Coin Sensor Endurance Test

(Abridged test data from R H Brown, Pennwalt Piezo Film Ltd, Apr/May 90)

Introduction

The sensor under discussion was a custom-produced 28 µm PVDF film laminated with 125 µm polyester on one side, very similar in construction to current production element LDT0-028K (MSI part number 0-1002794-1) with the exception of slightly different active area, and connection method. The sensor was designed to be mechanically clamped at the lead-attachment site, so that a deflection of the tip of the cantilever structure would result in significant strain on the PVDF film. The sensor was introduced into the path of coins ejected from a mechanism, and the function of the sensor was to provide a reliable count. The electrodes on the PVDF film comprised printed silver ink patterns, with one side bearing a through-hole to allow two connection pads to be formed on a single surface of the sensor. These pads were held against corresponding copper traces on a printed circuit board by two rivets, passing through an insulating clamping strip which also served to define the active bending length of the cantilever. The printed circuit board carried a simple op-amp network which generated a fixed-width pulse output for each trigger signal generated by the piezo film sensor. The op-amp output finally drove a MOSFET, to allow interfacing to control electronics as if the coin sensor acted entirely as a conventional switch.

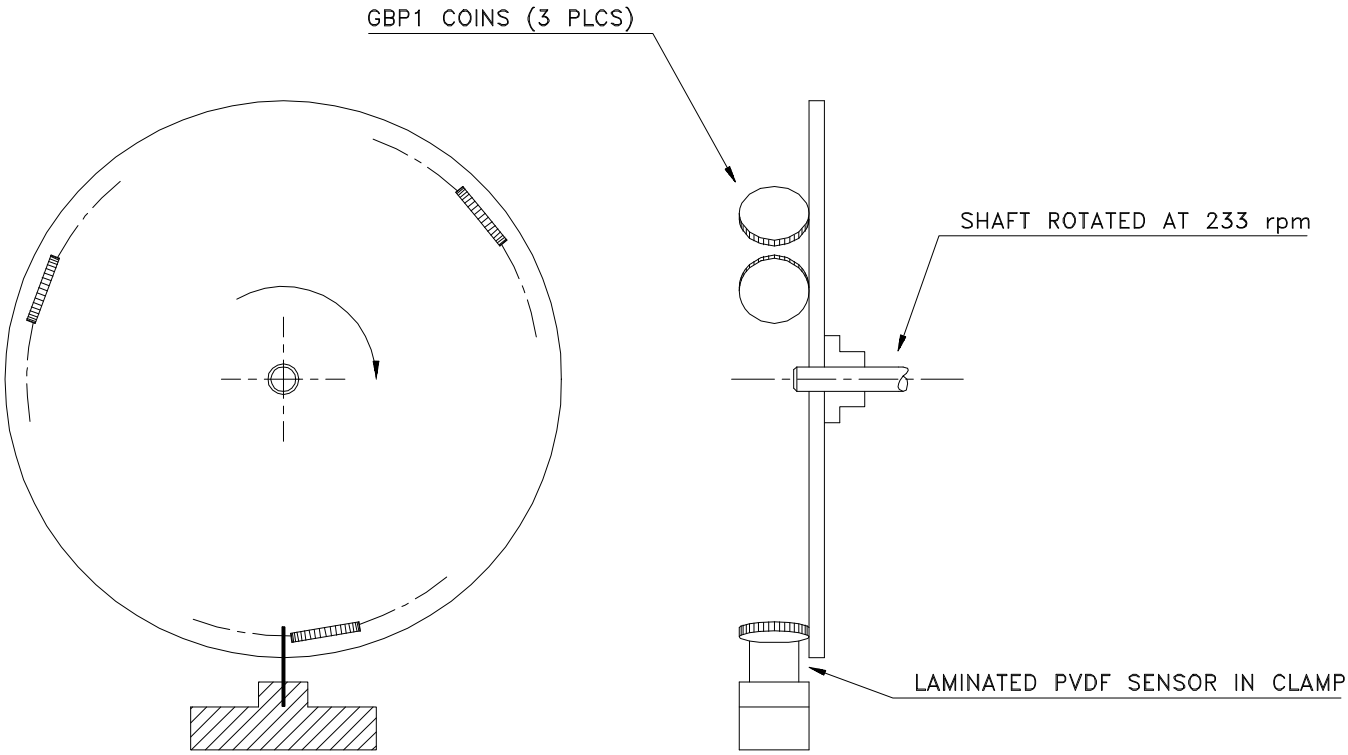
The system formed a means to verify the payout of a gaming machine. Such independent verification is required by law in certain countries (e.g. Netherlands).

Description of Test Set-up and Procedure

Three typical coins (UK £1) were bonded at their edges to a rotating disc assembly at a radius of 83 mm. The sensor under test was clamped to its correct operating length so that the coins impacted near the tip of the bending element. The polyester laminate served two purposes: it displaced the PVDF element away from the neutral axis of bending, and also served as a wear surface to prevent abrasion of the silver ink electrodes. The disc was rotated by a motor and gearbox, set to 233**a** rpm, giving 700 impacts per minute to the sensor (0.086 s period between impacts). This speed was selected after examination of the voltage output from the sensor, which showed an initial positive peak from the first contact with the coin, followed by a negative-going pulse and decaying oscillation as the coin passed and released the beam, with accompanying mechanical oscillation.

A counter driven directly by the sensor output was used to check the number of impacts recorded against the calculated total. The waveform at start of testing was recorded on a digital storage oscilloscope, and compared with the waveform after 12 days of testing (12.2 million cycles). No perceptible change had occurred. Visually, the sensor had taken a slight mechanical set (minor deformation in the direction of coin travel), and some slight scratching was observed on the polyester laminate. Despite the mechanical deformation, the output waveform was unaffected (since the piezo film output depends only on the change in deflection and not on the absolute position of the sensor in space). The test was stopped at this stage as the customer requirements had been met successfully (> 1 million cycles) and the instrumentation was required for other efforts.

An outline drawing of the test apparatus is attached, together with the original waveform plots from start and end of test.



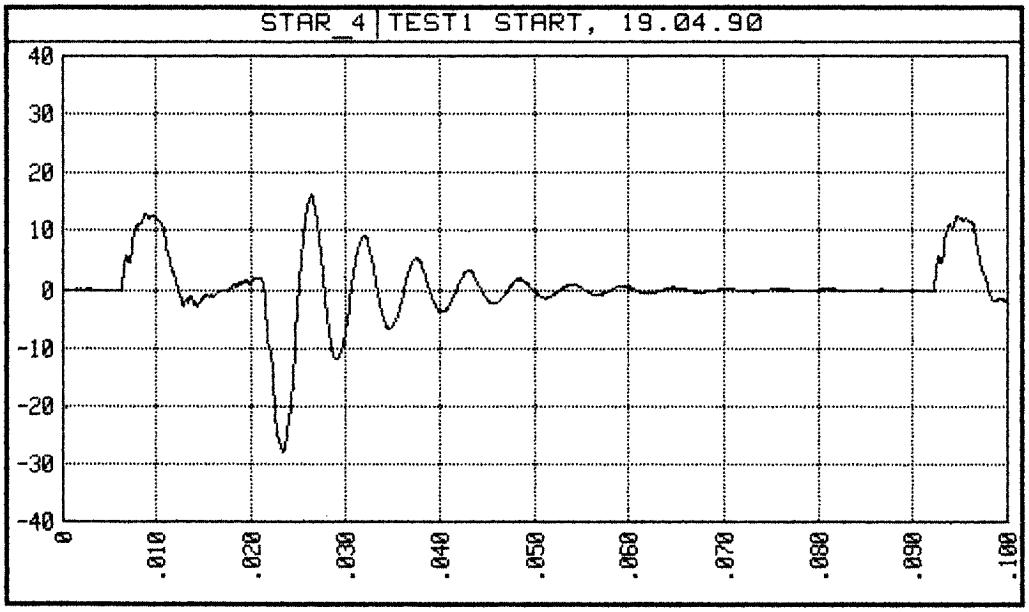
COIN SENSOR ENDURANCE TEST SET-UP

POLYESTER LAMINATED SURFACE RECEIVES IMPACTS
TEST STARTED 16:00 ON 19.04.90, STOPPED 17:45 ON 01.05.90

12,200,000 IMPACTS (700/min)

R H BROWN MEASUREMENT SPECIALTIES INC, SENSOR PRODUCTS DIVISION
REDRAWN 03.06.99

COINS 22.5 mm DIAMETER, 3 mm THICK, GLUED TO DISC WITH EPOXY RESIN
PVDF ELEMENT 26mm x 16mm OVERALL, 17mm x 15mm ACTIVE AREA
PVDF THICKNESS 0.028mm, POLYESTER LAMINATE 0.125mm
SENSOR OUTPUT FED DIRECTLY TO PHILIPS PM6672 COUNTER/TIMER
WAVEFORM MONITORED BY GOULD 4035 DIGITAL STORAGE OSCILLOSCOPE



MIN: -28 MAX: 16.45 Pk-Pk: 44.45

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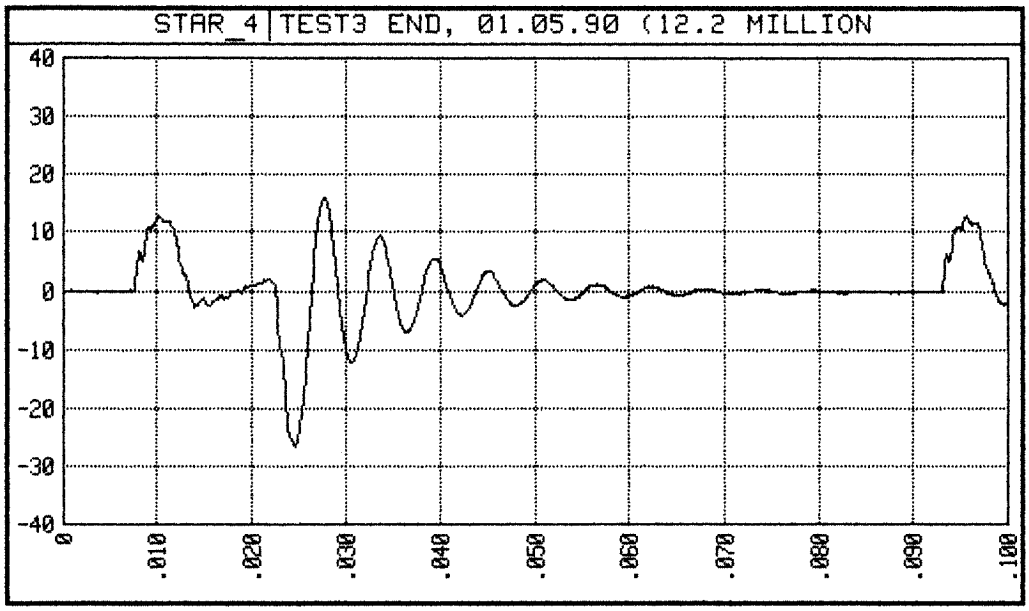

MIN: -26.6 MAX: 16.1 Pk-Pk: 42.7

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