DP-MS-88-2

APPLICATION FOR R&D 100 AWARD: THE UNWRAP SYSTEM

by

W. C. Mosley

E. I. du Pont de Nemours and Company
Savannah River Laboratory
Aiken, SC 29808

Award Banquet to be held in
Chicago, IL
September 22, 1988

This paper was prepared in connection with work done under Contract No. DE-AC09-76SR00001 with the U.S. Department of Energy.

NAME OF SUBMITTING COMPANY OR ORGANIZATION:

Parent company E. I. du Pont de Nemours & Company
Division or Subsidiary (if appropriate) Savannah River Laboratory
Address _____ City Aiken
State SC Zip 29808 Country USA Telephone 803-725-2404
If this is a joint entry, check here and provide details in question 10. / /

DESCRIPTION OF PRODUCT

1. **Brand Name:** THE UNWRAP SYSTEM

2. **What is entry ?:** A True-Color Tube Bore Inspection System

3. **Product's Primary Function:**

The UNWRAP SYSTEM produces undistorted, true-color images of bore surfaces of sections of small diameter tubes. It was developed as a nondestructive examination tool to determine if bore surfaces of stainless steel tubes are sufficiently smooth and clean for making high quality closure pinch welds.

The UNWRAP SYSTEM is shown in Figure 1. Components of the system are depicted in Figure 2 and listed in Table 1. Except for the positioner and the image system software that were developed at the Savannah River Laboratory, all other components are available commercially.

Color video images of a tube bore taken through a forward-viewing microborescope are digitized and stored sequentially by the computer-based image system as the positioner steps the tube axially along the borescope. Picture elements from a circle in each image are redisplayed as lines in an undistorted rectangular image. This final image is like the view one would obtain by

cutting the tube along one side and unwrapping it to reveal the flat inner surface. Histograms of red, green and blue images provide data for quantifying the condition of a tube bore surface and determining acceptability for pinch welding (see Figures 3 and 4). Images may be stored on magnetic disks for subsequent viewing and/or analysis.

4. Approximate Price

The UNWRAP SYSTEM was developed at government expense to support work sponsored by the United States Department of Energy and not for marketing. The approximate cost of components is $40,000.

5. Does this product provide significant improvements over existing products now on the market?

The UNWRAP SYSTEM provides significant improvements over existing products now on the market. A single image made with the UNWRAP SYSTEM shows the bore surface along a selected length of tubing. Borescopes interfaced with photographic cameras (such as those available from borescope manufacturers like Instrument Technology, Inc., Reichert Fiber Optics, Richard Wolf Medical Instruments Corp., and Olympus Corp.) require many photographs for coverage of a tube bore. Borescopes interfaced with closed circuit video cameras and recorders (also available from borescope manufacturers) require viewing of moving images to provide coverage of a tube bore.

6. Is this product a unique entry into the marketplace that is not directly competitive with existing products?

The UNWRAP SYSTEM is a unique entry into the marketplace because of the production of an undistorted, true-color image of the tube bore surface. See discussion #5 for descriptions of differences with existing products.

7. Describe the principal application(s) of this product

In addition to bore surfaces of small tubes, the UNWRAP system can be used for single-image nondestructive examination of other cylindrical inner surfaces such as heat exchangers, gun barrels, etc. Single images are more practical for storage and analysis than multiple or moving images.

8. Stage briefly why you feed that your product should be given and R&D 100 award. (What is it important to have this product?)

The UNWRAP SYSTEM deserves a R&D 100 Award because it introduces a new concept into the field of nondestructive examination using borescopes. Evaluation of a single, undistorted, true-color image of a tube bore surface is easier and more accurate than working with multiple or moving images.

---

* The information contained in this article was developed during the course of work under Contract No. DE-AC09-76SR00001 with the U.S. Department of Energy.

PRODUCT DEVELOPMENT

9. List the name and position of the inventor or principal developer of this product or process.
Name W. C. Mosley Position Research Staff Physicist
Co-developers: R. D. Kirkpatrick, W. A. Keeter, Jr., T. P. Martin, and E. R. Selden

10.a. Did submitting organization do research and/or development on this product?
All X Some _____ No _____

b. Did any other organization do research and/or development on this product?
Yes _____ No X If Yes, list name: _____

c. Is this a joint entry with above? Yes N/A No N/A If Yes, give name of contact person in that organization, mailing address, and telephone number.

_____

11. Do you hold any patents on this product? No
Have you any patents pending? No

12. Do others in the industry hold patents on this product or a similar product line?
Please specify. Not to our knowledge

Note: All data concerning development time and cost will be treated as confidential. This information is used in judging the entries and, without violating your confidence, in general summaries about the competition.

13. When did your firm start the development of this product? Month January Year 1985

14. When was this product first marketed or available for order? Month October Year 1987
(See instructions under "Eligibility".)

15. Approx. how many man-hours went into development of this product? 900

16. Approx. how much was the total development cost for this product? $ 90,000

Of this cost, what percent was for materials? 50 %; outside professional services? 0 %; salaries 50 %. Approx. what percent of the total development costs was federally funded? 100%

AFFIRMATION: I affirm that the foregoing information and all other information submitted as a part of, or supplemental to, this entry presents a fair and accurate representation of this product.

(signature) W C Mosley submitter
Entries that are not signed may be rejected.

17. This entry form is being submitted by:
Name (Mr., Ms., or Dr.) W. C. Mosley Position Research Staff Physicist
Company E. I. du Pont de Nemours Div. Savannah River Laboratory
Address _____ City Aiken State SC Zip 29808
Country USA Telephone 803 /725-2404 Ext _____

ENTRY DATA

Please complete all questions in this part. If entry wins an R&D 100 Award, detailed addresses will expedite our communications with your organization.

18.a. Who is the contact person in your organization to handle all arrangements on exhibits, banquet, and publicity?

Name (Mr., Ms., or Dr.) W. C. Mosley Position Research Staff Physicist
Company E. I. du Pont de Nemours Div. Savannah River Laboratory
Address _____ City Aiken State SC Zip 29808
Country USA Telephone 803 /725-2404 Ext _____

b. Chief executive officer (corporate or university president, government research center director, etc.)

Name (Mr., Ms., or Dr.) Edgar S. Woolard, Jr. Position President and Chief Executive Officer
Address Du Pont Building City Wilmington State DE Zip 19898
Country USA Telephone 302 /774-2707 Ext _____

c. Research director Dr. J. T. Lowe
Address Savannah River Laboratory City Aiken State SC Zip 29808
Country USA Telephone 803 /725-3422 Ext _____

d. Advertising manager N/A
Address _____ City _____ State _____ Zip _____
Country _____ Telephone _____ Ext _____

e. Public relations director J. C. Felder, Jr.
Address Savannah River Plant City Aiken State SC Zip 29808
Country USA Telephone 803 /725-3164 Ext _____

TABLE 1

COMPONENTS OF THE UNWRAP SYSTEM

MICROBORESCOPE
Instrument Technology, Inc.
Model 124300-5-F

FIBER OPTIC CABLE
Instrument Technology, Inc.
Model 125500

ILLUMINATOR
Instrument Technology, Inc.
Model 125020

CCTV ADAPTER
Instrument Technology, Inc.
Model 126070

CCTV COLOR CAMERA
Pulnix
Model TWC 54R/56R

STEPPING MOTOR
Unislide
Model M092-FD08

POSITIONER LEAD SCREW
Unislide
Model B4009BJ

MOTOR CONTROLLER
Unislide
Model 8313

IMAGE SYSTEM
IBM Industrial AT Computer
with IVG-120 Boards

VIDEO DISPLAY
Sony
Model PVM-1271-Q

VIDEO PRINTER
Hitachi
Model VY50A

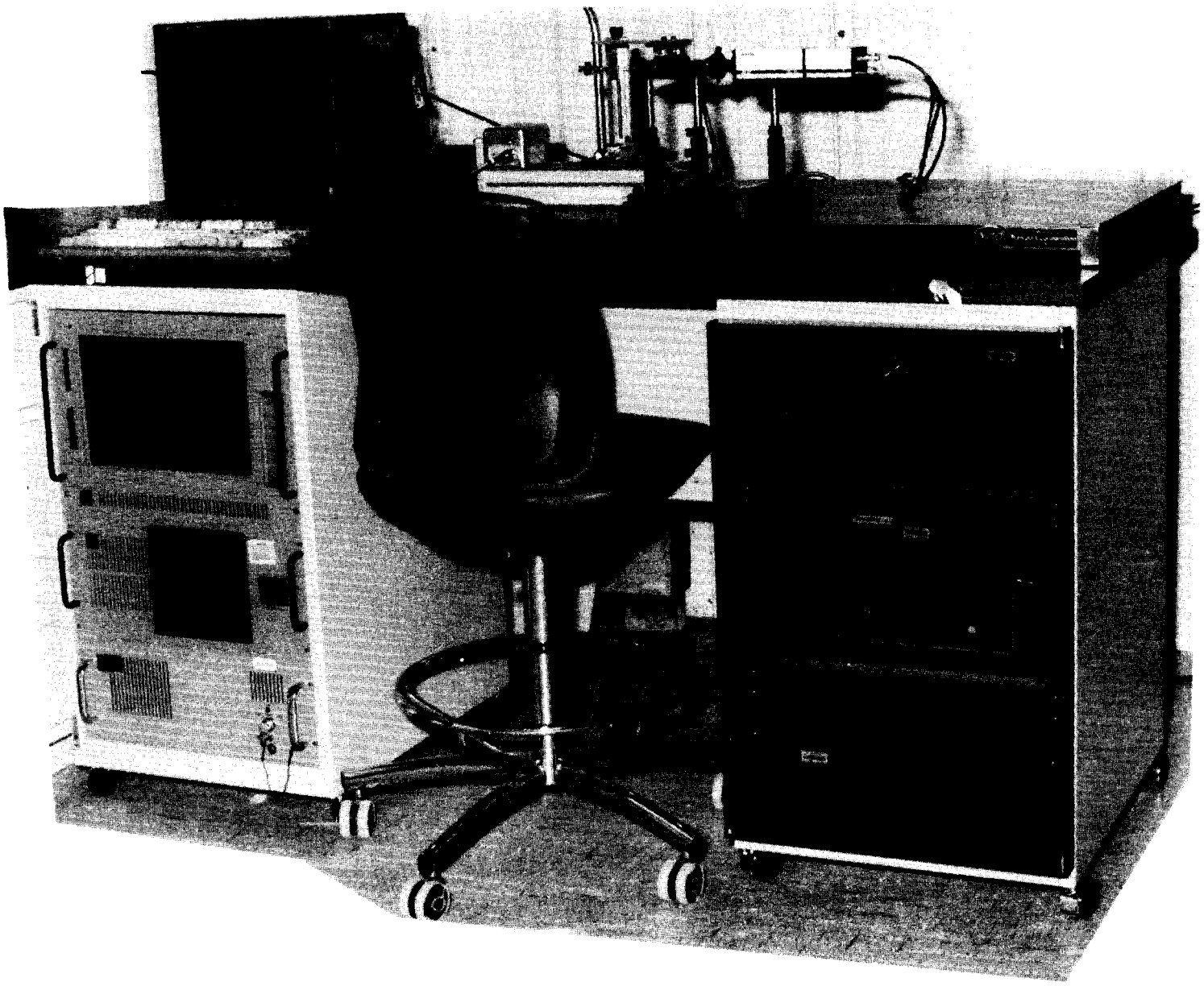

FIGURE 1. THE UNWRAP SYSTEM

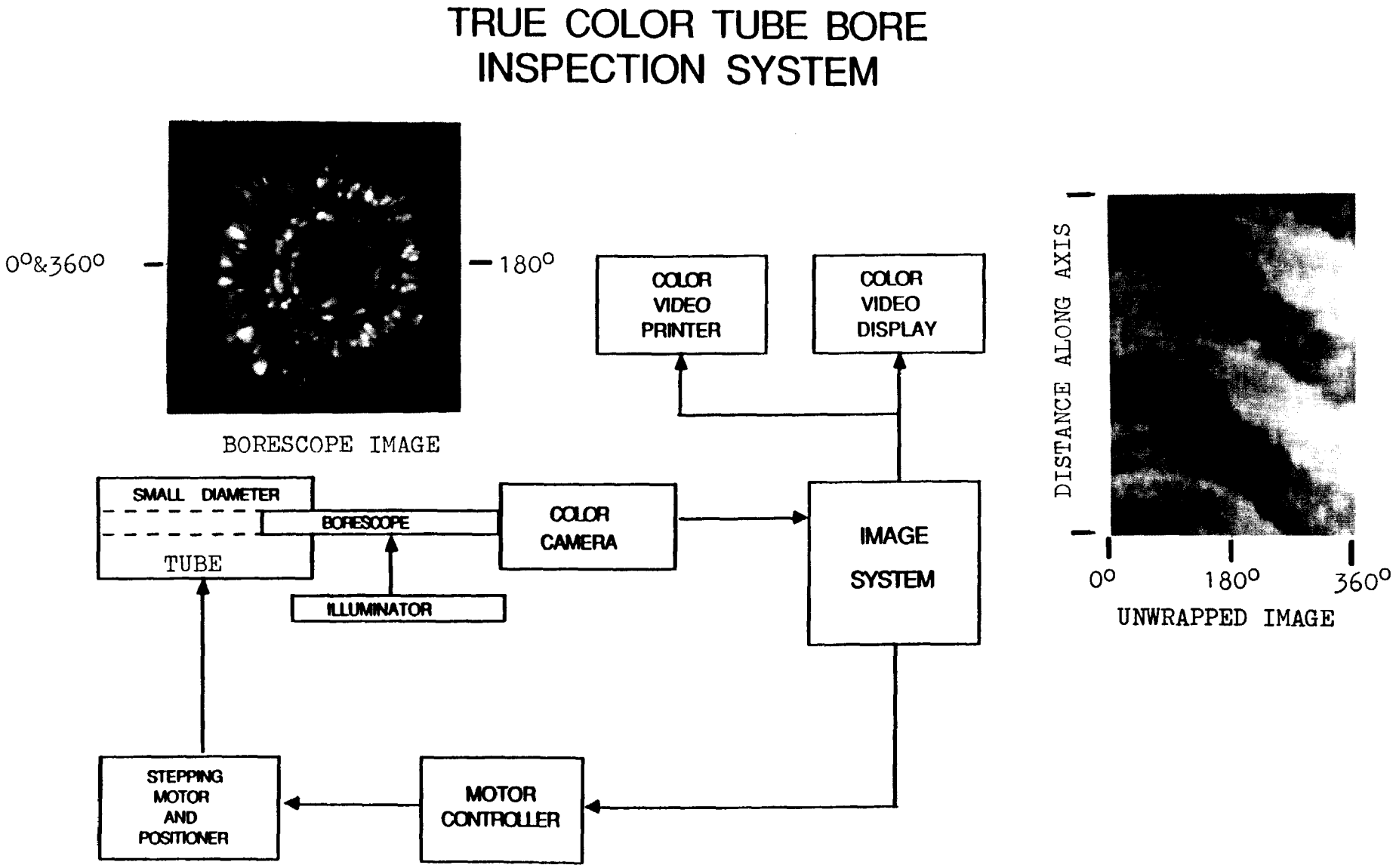

FIGURE 2. THE UNWRAP SYSTEM COMPONENTS

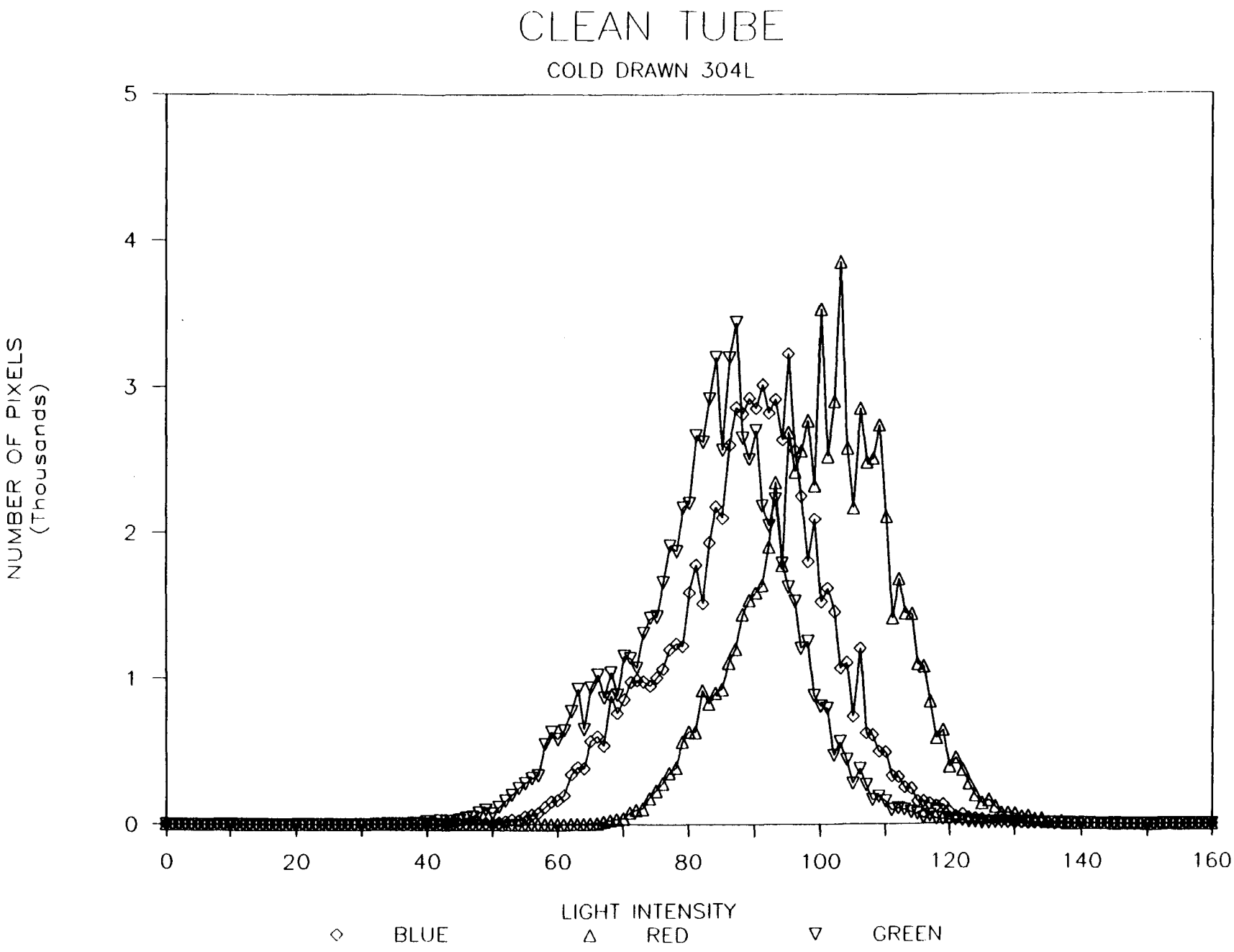

FIGURE 3. HISTOGRAMS OF COLOR VIDEO SIGNALS FROM A CLEAN TUBE

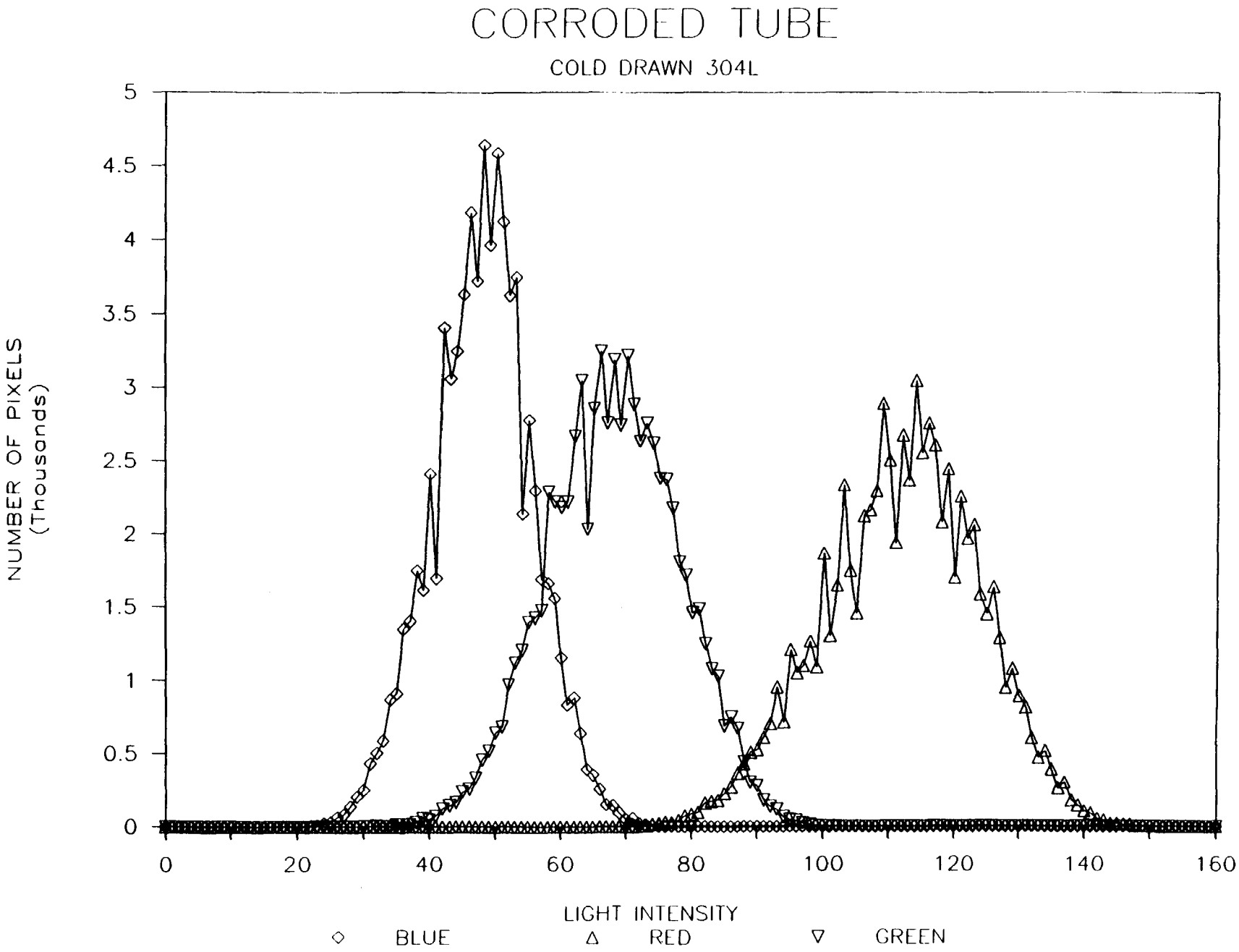

FIGURE 4. HISTOGRAMS OF COLOR VIDEO SIGNALS FROM A CORRODED TUBE