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WOVEN-WIRE TAPE VENDOR
DEVELOPMENT FY73-3

PDO 6984822, Quarterly Report

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Project Team:
T. E. Brown
R. C. Swoboda

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**Kansas City
Division**

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Quarterly Report

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WOVEN-WIRE TAPE VENDOR DEVELOPMENT FY73-3

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August 1973

Prepared by D. H. Chambers, D/834, under PDO 6984822

Vendors are being assisted in their development of processes necessary to produce woven-wire tape. To improve the control of the weaving process, a creel was designed and fabricated and initial process prove-in activities were completed.

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THE BENDIX CORPORATION

KANSAS CITY DIVISION

KANSAS CITY, MISSOURI

A prime contractor for the
Atomic Energy Commission

Contract Number AT(29-1)-613 USAEC

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SUMMARY

This project is designed to assist vendors in developing a dependable method for weaving 90-conductor wire tape. Precise control of the weaving process is necessary to obtain a reliable product.

Previous activities have included literature surveys of woven wire tapes, woven wire tape processes, and vendors of woven wire tape. In an effort to control warp-wire tension during the weaving operation, the tension and heddle equipment were investigated. A frictional tensioner was developed that controls the warp-wire tension.

This quarter a loom-creel was designed using the frictional tensioner previously developed. Two loom-creels were fabricated and successfully produced woven wire tape at Bendix Kansas City. The visual quality of the woven-wire tape is comparable to previously obtained product. After initial insulation resistance tests have been made on this tape, the creel will be shipped to Woven Electronics for process prove-in.

Future activity includes the evaluation of woven wire tape produced using the frictional tensioner creel at Bendix Kansas City and at potential suppliers.

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DISCUSSION

SCOPE AND PURPOSE

The purpose of this effort is to assist in the development of properly controlled weaving processes by the vendors of woven-wire tape. The precise control of the weaving process is required to prevent damage to the insulation of the copper wire and to prevent elongation of the wire conductor.

PRIOR WORK

Previous activity on this project is documented in quarterly reports "Woven Wire Tape Vendor Development." The areas of interest discussed in these reports include:

- The evaluation of literature concerning woven-wire tape;
- The evaluation of the weaving processes as related to product requirements;
- The evaluation of the vendor market survey;
- The status of the existing vendors of woven-wire tape; and
- The evaluation of tensioners and heddles used for the warp-wire.

ACTIVITY

A creel using frictional tensioners was designed and fabricated this quarter. Initial process prove-in activities have been completed and the creel has been prepared for shipment to Woven Electronics for evaluation of its adaptability to the supplier's facility and equipment.

Frictional Tensioner

To efficiently control the tension of the warp-wire and to reduce the possibility of damage to the insulation and conductor during the weaving process, a frictional tensioner was developed and fabricated (Figure 1).

Figure 1. Frictional Tensioner

Theoretically, a majority of the warp-wire tension is produced at point 1 by the force of the aluminum bar and bearing pad on the spool of wire and by the friction of the material used in the bearing pad against the wire. However, some additional forces that may increase warp-wire tension are produced by the weight of the wire spool, aluminum frame, and bearing pad against the steel axle shaft at point 2, and the friction of the pulleys against their respective contacts, point 3. The friction tensioner discussed in quarterly report "Woven Wire Tape Vendor Development" permits the following functional objectives to be accomplished.

- Each warp-wire can be tensioned independently.
- Tension is independent of spool size and the amount of wire on each spool.
- The dynamic tension (caused by the opening and closing of the shed) is independent of wire and spool mass.
- A creel using this tensioner can occupy a small amount of space and be reliable, maintenance free, and cost less than commercially available tensioners.

Creel Design and Prove-In

A creel (Figure 2) was designed using the frictional tensioners previously discussed. The creel was loaded with copper wire and prepared for the weaving operation. Although the initial weaving operations proved relatively successful, several problems were encountered.

- A felt material originally was used as a bearing pad material. Felt fibers from the pad were transferred to the copper wire on each spool. The felt fibers wrapped around the copper wire and caused the copper wire on each spool to loosen and bind, which in turn caused the copper wire to fracture or jump from the pulleys. The felt pads were removed and replaced by plexiglass pads.
- On some frictional tensioners, the cantilever spring was in such tension that the copper wire contacted the spring. Although additional cantilever springs were evaluated, the reversal of the original spring attachment system eliminated the problem.
- Because of tension in connection with the extreme angle obtained when copper wire was removed from the spool during the weaving process, the copper wire randomly jumped from the cantilever spring pulley. The depth of each pulley on the frictional tensioner was increased by 0.025 inch (0.000635 m).
- The warp-wire tension was affected by the copper wire spools rubbing against each other and by each spool binding against the axle. Inserts were fabricated from an acetal resin polymer, Delrin* AF, to prevent the copper wire spools from contacting adjacent spools and binding against the axle.

These activities decreased the tension of each warp wire from a range of 0.44 to 0.88 pound-force (2.0 to 4.0 N) to a range of 0.11 to 0.33 pound-force (0.05 to 0.15 N). The creel proved capable of producing woven-wire tape with visual quality as good as has been previously obtained. Four woven-wire tape reels of 346 feet (105 m) lengths were produced for insulation resistance tests and fabrication of product.

*Registered Trademark of E.I. duPont deNemours

Figure 2. Frictional Tensioner Creel

ACCOMPLISHMENTS

- A new creel was designed using the frictional tensioner.
- The creel was capable of producing a woven wire tape with a quality appearance equal to that previously obtained.
- The creel was prepared for shipment to Woven Electronics for additional evaluation.

FUTURE WORK

Future activities will consist of the continued evaluation of the woven wire tapes produced using the frictional-tensioner creel design. These evaluations will be completed using woven-wire tapes produced at Bendix Kansas City, Woven Electronics, and other potential vendors.

Approximately five rolls of woven-wire tape will be ordered from each supplier. The tape will be subjected to visual inspection and nondestructive laboratory analysis. If of acceptable quality, they will be used to fabricate parts for additional evaluation.

Five assemblies will be fabricated from woven-wire tape obtained from each supplier. These assemblies will be subjected to thermal cycling tests according to Sandia Specification SC 4451, paragraph A5b. The insulation resistance between adjacent wires will be monitored during these tests. Results of all tests will be analyzed to determine if the vendors' woven-wire tapes are of acceptable quality.

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Appendix A

DEFINITION OF WEAVING TERMS

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Appendix A

DEFINITION OF WEAVING TERMS

Beat Up	The action of the reed that drives the fill yarn against the woven fabric.
Bobbin	Spool which carries the fill material in the shuttle.
Count	Number of warp yarns per inch or number of fill yarns per inch.
Creel	Frame which holds spools of warp fibers (or wire).
Dent	Open space in reed.
Fabric, Woven Narrow	A fabric less than 12 inches (0.305 m) in width with a selvage on each side.
Fill	The wire running crosswise in the fabric (perpendicular to the selvage).
Heddle	A series of vertical cords or wires that raise and lower the warp to form the shed.
Pick	An individual fill yarn.
Pick Count	The number of fill yarns per inch of fabric.
Reed	The part of a loom consisting of numerous thin parallel vertical strips that drives the fill yarn against the woven fabric.
Resort Spring	Spring, contained in the shuttle, which maintains tension on the fill material.
Selvage	The woven edge portion of a fabric parallel to the warp.
Shed	The opening produced by separating the warp wires vertically to allow passage of the shuttle.

Shuttle	The device used to carry the fill yarn to and fro between the warp.
Slay	The portion of the loom, to which the reed is mounted, that moves forward to beat up the fill material.
Tape	A narrow woven fabric with a maximum width of 8 inches (0.203 m).
Warp	The yarn running lengthwise in a woven fabric.
Weave, Plain	A fabric pattern in which each yarn of the fill passes alternately over and under a yarn of warp and each yarn of warp passes alternately over and under a yarn of the filling.
Weft	Fibers perpendicular to warp; also known as woof, or fill.
Woof	Fibers perpendicular to warp; also known as weft, or fill.