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Concentricity Determinations for Hollow Cylindrical Shapes Utilizing Resonant Energy

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a magnetic field quantum unit of about 0.1 G. The first striking result of this experiment is that quantization effects are manifested on a macroscopic scale. The second result is that the quantized unit is not $\frac{hc}{e}$ but $\frac{hc}{2e}$, thus implying that the quantized entity has charge $2e$.

We have said nothing about the considerable theoretical advances in the past few years. Most notable was the theory of Bardeen, Cooper, and Schrieffer (BCS) in 1957, which hinges on long range correlations between pairs of electrons to create the energy gap and to describe a current-carrying, lossless state. Thus, the flux quantization showing that the current-carrying entity has charge $2e$ is a striking experimental confirmation of the basic BCS pairing ideas.

The discussion above does not attempt to completely explain the phenomenon of superconductivity. Instead, some of the key experiments have been presented to display the most important aspects as we now understand them. A full explanation requires a thorough understanding of quantum mechanical processes in many-particle systems.

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Concentricity Determinations for Hollow Cylindrical Shapes Utilizing Resonant Energy¹

ROY L. BUCKROP

Abstract. The inner to outer diameter concentricity relationship of several long, hollow cylindrical shapes was determined by evaluating their wall thickness uniformity. This was accomplished through the utilization of the ultrasonic resonance gauging technique.

It is difficult, if not virtually impossible, to determine the inner to outer diameter concentricity relationship of long hollow cylindrical shapes, such as tubing, by conventional methods. For this reason the following is suggested.

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THEORY

It should be possible to determine the inner to outer diameter concentricity relationship of long hollow cylindrical shapes by gauging their walls for thickness uniformity. Any variation in wall thickness would indicate eccentricity. It has been found that specimen wall thickness can be determined nondestructively with only one side accessible by a resonant energy technique.

The specimen is made to resonate and the thickness determined from the relationship of resonant frequency, wave length, and velocity. When this system is operated near the fundamental frequency, its lowest resonant frequency, f_1 is equal to $v/2t$, where t is the specimen thickness and v is the longitudinal velocity of the vibration.

A continuous, wide-band frequency sweep is used to vibrate the specimen, and a means is provided for detecting resonance and presenting it on an oscilloscope screen. Each time the resonance frequency is passed the impedance in the electrical driving circuit becomes minimum, and this causes an increase of electrical load on the source. This change in electrical load is amplified and displayed on a cathode ray tube. A transparent scale, calibrated in thousandths of an inch and prepared for a specific material and thickness range, is placed in front of the cathode ray tube. Section thickness is interpreted directly from the transparent scale. A single line for the fundamental frequency is displayed by the cathode ray tube when the specimen thickness is one half wave length. Two or more lines for corresponding harmonics are displayed when the specimen thickness is equal to various multiples of one half wave lengths. Higher-order harmonic resonance frequencies, f_n , may be represented as $nv/2t$ where n is an integer. Test specimen thickness is then equal to $nv/2f_n$.

The fundamental frequency, f_1 , can also be obtained if the frequencies of two successive harmonics are found, since $f_1 = f_{(n+1)} - f_n$.¹ This value of f_1 is then set equal to $v/2t$, as explained above.

Scales are usually calibrated to read directly in thickness instead of frequency, since it is the thickness which is usually of interest.

Thin sections display fewer harmonic resonant lines than thicker ones, since for a given resonant frequency fewer half wave lengths will be divisible into a thinner section.

EQUIPMENT

The apparatus for this work consisted of an automatic ultrasonic resonance testing unit fitted with a special scale having .0005 inch division, extending over a thickness range of .410 to .470 inch. A 2 to 4 mc sweep oscillator was used to drive a 4.5

mc crystal transducer which was coupled to the test specimen with a light grease. Special calibration test blocks were made from the same material as the tubing being tested. Thickness tests were made on the tubing using the test blocks for reference.

CONCLUSION

The ultrasonic test results were confirmed by physical measurements and found to be accurate to .0005 inch for .4500 inch of specimen wall thickness. Thus the difficult operation of determining the inner to outer diameter concentricity relationship of a long hollow cylindrical shape was easily and accurately accomplished with ultrasonic resonant gauging.

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Solar Protons and Their Geophysical Effects

S. M. KRIMIGIS¹

Abstract. In this paper, a review of the present state of knowledge of solar particle emission is given, and the effect of this emission in geophysical phenomena is analyzed. It is pointed out that the particle emission can be categorized into (a) continuous plasma emission and (b) occasional emission of solar cosmic rays. The plasma emission mainly determines the shape of the magnetospheric boundary, whereas the cosmic ray emission accounts for the geomagnetic storms, intense aurorae, ionization of the upper atmosphere, and Forbush decreases in the primary cosmic radiation. In addition, some of the remaining fundamental questions to be investigated in the future are pointed out.

We shall begin by quoting a passage from "Stars and Atoms" of the famous British physicist, Sir Arthur Eddington. "In ancient days two aviators procured to themselves wings. Daedalus flew safely through the middle air and was duly honoured on his landing. Icarus soared upwards to the sun till the wax melted which bound his wings and his flight ended in fiasco . . . The classical authorities tell us, of course, that he was only 'doing a stunt'; but I prefer to think of him as the man who brought to light a serious constructional defect in the flying machines of his day.

"So, too, in science. Cautious Daedalus will apply his theories where he feels confident they will safely go; but by his excess of

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