UT Phased Array

- Concept from Philippe COPERET General & Technical Manager
- Speaker Serge CARRASCOSA Export Manager

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GOAL

Brand New UT Phased Array Testing System for Very Fast Tube & Pipe Production Lines:

- OCTG MARKET: Detection, through One 2D MATRIX Array Probe, of Longitudinal, Transversal and All Oblique Flaws, Internal & External, oriented every 5° over the 360° of large diameter tube in Rotation at up to 2.5 m/sec Circumferential Speed

- Detection, through four 2D SURROUDING Array Probes, of Longitudinal & Transversal Flaws, Internal & External, in High Precision Tube linear feeding lines at 24 m/mn Speed
How do we do that?

• FIRST WE HAVE DESIGNED A PULSER ABLE TO GENERATE MULTI-BEAMS WITHIN A SHOT THROUGH A UT MULTI-ELEMENT PROBE.

• THEN WE HAVE DEVELOPPED A REAL TIME DATA PROCESSOR ABLE TO DETECT AND CHARACTERIZE ALL UT ECHOES BACK FROM FLAWS.
FAAST Linear Pulser

Patented  WO 03029808
Pulser signal calculation

Settings fully independent per Angle:

- Frequency, Amplitude, Cycles
- Filters (Hamming, Hanning, etc...)
- Spatial Apodization

For each element of the probe, the composite pulser signal is the SUM of all signals calculated for each angle.
Conventional Phased Array Square wave pulser

One shot = One Angle
One shot = Multiple Angles with 1D Linear Probe
One shot = Multiple Angles with 1D Linear Probe
One shot = Multiple Angles with 1D Linear Probe
3D AUTOMATIC DELAY LAWS GENERATION WITH 2D MATRIX PHASED ARRAY PROBE FOR TUBE TESTING AND FLAW DETECTION IN ALL ORIENTATIONS OD & ID
PULSER SETTING UP WITH SUMMATION OF DELAY LAWS
FAAST II
APPLICATIONS
One shot = Multiple Angles with 1D Linear Array Probe
NO ROTATION OF TUBE

NO ROTATION OF PROBE

TUBE DIAMETER 15 – 50mm

TUBE THICKNESS 1.0 to 4.0mm

4 x BI-LINEAR RING PROBES
32x140E – 7.5 MHz

LONGITUDINAL & TRANSVERSAL FLAW DETECTION, ID/OD/CW/CCW

LINEAR SPEED OF TUBE
# 200mm/sec
BI-LINEAR ARRAY RING ACTIVE PROBE
32 x 140 Elements
Embedded Pulsers/Multiplexers/Preamplifiers
COMPLEMENTARY UT DIMENSIONAL MEASUREMENT E.ROTA SYSTEM TO FAAST II SYSTEM FOR FLAW DETECTION WITH 2D SURROUNDING ACTIVE ARRAY PROBE ON HIGH SPEED LINEAR FEEDING TUBE LINES
Reference Stainless/Titanium tubes:
Diameter 15 - 50mm
Thickness 1 - 4mm
Longitudinal Weld TIG/LASER OD/ID Notches:
¼” long - min 3mm
Depth 10%-min75µm

OR

Seamless tubes Zirconium/Stainless/Alloys......
ALTERNATIVE TO ROTARY HEADS

WITH

NO ROTATION OF TUBE

NO ROTATION OF PROBES

FAAST II FLAW & E.ROTA-12 DIMENTIONAL
ROTATING TUBE TECHNIQUE

SURFACE SPEED UP TO 2.5m/sec

2D MATRIX ARRAY ACTIVE PROBE
8x40E – 2.0 MHz
PITCH 29mm with Aperture 8x8E

MULTI-ORIENTED BEAMS
IN A SINGLE SPRAY (Patent)

ALL FLAWS OD/ID/CW/CCW DETECTED & PROCESSED WITHIN A SHOT:

- Longitudinal
- Transversal
- Oblique every 5° of orientation
2D MATRIX ARRAY ARRAY PROBE
8 x 40 Elements – 2MHz
Embedded Pulsers/Multiplexer/Preamplifier
2D MATRIX FOR ALL OBLIQUE FLAWS AND 1D LINEAR FOR WT & LAMINATION FLAWS
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2D MATRIX FOR ALL OBLIQUE FLAWS AND 1D LINEAR FOR WT & LAMINATION FLAWS
One A-Scan Acquisition & Display every 22.5° Reflector over 360° for Conventional Gate Monitoring.
2D MATRIX FOR ALL OBLIQUE FLAWS AND 1D LINEAR FOR WT & LAMINATION FLAWS
C-SCAN AMPLITUDE MAPPING REPRESENTATION OF 16 EXTERNAL NOTCHES EVERY 22.5° IN TUBE
C-SCAN AMPLITUDE MAPPING REPRESENTATION OF 16 INTERNAL NOTCHES EVERY 22.5° IN TUBE
# Extremity of Tube Inspection – 300mm

One 2D matrix for all oblique flaws and one 1D linear for WT & lamination flaws

<table>
<thead>
<tr>
<th>Tube Diameter (mm)</th>
<th>Tube Thickness (mm)</th>
<th>Surface Speed (m/s)</th>
<th>Number of Rotations per second (RPS)</th>
<th>UT Scanning Time Per Extremity (s)</th>
<th>Time for additional operations (s)</th>
<th>Global Inspection time per End (s)</th>
<th>PRODUCTIVITY (Tube End/hour)</th>
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FULL BODY INSPECTION – 13 meters
SIX (6) 2D MATRIX FOR ALL OBLIQUE FLAWS AND
Three (3) 1D LINEAR FOR WT & LAMINATION FLAWS

1. Gantry Support for longitudinal beam
2. Longitudinal beam with rack bar of 18 m long
3. Probe Module with socket and probe holder for Phased Array Probes
4. Inspection Unit
5. Cable runner
FULL BODY INSPECTION – 13 meters
SIX (6) 2D MATRIX FOR ALL OBLIQUE FLAWS AND
Three (3) 1D LINEAR FOR WT & LAMINATION FLAWS

3 Phased Array Probes per Module:
- 2 x 2D MATRIX
- 1 x 1D LINEAR
- Mechanical Pitch 58mm per Module
- Total Mechanical Pitch with 3 Modules: 174mm
FULL BODY INSPECTION – 13 meters
SIX (6) 2D MATRIX FOR ALL OBLIQUE FLAWS AND
Three (3) 1D LINEAR FOR WT & LAMINATION FLAWS

Inspection units in calibration position
**FULL BODY INSPECTION – 13 meters**

**SIX (6) 2D MATRIX FOR ALL OBLIQUE FLAWS AND Three (3) 1D LINEAR FOR WT & LAMINATION FLAWS**

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64 channel
Industrial PC Racks

MAIN FEATURES

- PATENTED PHASED ARRAY TECHNOLOGY
  FAAST II
- FULL PARALLEL SYSTEM
- UP TO 2048 CHANNELS
- MULTI-BEAM TRANSMISSION
  IN ONE SINGLE SHOT
  VIA MULTI-ELEMENT PROBES
- REAL TIME DATA PROCESSING
  AND MULTI-ASCAN DISPLAY
- LINEAR & SECTORIAL SCANNING
  WITH SINGLE OR MULTIPLE BEAMS
- COMPATIBLE WITH ALL TYPES OF
  MULTI-ELEMENT PROBES:
  1D LINEAR, 2D MATRIX, 2D CIRCULAR,
  2D SURROUNDING, ...
- COMPATIBLE WITH ACTIVE PROBES
  EMBEDDING ELECTRONICS: PULSERS,
  PREAMPS, MULTIPLEXERS.

ETHERNET LINK
Conclusion

1. FAST II is a UT phased array system especially designed for high speed production lines and able to replace more than 8 conventional phased array systems in parallel.

2. FAST II is compatible with standard multi element probes as well as with “active” probes with embedded electronics such as pulsers, preamp and multiplexer.

- Allowing the limitation of connectors when using a huge number of elements. Exemple with a 2D matrix array probe 128x8 elements and only 64 connectors.

- Solving impedance adaptation issues with 2D matrix probes.
The end

You may applause please

!!!!

Thank you