory, for many purposes, because of irregular patterns obtained upon the test paper and consequent unreliable interpretations as to the efficiency of lubrication.

It is an object of the present invention to provide a lubrication indicator which will provide reproducible oil patterns upon a test paper. A further object is to provide an indicator of this type which may be adjusted to provide sharp oil patterns upon a test paper under varying conditions of pressure within a given pressure range. A still further object is to provide a lubrication indicator which may be easily modified for use at any desired pressure. Other objects, together

with some of the advantages to be derived from utilizing the present invention, will become apparent from the following detailed description of the invention, taken together with the accompanying drawings which form a part of the specification and wherein:

Figure I is an elevational view showing an arrangement for employing the present invention in conjunction with a steam cylinder; Figure II is an elevation, partially in cross-section, showing construction details of the lubrication indicator; Figure III is a partial elevation in cross-section showing a modification of one feature of the invention.

Referring to Figure I, a conduit leading from the head end to the crank end of a steam cylinder 1 is provided with a three-way valve 3. The lubrication indicator is mounted in flow communication with one port of valve 3, whereby steam may be passed through conduit 2 and into lubrication tester 4 by proper alignment of valve 3.

In Figure II, a second three-way valve 22 is adapted for threaded engagement at 5 with valve 3. A second port of valve 22 discharges to atmosphere through conduit 6 and the third port is in flow communication with Venturi housing 8 through coupling 7. The interior of Venturi housing 8 is shaped to provide a Venturi throat as at 21 and is internally threaded to receive jet 20. An annular test paper support 11 is rigidly affixed to three support legs 10 as shown, legs 10 being in turn supported by element 9 which is slidably mounted on Venturi housing 8. A longitudinal slot 19 is provided in the side of Venturi housing 8 and is adapted to receive set screw 18 which passes through element 9, which may thus be rigidly positioned at any desired point along slot 19.

A cap 12 in the form of a disk is hingedly attached at 14 to paper support 11, a conventional latch arrangement being provided at 16, 17, to secure cap 12 when in a closed position. Knob 15 serves to lift cap 12 to an open position when the latch is released. A test paper 13 in the form of a disk is supported by element 11 and is backed by cap 12.

Figure III illustrates the invention in a modified form wherein jet 20 is positioned at the narrowest point of Venturi throat 21, the jet itself thus forming part of the Venturi throat.

The operation of the device is as follows:

With the lubrication tester installed as shown in Figure I, valve 3 is turned to permit steam to pass to the lubrication indicator and valve 22

(Figure II) is turned to pass steam through exhaust conduit 8. Several strokes of the piston under these conditions are permitted in order to clean the various lines. Cap 12 is then raised to the open position and valve 22 turned to permit steam to pass through Venturi 21, several strokes again being permitted to clean the passages within the lubrication indicator. Valve 22 is then returned to the exhaust position and a test paper placed on support 11. Any absorbent paper, such as laboratory filter paper, will be found suitable for this purpose. Cap 12 is then closed and latched and valve 22 returned to the position permitting steam to pass through venturi 21 and impinge against the test paper for several strokes of the piston, whereupon valve 22 is again turned to the exhaust position and valve 3 returned to normal operating position.

In the event that a sharply defined pattern is obtained on the test paper, the above procedure is repeated after adjustment of the distance between the test paper and venturi 21 by means of sliding element 9 and set screw 18.

The determination as to whether a satisfactory pattern on the test paper has been obtained is made by visual examination of the test paper after steam impingement, the appearance of the pattern being analogous to that of a photograph, the pattern being sharply defined and "in focus" with the proper spacing between the test paper and the venturi, and ill defined or "out of focus" when the setting is improper. With a little experience in using the lubrication indicator, the operator rapidly becomes adept at judging the sharpness or "focus" of the test paper pattern.

It has been found preferable to vary the size of the pressure reduction jet 20 in accordance with various operating pressure ranges. The following jet sizes for various pressure ranges have been found satisfactory:

Pressure range	Minimum I. D. of jet
25 to 75 p. s. i.	Inch 1/64
75 to 125 p. s. i.	1/32
125 to 150 p. s. i.	1/16
150 to 200 p. s. i.	3/64
200 to 250 p. s. i.	1/8

Using jets of the sizes prescribed above, sharp test patterns may be obtained at all operating pressures within the ranges occurring under normal operating conditions if the distance from the venturi to the test paper is adjustable over an approximate range of 3 to 5 inches. Under exceptional and unusual conditions, as for example wherein the indicator is to be used on an engine employing very low pressures and wet steam, it may be necessary to use a smaller jet in order that a longer period of exposure of the test paper to the impinging stream may be utilized to obtain a satisfactory pattern and at the same time avoid disintegration of the paper by the stream.

After a sharply defined discharge pattern has been obtained upon the test paper, conclusions as to the following factors in the operation of a steam engine may be determined by a reasonably skilled operator: The dispersion of the steam cylinder oil in the steam, distribution of the steam cylinder oil in the head and crank ends of the cylinder, degree of atomization of the oil (showing quill performance), excess or insuff-

ficient lubrication of the various parts of the cylinder, contamination of the steam entering the engine (rust, scale and other foreign deposits), engine wear as shown by the type of iron deposit on the test paper, coking or carbonization of compounding materials added to the oil, leaking valves in the engine as shown by difference in quantity of condensate impinging on the test paper when comparing head end and crank end patterns, faulty oil separator, etc.

When used in testing air compressors, the following factors may be determined: Atomization and distribution of compressor oil, contamination of intake air, excess or insufficient lubrication in various parts of the cylinder, presence of lubricating oil in air passing through coolers into air receiver, etc.

The fact that these numerous operating factors may be determined with accuracy is primarily due to the particular structure disclosed, i. e., the arrangement whereby the impinging stream is passed through a venturi before striking the test paper and the adjustable means for supporting the test paper whereby sharp "focus" of the impingement pattern may be obtained. These features directly contribute to the formation of regular and reproducible impingement patterns instead of the diffused and haphazard patterns obtained by the use of a simple orifice and accordingly permit accurate interpretations of the impingement patterns in determination of the operating factors discussed above.

I claim as my invention:

1. In a lubrication indicator of the class described the combination comprising a Venturi housing including a Venturi throat therein, conduit means arranged and adapted to supply lubricant carrying fluid to said Venturi housing under pressure, support means slidably mounted on said Venturi housing arranged and adapted to support a test paper in spaced relationship from the exhaust side of said Venturi throat and in a plane perpendicular to the longitudinal axis of flow through said Venturi throat whereby lubricant carrying fluid passing through said Venturi throat impinges upon said test paper.

2. In a lubrication indicator of the class described the combination comprising a Venturi housing including a Venturi throat therein, conduit means arranged and adapted to supply lubricant carrying fluid to said Venturi housing under pressure, pressure reduction jet means demountably positioned in said Venturi housing between said conduit means and said Venturi throat, and support means arranged and adapted to support a test paper in spaced relationship from the exhaust side of said Venturi throat and in a plane perpendicular to the longitudinal axis of flow through said Venturi throat, whereby lubricant carrying fluid passing through said Venturi throat impinges upon said test paper.

3. In a lubrication indicator of the class described the combination comprising a Venturi housing including a Venturi throat therein, conduit means arranged and adapted to supply lubricant carrying fluid to said Venturi housing under pressure, pressure reduction jet means demountably positioned in said Venturi housing between said conduit means and said Venturi throat and forming part of said Venturi throat, and support means slidably mounted on said Venturi housing arranged and adapted to support a test paper in spaced relationship from the exhaust side of said Venturi throat and in

a plane perpendicular to the longitudinal axis of flow through said Venturi throat whereby lubricant carrying fluid passing through said Venturi throat impinges upon said test paper.

4. In a lubrication indicator of the class described the combination comprising conduit means arranged and adapted to supply lubricant carrying fluid under pressure from an engine, a pressure reduction jet disposed in said conduit means, support means arranged and adapted to support a test paper in spaced relationship from said pressure reduction jet and in a plane perpendicular to the longitudinal axis of flow through said pressure reduction jet, whereby lubricant carrying fluid passing through said pressure reduction jet impinges on said test paper, and means arranged and adapted to vary the spaced relationship between said test paper support and said pressure reduction jet over a predetermined range.

5. In a lubrication indicator of the class described the combination comprising conduit means arranged and adapted to supply lubricant carrying fluid under pressure from an engine, a three-way valve in flow communication with said conduit means, an exhaust conduit in flow communication with a second port of said valve, a Venturi housing including a Venturi throat in flow communication with the third port of said valve, test paper support means, structural support means supporting said test paper support in spaced relationship from said Venturi

housing and in a plane perpendicular to the longitudinal axis of flow through said Venturi throat, and a support member slidably mounted on said Venturi housing and supporting said structural support means, said support member being arranged and adapted for sliding movement along the longitudinal axis of said Venturi housing over a predetermined range.

6. The combination according to claim 5 including a pressure reduction jet demountably positioned in the Venturi housing on the intake side of the Venturi throat.

7. The combination according to claim 5 including a pressure reduction jet mounted in the Venturi housing and forming a part of the Venturi throat.

8. In a lubrication indicator of the class described the combination comprising a Venturi housing including a Venturi throat therein, conduit means arranged and adapted to supply lubricant carrying fluid to said Venturi housing under pressure, pressure reduction jet means positioned in said Venturi housing between said conduit means and said Venturi throat, and support means arranged and adapted to support a test paper in spaced relationship from the exhaust side of said Venturi throat and in a plane perpendicular to the longitudinal axis of flow through said Venturi throat, whereby lubricant carrying fluid passing through said Venturi throat impinges upon said test paper.

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