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APPENDIX A

Copy of Reference # 2

Ultrasonic Arrays' DMS-1000 Detects Missing Connecting Rod Bearing Inserts

13 October 1997

Ultrasonic Arrays' DMS-1000 Detects Missing Connecting Rod Bearing Inserts

WOODINVILLE, Wash., Oct. 13 /PRNewswire/ -- Ultrasonic Arrays, Inc., has introduced a precise, non-contact, ultrasonic measurement system for use in detecting missing connecting rod bearing inserts on-line at engine manufacturing plants.

The DMS-1000 Connecting Rod Bearing Detection System ensures that engines with missing inserts will be detected prior to hot test. When installed at the torque to turn station, the DMS-1000 inspects for missing inserts with unprecedented accuracy and reliability by measuring the length of the piston stroke for each cylinder, comparing it to a standard, and automatically passing or failing the engine based on stroke measurement.

The Ultrasonic Arrays' sensors are installed at the existing torque to turn station. Only minor station modifications are necessary, since there are no moving parts. The only requirement is for the sensors to have a clear line of sight to the piston faces or connecting rod end caps.

The DMS-1000 solves one of the largest quality problems in modern automotive engine plants, that of engines being assembled with the connecting rod bearings missing. If the missing bearing remains undetected until hot test, at the end of the assembly process, it is very expensive to correct. The engine oil must be drained and the engine completely torn down, repaired, reassembled, and retested. If the missing connecting rod bearing gets out of the plant and installed in a car, premature and catastrophic engine failure will result. Ultrasonic Arrays non-contact Connecting Rod Bearing Detection System will eliminate this problem.

The DMS-1000 is a completely non-contact system. Since the sensors are permanently mounted out of the way of the engine, there is no need for them to be indexed into position as each engine is presented. Engineered for industrial environments, it employs its own external reference to compensate for environmental changes, and is completely self-calibrating. Ultrasonic Arrays' non-contact, ultrasonic measuring systems are unaffected by surface color, texture, temperature, reflectivity, or lighting, and are significantly more accurate than contact, optical, or laser systems.

"This system is providing a reliable means of ensuring that each engine manufactured in our plant has been inspected," said Mike Bartkowiak, Control Engineer for General Motors Powertrain in Flint, Michigan. "Missing inserts can happen frequently on the assembly line; however, this system inspects for and eliminates these problems while saving time and money," he added.

Ultrasonic Arrays manufactures and distributes measurement systems for a variety of industries and applications and works with systems ingetrators and end-users to develop systems solutions to measurement problems.

SOURCE Ultrasonic Arrays Inc.

News Archives: [13 October 1997] [October 1997] [All Articles]

APPENDIX B

Copy of Reference # 7

READY REFERENCE

Lubricant Additives

Very little unadditized mineral oil is sold as a lubricant. Almost all commercial lubricants contain additives to enhance their performance in amounts ranging from less than 1% to 25% or more. By far the largest market for such additives is in the transportation field, including additives for engines and drivetrains in cars, trucks, buses, locomotives and ships. The function of additives can be summarized as:

- Protect metal surfaces (rings, bearings, gears, etc.)
- Extend the range of lubricant applicability
- Extend lubricant life

The same general range of additive types find application in other fields; for example, industrial lubricants, along with materials designed to impart specific properties such as:

- Emulsifiers
- Demulsifiers
- Tackiness agents
- Bactericides
- Gelling agents (for greases)

To be acceptable to blenders and end users alike, additives must be capable of being handled in conventional blending equipment, stable in storage, free of offensive odor, and nontoxic by normal industrial standards. Because many are highly viscous materials or actual solids, they are generally sold as concentrated solutions in diluent oil (HVI 100 Neutral or similar).

Surface Protective Additives — Automotive Lubricants

Additive Type	Purpose	Typical Compounds	Functions

Antiwear and EP Agent	Reduce friction and wear and prevent scoring and seizure	Zinc dithiophosphates, organic phosphates, acid phosphates, organic sulfur and chlorine compounds, sulfurized fats, sulfides and disulfides	Chemical reaction with metal surface to form a film with lower shear strength than the metal, thereby preventing metal-to-metal contact
Corrosion and Rust Inhibitor	Prevent corrosion and rusting of metal parts in contact with the lubricant	Zinc dithiophosphates, metal phenolates, basic metal sulfonates, fatty acids and amines	Preferential adsorption of polar constituent on metal surface to provide protective film, or neutralize corrosive acids
Detergent	Keep surfaces free of deposits	Metallo-organic compounds of sodium, calcium and magnesium phenolates, phosphonates and sulfonates	Chemical reaction with sludge and varnish precursors to neutralize them and keep them soluble
Dispersant	Keep insoluble contaminants dispersed in the lubricant	Alkylsuccinimides, alkylsuccinic esters, and mannich reaction products	Contaminants are bonded by polar attraction to dispersant molecules, prevented from agglomerating and kept in suspension due to solubility of dispersant
Friction Modifier	Alter coefficient of friction	Organic fatty acids and amides, lard oil, high molecular weight organic phosphorus and phosphoric acid esters	Preferential adsorption of surface-active materials

Performance Additives — Automotive Lubricants

Additive Type	Purpose	Typical Compounds	Functions
Pour Point Depressant	Enable lubricant to flow at low temperatures	Alkylated naphthalene and phenolic polymers, polymethacrylates, maleate/fumerate copolymer esters	Modify wax crystal formation to reduce interlocking
Seal Swell Agent	Swell elastomeric seals	Organic phosphates and aromatic hydrocarbons	Chemical reaction with elastomer to cause slight swell
Viscosity Modifier	Reduce the rate of viscosity change with temperature	Polymers and copolymers of olefins, methacrylates, dienes or alkylated styrenes	Polymers expand with increasing temperature to counteract oil thinning

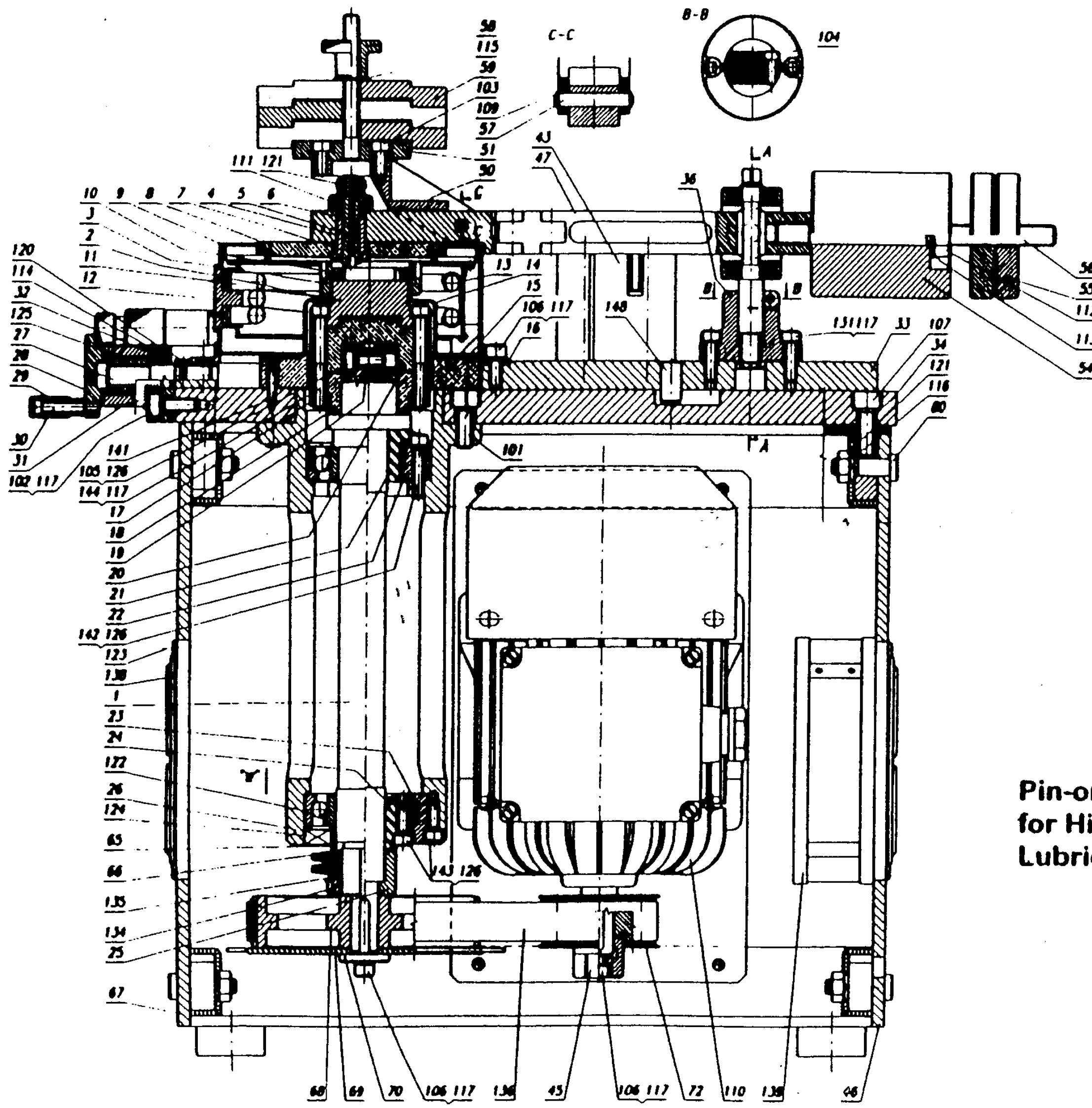
Protective Additives — Automotive Lubricants

Additive Type	Purpose	Typical Compounds	Functions
Antifoamant	Prevent lubricant from forming a persistent foam	Silicone polymers, organic copolymers	Reduces surface tension to speed collapse of foam
Antioxidant	Retard oxidative decomposition	Zinc dithiophosphates, hindered phenols, aromatic amines, sulfurized phenols	Decompose peroxides and terminate free-radical reactions
Metal Deactivator	Reduce catalytic effect of metals on oxidation rate	Organic complexes containing nitrogen or sulfur, amines, sulfides and phosphites	Form inactive film on metal surfaces by complexing with metallic ions

APPENDIX C

Technical Specifications of T-11 (Pin-on-disk Machine)

DESCRIPTION		PARAMETERS
1	Standard Loads, N	5-100
2	Temperature Range, °C	20-350
3	Disk dimensions, mm - diameter - thickness	 25.4 (1") up to 10
4	Pin diameter	1/8" and 1/4"
5	Pin and disk materials used for tests	any solid
6	Wear track radius, mm	6-10
7	Rotation speed, rpm	50-1600
8	Sliding velocity, m/s	0.1-1
9	Liquid lubrication	yes
10	Vapor phase lubrication	yes
11	Test chamber and specimen holder materials	stainless steel
12	Other features - Automatic switch-off - Safety stop	 yes yes
13	Measurements	friction force linear wear bulk temperature ball holder temperature sliding velocity
14	Data acquisition and computer control system software included	yes
15	Custom design option	yes
16	Delivery time	by the end of November 1996



Pin-on-Disk Machine
for High Temperature Liquid/Vapor
Lubrication Studies