AUTOMATED ULTRASONIC WELD SCANNER AND RECORDING SYSTEM

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The Automated Ultrasonic Weld Scanner and Recording System has been developed by the Non-Destructive Testing Section of the Ship Department to ultrasonically examine butt and tee butt welds in structures varying from 0·5 to 5·0 inches (12 to 130 mm) the surface of which can be curved, flat or in any orientation.

The weld scanner is the only one of its type in the world and has been patented by the Ministry of Defence (Navy) in six countries.

Description of the Equipment

The equipment consists of an ultrasonic unit (weight 110 lb), a recording unit (weight 115 lb), a pneumatic carriage (weight 28 lb) and a vacuum system and accessories (weight 100 lb) as shown in FIG. 1.

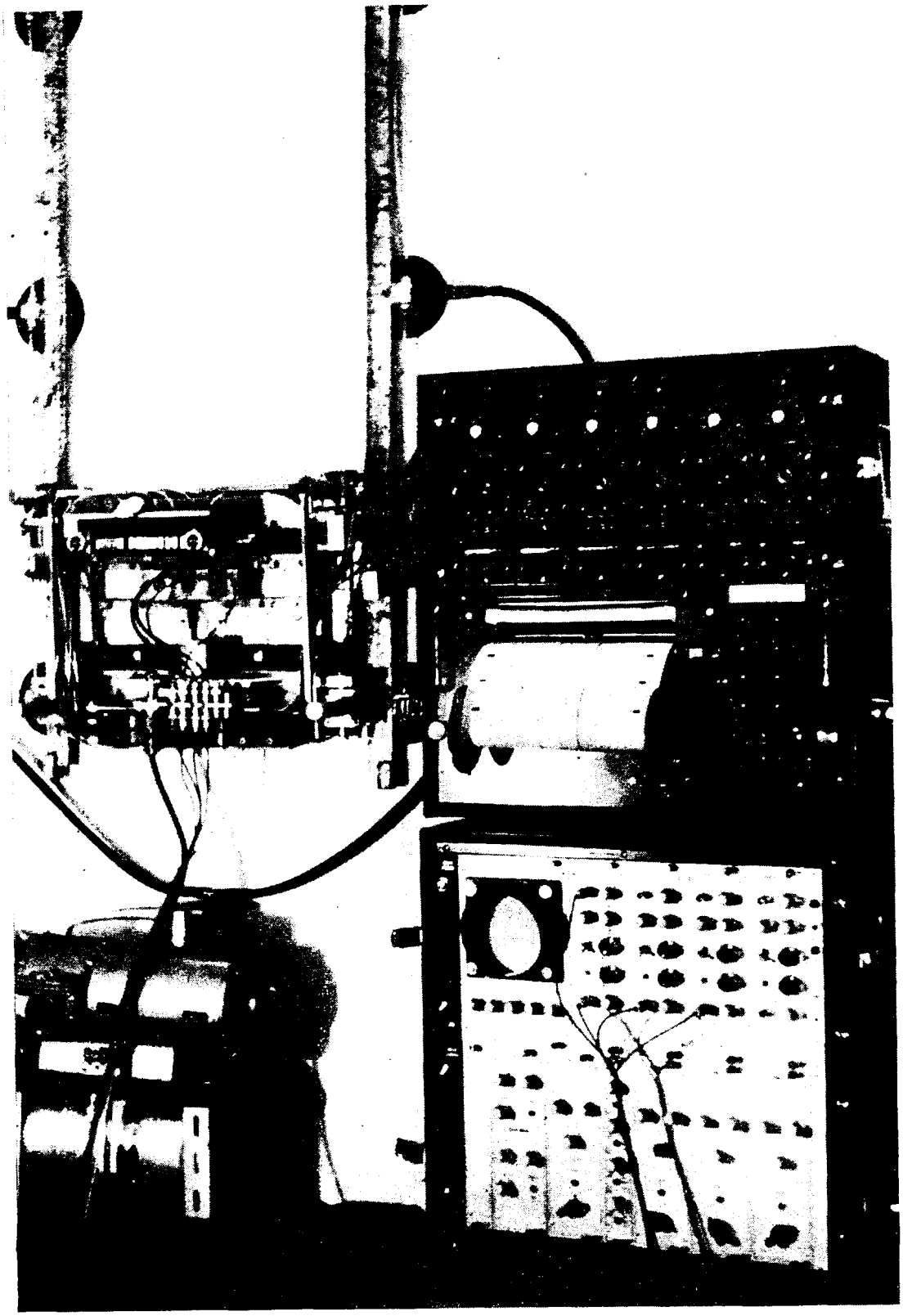

FIG. 1—THE COMPLETE SYSTEM

Pen recorder—top right, Ultrasonic unit—bottom right
Vacuum pump and reservoir—bottom left
Pneumatic carriage on the rails—top left

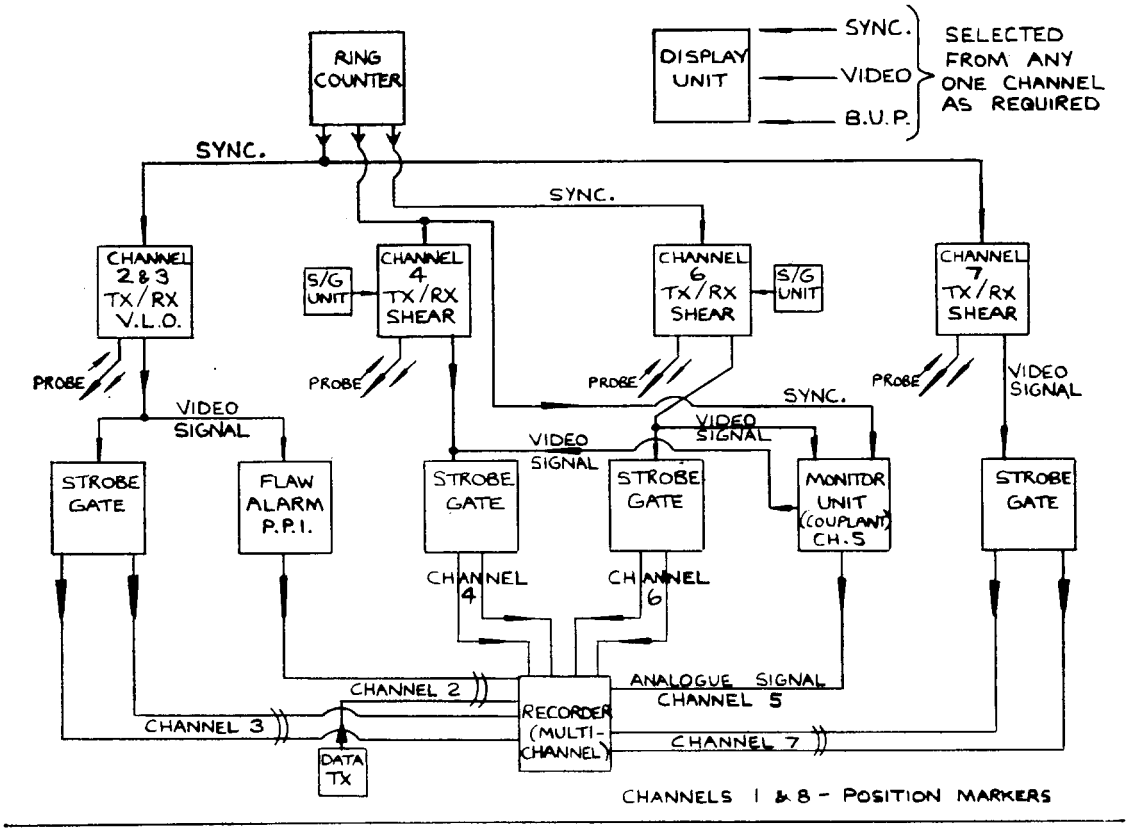

FIG. 2—AUTOMATED ULTRASONIC INSPECTION AND RECORDING SYSTEM

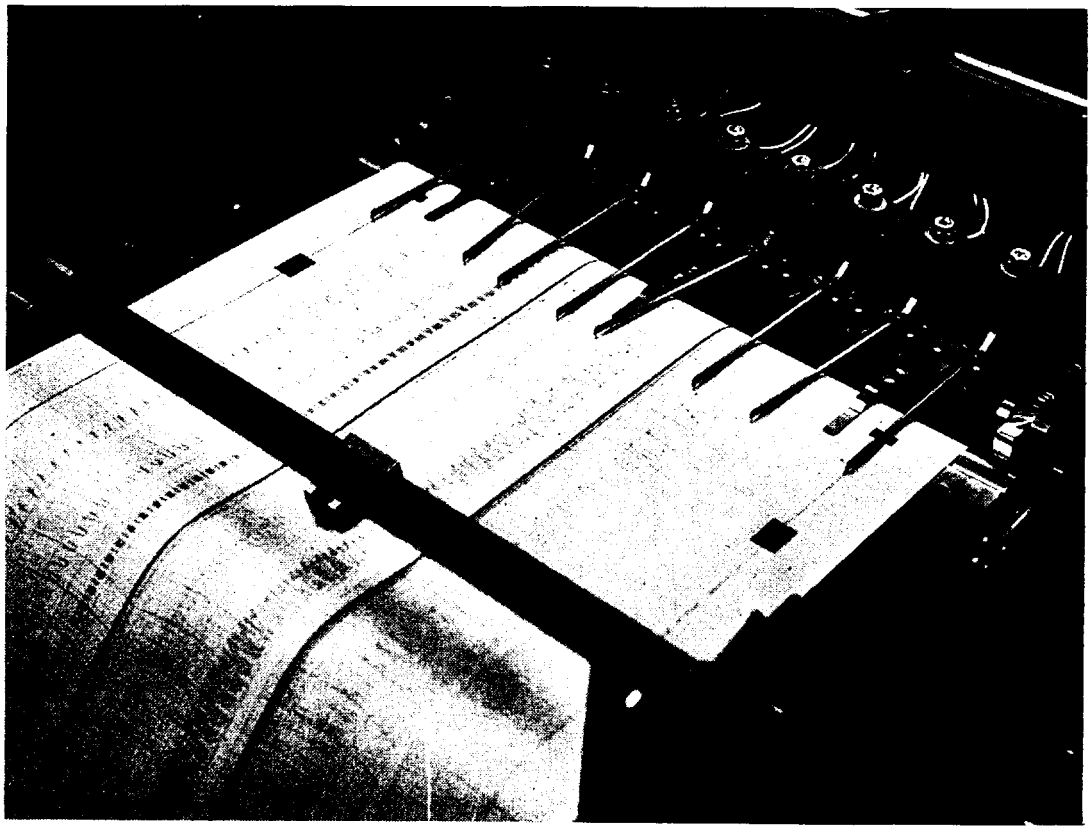

FIG. 3—PEN DECK

Pen 1 and 8—Event recorders (black rectangles at 12 in. datum marks)
Pens 2 to 7—Recorder weld details and defects therein

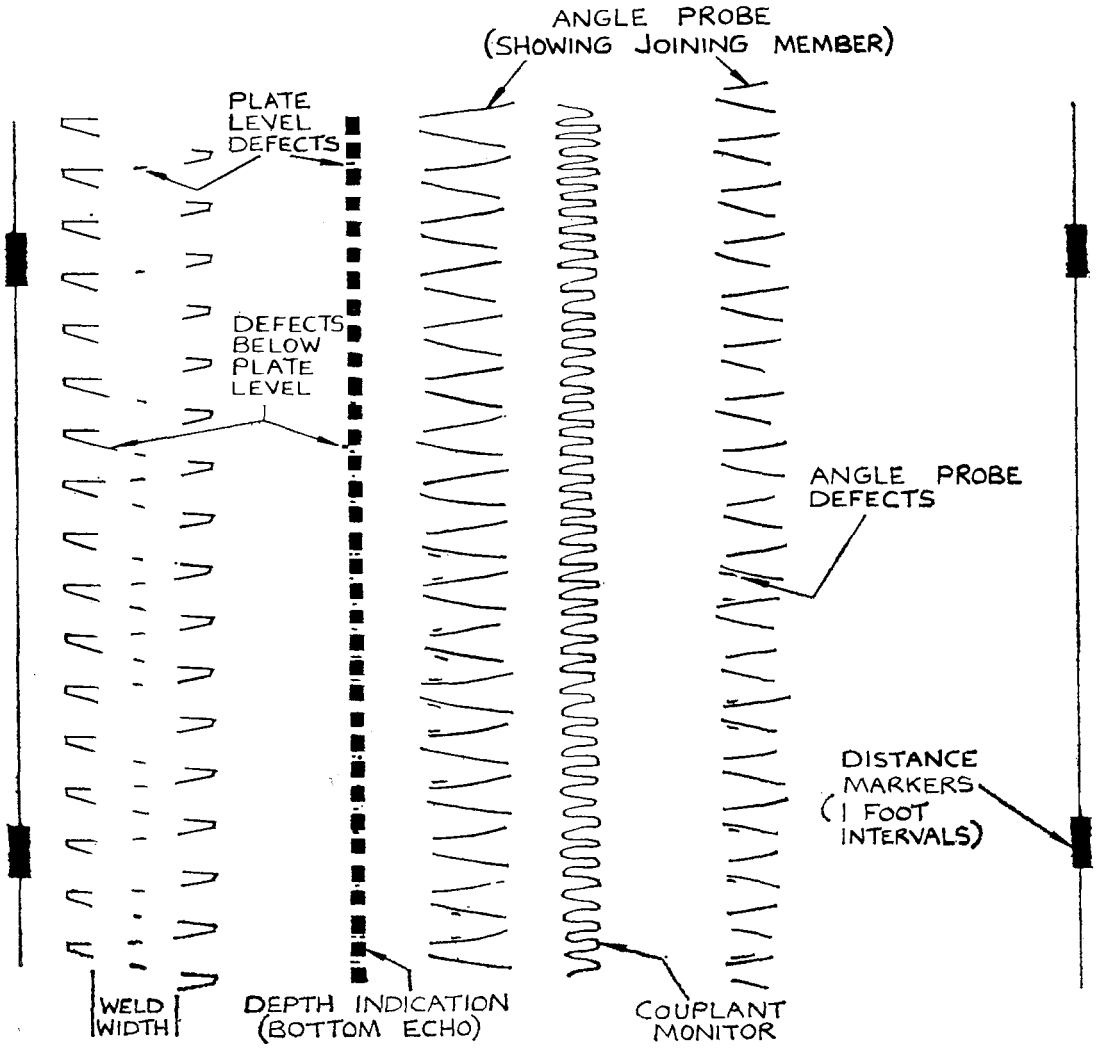

FIG. 4—TYPICAL PEN RECORDING

This equipment provides detailed information of the nature and orientation of flaws detected in the plates and the weld deposit, by using up to four transducers functioning simultaneously and records detailed information by means of the eight-pen six-channel recorder (FIG. 2).

The Ultrasonic Unit

This is comprised of four TX/RX modules with associated static gate flaw alarm, strobing gates, swept gain modules and a couplant monitor.

The structural components are manufactured to an international modular construction standard. Signals from each module can be displayed on one cathode ray tube by a selector switch system, these signals being relayed to the recorder unit.

Large robust recessed carrying handles enable the safe conveyance of the unit on site by two men.

The Recorder Unit

The recorder has six moving and two event pens and electro-sensitive paper nine inches wide, operating from 115/240 volts AC voltage supply. Amplifier modules for adjusting pen sweep and 'zero' are provided for pens 2 to 7 inclusive; pens 1 and 8 are event recorders activated by a micro-switch on the carriage at preset intervals, generally at 12 inches. The layout of the pen deck is shown in FIG. 3.

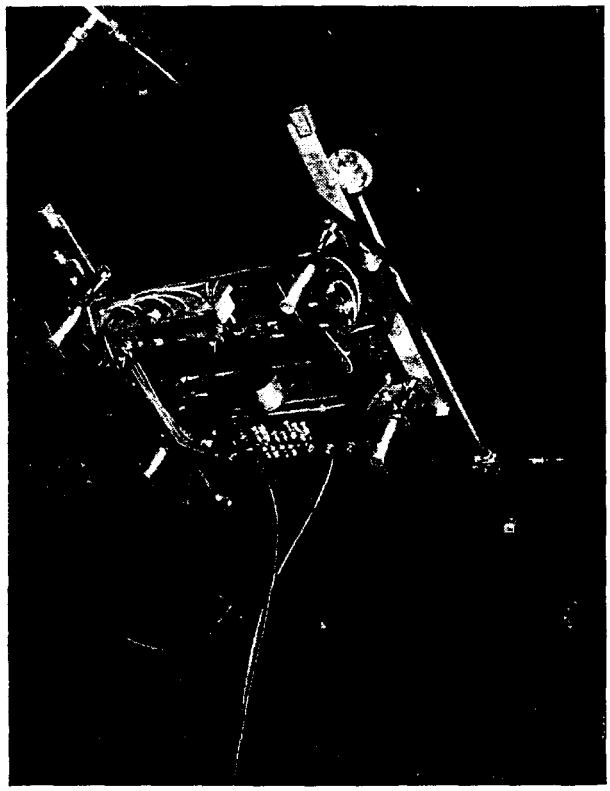

FIG. 5—THE PNEUMATIC CARRIAGE ON SITE

The recorder unit can readily be carried by two men.

The Pneumatic Carriage

The carriage which manipulates the transducers is mounted on rails held in position on the structure by vacuum cups. The forward progression speed of the carriage is six inches per minute, during which time the equipment carries out and records the flaws detected by all the probes in use at the time (FIG. 4).

The Associated Accessories

These are, in the main, components for holding the pneumatic carriage in position on the structure under test, such as the vacuum pump, rails which interlock with each other and are fitted with rubber suction cups, vacuum hose fitted with instantaneous self-sealing couplings, associated electric leads, calibration frame, test blocks and couplant.

The position of the carriage has been used at distances up to 200 feet from the ultrasonic/recorder unit. Contact between operators is maintained by Pye Pocketfone '70' AM 12·5 KHz 69·6 MHz.

The operation of the automated ultrasonic system is undertaken by a three-man team, one of which can be a skilled labourer.

The system, although mains operated, is designed for portability and can be set up in the working position within one hour from arrival on the site. (See FIG. 5).

Present State of Development and Usage

The pre-production equipment has been used successfully for hull surveillance of nuclear submarines at Faslane, Rosyth and Chatham under adverse weather conditions. Transport of the equipment from Foxhill to the site has been by road with no ill effects; it has always functioned satisfactorily on arrival.

Two production equipments are currently being manufactured by Messrs Wells-Fraukramer, one for Rosyth and one for Chatham. The Company is also negotiating a license with the National Research and Development Council to commercially exploit the equipment.

The equipment has been shown at several NDT exhibitions including the demonstrations at the naval training establishments in conjunction with the Working Party on the Application of Non-Destructive Techniques to the Examination of Warships' Hull, Machinery and Systems. The NDT Section is also jointly assisting in the presentation of a one-day seminar to present the automatic system at the Welding Institute. Proposals are also in hand for the examination of production welds by this equipment at the shipbuilders.

Advantages of the Automated Equipment

It is difficult to place an actual figure on the advantages of using the system but it is envisaged that the coverage would be approximately ten times greater than that achieved by manual scanning, with a corresponding saving in cost. The main advantages are:

(*a*) Considerable savings in cost and time.

(*b*) A permanent record is provided, as shown in FIG. 4, which can be interpreted under ideal conditions away from the site.

(*c*) Human error of the operator is eliminated which leads to greater efficiency and reliability of the NDT.

(*d*) The accuracy of repeatability is improved; subsequent surveys can be readily compared.

(*e*) The equipment examines welds at a constant rate regardless of the defects therein, whereas the rate of coverage in manual scanning is very dependent upon the number of defects found.