Lubrication failures in wire drawing

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The principle and design of an instrument to detect lubrication failures and tearing by no-contact measurement of the electrical resistance between the wire and the die was published in the November 1984 issue of 'Wire Industry'. The principle was discussed assuming electrical insulating lubricants were used. This article describes tests using molybdenum soaps having some electrical conductivity. The ability to detect small defects is also discussed.

A third report covering data acquisition and signal analysis to evaluate lubricants, die wear and wire quality is planned for Autumn 1985.

Measurements of electrical properties have been used to measure lubricant film thickness in bearings and gears, ref 1 and 2. Measurements of the electrical resistance between a wire and a die was used by Felder, ref 3, in experimental studies of film thickness in wire drawing. Felder measured the resistance in a range above the kohm level, although the existence of hydrodynamic lubrication was detected.

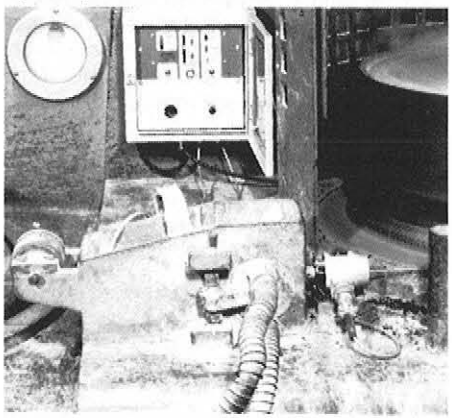


Fig 1 The lubrication failure detector consists of an exciter and transducer mounted to the die holder and a detector unit near the drawing machine

Nilsson and Stenlund, ref 4, developed a method to measure the near zero resistance between the wire and the die without contacting the wire, see Figures 1 and 2a. The method was used successfully to perform an automatic stop of the drawing machine when tearing was detected.

This article reports upon the use of electrically conductive lubricants and the detection and recording of small defects. Field trials from the drawing of carbon steel wire are also reported.

Using electrically conductive lubricants

If the lubricant is an electrical insulator the impedance, that is approximately the resistance, is related to the non-lubricated surface area as shown in the diagram, Figure 2a. Electrically conductive lubricants must have a much higher resistivity than the material of the wire and the die. The diagram in Figure 2b shows the typical relation when using a molybdenum soap lubricant together with pickled and borax treated wire. Soap lubricant together with Natrium-sulphate treated Kanthal and Nikrothal wires show about the same relations.

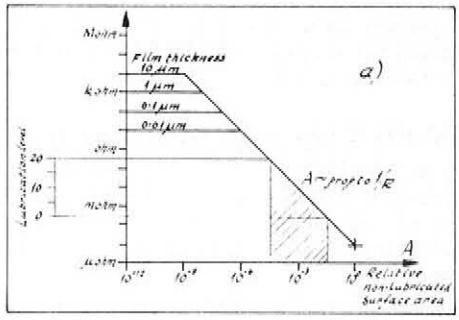
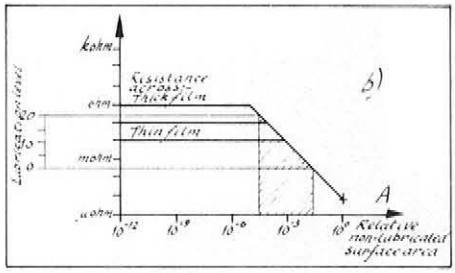


Fig 2 Diagrams showing the estimated relations between impedance (ie resistance) and non-lubricated surface area. (a) non-conductive lubricant (b) lubricant having some conductivity such as molybdenum soap



Detection of small defects at high speeds

The standard version of the detector has a time constant of 1 ms, permitting full scale deflection in 7 ms, see Figure 3.

Visual observation of fast events at the lubrication display, requires each individual LED (light emitting diode) to be illuminated for 2 ms or more, ie full scale deflections more than 9 ms will be visible.

The 1000:1 dynamic range complicates strip chart recordings of the lubrication signal. Scale compression must be arranged either through a compression network or dual channel recording using different ranges, eg 10 and 1 Volt. Reliable recordings of short events require a frequency response in Herz, being the inverse of the duration. Commonly available high frequency pen recorders performing at 50 to 100 Hz are not suitable for detecting

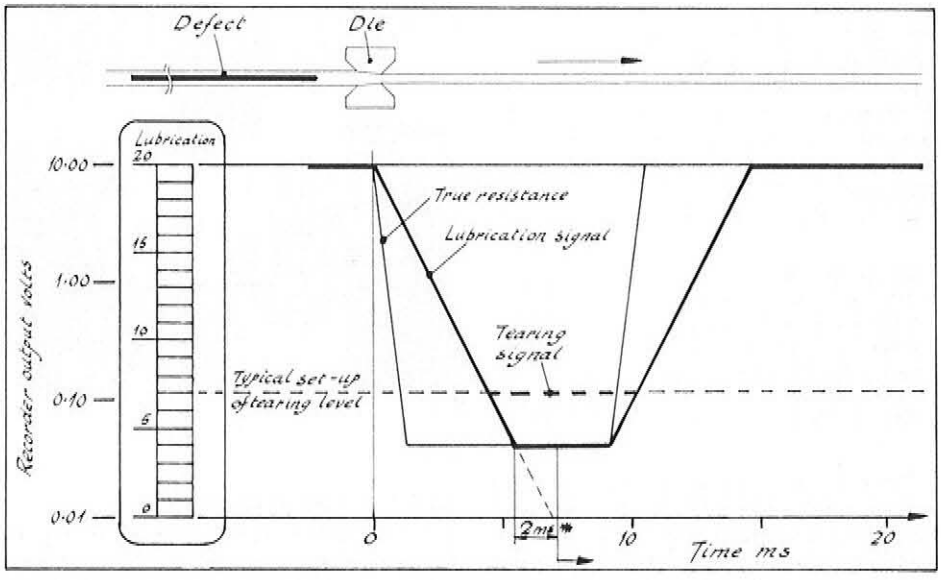


*Fig 3 The detector response is a few milliseconds. *A LED (light emitting diode) illuminated more than 2 ms will be visible to the human eye*