

### DYNAMIC LOAD SLIDING CONTACT TRIBOMETER AND METHOD TO SIMULATE WEAR THEREWITH

#### IITM Technology Available for Licensing

##### Problem Statement

- Appearance of white etching area followed by white etching cracks (WECs) formation is observed as a **dominant mode of premature failure** in rolling element bearings of wind turbine gearboxes, automobiles, vertical roller mills of cement industry and other components.
- In this instance a few patent literature discussed a few remedies however said prior arts includes the limitations as **lack of cyclic loading to reproduce service conditions of bearings, large number** of contact cycles required (>10 million cycles), **difficulty** in determining WEC in a large specimen.
- Hence, there is a need to mitigate above challenges & provide efficient solution.

##### Technology Category/ Market

**Technology:** Simulate accelerated wear of mating steel components;

**Industry:** Manufacturing, Instruments;

**Applications:** : Manufacturing, Instruments;

**Market:** The global Tribometer market is projected to **\$1.48B** by **2030**, at a **CAGR** of **4.5%** during 2023-2030.

##### Intellectual Property

**IITM IDF Ref.:**1568; **IN Patent No.** 386008

##### TRL (Technology Readiness Level)

**TRL- 4: Technology validated in Lab**

##### Research Lab

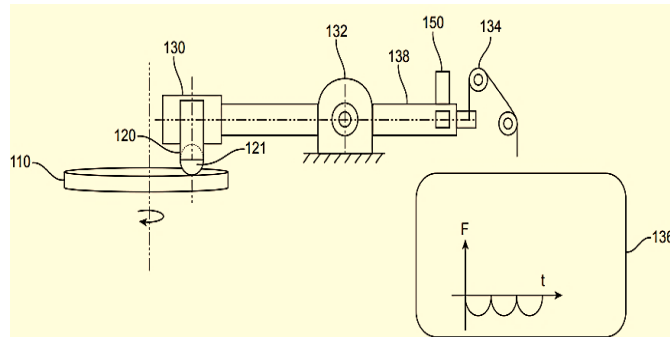
**Prof. Ramkumar P, Advanced Tribology Research Lab,** Dept. of Mechanical Engineering

##### Technology

- Present Patent discloses a **dynamic load sliding contact tribometer** configured to simulate accelerated wear of mating steel components.

- Further the said dynamic load sliding contact tribometer comprises a **motor-powered rotatable disc sample** configured to operate at a predetermined speed of rotation; a **pin holder** configured to hold a pin sample in sliding contact with the disc sample; & a **cyclic load generator** configured to transfer a cyclic load to the pin sample via a lever arm & generate a contact pressure.
- The lever arm having a **first end** & a **second end**, & **pivoted** at a fixed **hinge** located therebetween, the **first end** connected to the **pin holder** & the **second end connected** to the cyclic load generator.
- Further, the wear of **the disc** or the **pin sample** is adjustable by varying a **maximum pressure (upto 4GPa) generated** at the cyclic load generator. The **load cycling** is variable in the range of **1-60Hz**.
- Further, tribometer comprises a linear variable **differential transducer** configured to measure combined **wear depth** of the pin with reference to the disc sample.
- A method of **simulating accelerated wear** on a steel sample due to **Hydrogen - induced white etching** area formation using a pin-on-disc tribometer shown in flowchart.

##### Image



**Fig.1:** Illustrates side view of a tribometer.

##### CONTACT US

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**IITM TTO Website:**

<https://ipm.icsr.in/ipm/>

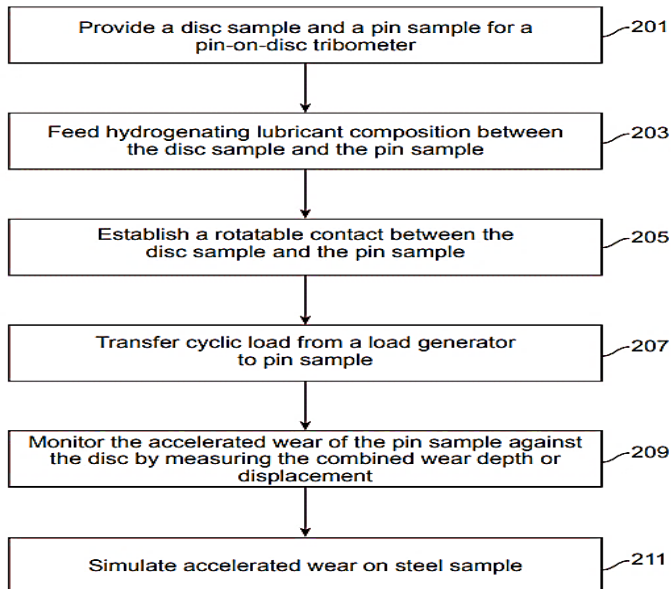
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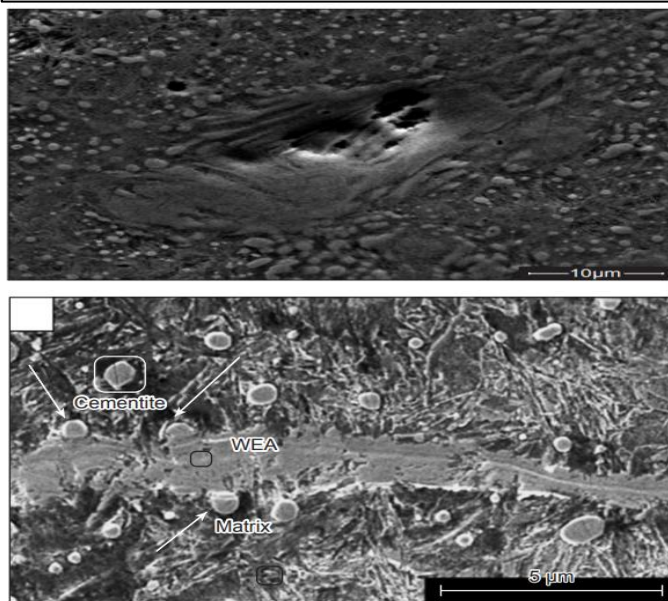
### Flowchart

**FIG.2:** depicts a flowchart of a method of simulating accelerated wear on a steel sample using a tribometer



### Experimental Results

**FIG. 3** depicts the SEM image of WEA formation due to cementite dissolution. Fig 4 depicts the EDS image of WEA formation due to cementite dissolution.



### Key Features / Value Proposition

#### ❖ Technical Perspective:

- ❖ The **pin** and the **disc samples** are of **bearing steel** and **accelerated wear** is indicated by **cementite phase dissolution** & **formation of white etching area (WEA)** in the subsurface of the **pin sample** or the **disc sample**.
- ❖ The **WEA** is **obtained** in a **test duration** of **40 h or less**.
- ❖ The **accelerated wear** is **obtained** in  $3 \times 10^5$  contact cycles or less.
- ❖ The sample includes a **gear, roller bearing element, or a ball bearing element**.

#### ❖ Industrial Perspective:

- ❖ Applicable in **Instrumentation** Industries, **Manufacturing** Industries. (Refer result shown in Table.
- ❖ Test rig used in the various studies and the typical contact cycle to **create WEA/WECs** as given in Table.

**Table 1**

No	Test rig	Number of cycles to form WEA/WECs
1	FE8 test rig	$1 \times 10^7$
2	RDM	$38 \times 10^7$
3	Two roller test rig	$4,2 \times 10^7$
4	Pre-hydrogenation and two roller tester	$40 \times 10^6$
5	<b>This invention</b>	$2,15 \times 10^5$

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