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QUARTERLY PROGRESS REPORT
JULY 1 thru SEPTEMBER 30, 1962
CRYSTAL UNIT CR-(X-1234)
ORDER 7622-PP-00-01-00
KEYSTONE CONTROLS COMPANY, INC.

Best Available Copy

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QUARTERLY PROGRESS REPORT

Period Covered
July 1, 1962 to September 30, 1962

CRYSTAL UNIT CR-(XM-28)/U

ORDER NO. 7622-PP-59-81-81
CONTRACT NO. DA-36-039-SC-81275

Placed By
U.S. Army Signal Supply Agency
225 South 18th Street
Philadelphia 3, Penna.

Placed With
Keystone Electronics Co.
65-67 Seventh Avenue
Newark, New Jersey

Prepared by
James M. Ronan
Vice President
Engineering & Manufacturing

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ABSTRACT

Attempts to obtain consistently satisfactory seals of the HC-27/U type holder have been unsuccessful. A design for a new holding fixture is shown, and a commercially available sealing machine is reported.

Results indicate that the unglazed base is superior to the glazed in obtaining good seals of the glass parts. A method of cleaning Kovar is reported on, as well as a satisfactory Pyroceram mixture.

PURPOSE

The Contract requires that a facility be established to manufacture Crystal Unit CR-(XM-28)/U at the rate of 500 per eight-hour shift, utilizing the HC-27/U all-glass holder, and to produce 500 units at each of five frequencies.

REQUIREMENTS

3.10 Detail requirements for Crystal Unit CR-(XM-28)/U. -

3.10.1 Description. - Metal plated plate, mounted in glass holder; designed to operate at series resonance on the third overtone mode of the fundamental frequency of the plate, and under noncontrolled temperature conditions.

3.10.2 Holders. - Holders shall be glass, type HC-(XM-2)/U, conforming to 3.11 below, and 3.2.2.1 above.

3.10.2.1 Thermal shock of envelope. - The glass envelope of Crystal Unit CR-(XM-28)/U shall meet the thermal shock requirements specified in 3.2.2.1 above.

3.10.3 Evacuation. - Paragraph 3.4.4 as applicable to glass holders shall apply. Method selected shall be at the contractor's discretion, but shall be such that all performance requirements are met.

3.10.4 Other requirements. - Except for the applicable requirements of this document, Crystal Units CR-(XM-28)/U shall meet all the requirements for Crystal Unit CR-52/U as specified in Specification MIL-C-3098.

(Excerpt from SCS-18)

NARRATIVE

Sealing and Equipment

Further attempts were made to overcome the "spongy" appearing seals discussed in previous reports. Although our sealing equipment is not as yet perfected, results were adequate to permit us to draw some definite conclusions.

As a result of the processing and sealing of several more control groups of glass holders, each group containing an equal number of bases with glazed and unglazed Kovar rings, we have reached the conclusion that the glaze, or glass frit, adds nothing and in no way improves the sealing of the glass. On the contrary, all the evidence points to a detrimental effect on the final product.

Although we have no documented proof, we are of the opinion that the glass frit probably has a filler of some kind to aid adherence during the glazing of the ring. We believe that this may change the temperature coefficient, or coefficient of expansion from that of 7052 glass. This, together with a boiling out of the filler during sealing appears to be the cause for some of the poor seals.

One of the sidelights developed as a result of these investigations is the fact that we had more success in sealing the envelope to the unglazed base, if the bases were "fresh", that is, had not been on the stock shelf for any length of time. We found that bases (actually the Kovar ring), stored for periods exceeding six months, could be restored to the "fresh" condition by a thorough washing in a dilute solution of hydrochloric acid, followed by a rinse in distilled water.

A solution of 10 parts of distilled water to 1 part of hydrochloric acid has proven satisfactory, although the proportions are not critical.

Narrative (continued)

Since learning of this technique, our yields of successful seals have been as good with the cleaned, stored bases, as with bases of recent fabrication.

Our inability to substantially increase our yield of good seals over the 50% mark, in the last several months, however, has led us to contact the Lepel High Frequency Laboratories with regard to price and delivery of a complete glass sealing equipment for quartz crystal units, announced in the Lepel Engineering Review, Issue #10. However, we are informed by Lepel that they make only the induction generators, work coils and concentrators. The holding fixtures and associated vacuum system, pictured in the "Review" are proprietary items of the crystal manufacturer.

A review of all available R & D and P E M reports on the subject was made in an effort to determine wherein we were at fault. However, all the reviewed reports were, at best, vague or sketchy in the details pertaining to the fixturing. All reports reviewed however, had one thing in common-the use of Lepel induction generators.

Toward the end of the reporting period, a visit was made to the U. S. Army Signal Research & Development Laboratories to discuss, with members of the Frequency Control Division, our problems and seek a solution. We are greatly indebted to Mr. M. Bernstein, Mr. Lewis Nelson and Mr. Walter Warden, for the courtesies they extended, and the invaluable assistance they have rendered us.

Permission was granted to copy their fixturing and techniques of sealing, if we so desired.

The Frequency Control Division, USASRDL, is using a Lepel Induction Generator of 1 1/2 KW capacity. We intend to contact Lepel for quotations on this equipment during the coming period.

Narrative (continued)

Crystal Unit CR-(XM-28)/U

No problems have been encountered thus far, nor are they anticipated, in the fabrication of the crystal blanks, since the parameters of the crystal are similar to the standard Military type CR-52/U type of unit which is in large production. Process specifications of the units are shown in Appendix I.

Problems which are apparent are those associated with the sealing of the envelope, which has caused non-uniform changes in frequency and apparent changes in the characteristics of the bonding cements which we have employed. It is our belief that the changes in frequency are directly the result of the break-down occurring in the bond. For this reason we intend to continue our investigations of bonding cements before attempts are made to stabilize the frequency change.

One of the cements to be investigated during our aging studies will be Pyroceram. During the reporting period, a number of attempts were made to obtain a satisfactory bond of sufficient mechanical strength and good electrical conductivity.

Since we were unaware of any theoretical manner of determining the correct ratios of the Pyroceram, silver and amyl acetate and nitrocullulose, we were forced to determine the proportions empirically. After several attempts, we achieved satisfactory results from a mixture of nine (9) parts of Pyroceram, two (2) parts of Handy and Harmon Silver Flake, adding the amyl acetate and nitrocellulose to achieve a heavy cream consistency.

CONCLUSIONS

We are convinced that it will be necessary to replace our present induction generator in order to achieve consistently good seals of the glass envelopes.

We are also satisfied that superior seals can be achieved through the use of bases which have no glaze on the Kovar ring.

VISITS AND CONFERENCES

On 24 July 1962, Mr. Ronan visited the U. S. Army Electronics Materiel Agency, Philadelphia and discussed with the Contracting Officer, Mr. G. Munger, and the Project Engineer, Mr. E. Mason, progress and future plans for the contract.

During August, Mr. Mason and Mr. Ermon Jones, Project Engineer for the U. S. Army Electronics Materiel Support Agency, visited Keystone to discuss and review progress of the program.

MANHOURS OF ENGINEERING TIME EXPENDED
DURING THE PERIOD

J. M. Ronan	48 hours
M. Epstein	38 hours
A. Wargo	76 hours
Mrs. I. Wells	52 hours
Technicians and Shop Labor	64 hours

PUBLICATIONS AND REPORTS

No publications or outside reports were prepared during the period.

PROGRAM FOR THE NEXT PERIOD

1. Continue efforts to achieve consistently successful seals of the HC-27/U holder.
2. Obtain complete information from Lepel relative to their Induction Generator and obtain Contracting Officer's approval to purchase it.
3. Begin preparation of the necessary crystal blanks to conduct the aging studies included in our development program.

APPENDIX I

Typical Crystal Unit Processing Specification

Nominal Frequency: 30.0 mc

Holder: HC-27/U Type: CR-(XM-28)/U

Description: 3rd Overtone, series resonant operation

Frequency Tolerance: $\pm 0.005\%$ from -55°C to $+105^{\circ}\text{C}$

Cut: AT Orientation: $Z Z'$: $35^{\circ} 26' \pm 2$

XX' : $0^{\circ} \pm 15'$

Edge: $0^{\circ} \pm 15'$

Blank Diameter: .490"

Diced Blank: Thk: .035"

Rough Lap: Thk: .025" Abrasive: #320 Si C

Inter lap #1: Thk: .011" Abrasive #600 Si C

Inter lap #2: Freq: 7960kc ± 20 Abrasive: 12.5 micron

Finish lap: Freq: 9040kc ± 20 Abrasive: 5 micron

Polish: Freq: 10040kc ± 20 Abrasive: Cerium Oxide

Base Plating: Aluminum. Spot; .185"