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SCIAKY BROS., INC.
RESEARCH DIVISION
2311 PURDUE AVENUE, LOS ANGELES, CALIFORNIA,
Contractor

Final Report
of
Seamwelding Development Program
on
Zirconium Can End Closures
Prime Contract No. W-31-109- Eng-52
1 June 1956 to 31 August 1956

FOR
General Electric Company
Hanford Atomic Products Operation
Richland, Washington

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1 September 1956

SUMMARY

The following report concludes an investigation to determine the feasibility of resistance seamwelding zirconium can assemblies. The initial investigation was carried out on flat sheet stock. A satisfactory welding schedule was developed demonstrating consistent quality welds.

The final phase of the investigation consisted of developing a schedule for welding actual zirconium can assemblies. A satisfactory welding schedule was readily achieved.

Seventeen zirconium can assemblies were seamwelded and submitted to General Electric Company Hanford Atomic Products Operation for their evaluation and further testing.

1. INTRODUCTION

1.1 The General Electric Company, Hanford Atomic Products Operation, Richland, Washington, contracted with Sciaky Bros., Inc., Research Division, Los Angeles, California to conduct an investigation on resistance seamwelding zirconium can assemblies.

2. SCOPE

2.1 This report describes the experimental and testing involved in developing a leak-tight joint between zirconium end caps and cans by the resistance seamwelding process. In addition, recommendations are included which describe the equipment, estimated cost and procedure for a production set-up to manufacture zirconium can assemblies.

3. OBJECTIVES

3.1 To develop a technique for seamwelding zirconium can assemblies as shown in Figure 1 and Figure 5.

3.2 To develop a gas-tight seamwelded joint between the zirconium can and end cap that will withstand a helium leak detector test to a leak magnitude of 2 by 10^{-8} cc/sec on a Leak Detector, Consolidated, Electro Dynamic Model 24-101A.

3.3 Evaluate weld metallurgical and mechanical properties.

3.4 To fabricate and deliver to General Electric Company, 20 final test welded specimens.

3.5 To determine minimum allowable edge margin required for quality seam welding.

4. EQUIPMENT

4.1 Welding Machine

Sciaky PM2TLC

Maximum Welding Force (pounds) : 4,500

Maximum Secondary Current (amp res) : 80,000

1.

Figure 1. Final Zirconium Test Specimens Configuration.

995 004

ZIRCONIUM CAN, HAPO

SCIARKY BROS., Inc.

2311 PURDUE AVENUE

RESEARCH DIVISION

LOS ANGELES 64, CALIFORNIA

SERIES -

R - A-1174

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Part A: Cap

Part B: Can

Tolerances of cap and can to be arranged for slip fit.

Figure 5. Typical Can Assembly Details

SPARE PARTS CLASS'N	QUANTITY	SER.	DRAWING	DET.	PATT.	STORE SHOP OR MANUFACTURER	DESCRIPTION	MATERIAL	FINISH	SIZE
	SCALE: full					E-INDICATES ELECTRICAL CONTACT SURFACE TO BE POLISHED AND FREE FROM TOOL MARKS.				
	BILL OF MAT'L:					WEIGHT OF CASTING:				
	ASSEMBLY DRWG:					SERIES -				
ALL CORNERS BROKEN 1/64" CHAMFERED UNLESS OTHERWISE SPECIFIED					LIMITS ON DIMENSIONS UNLESS OTHERWISE SPECIFIED	ANGULAR	FRACTIONAL	DECIMAL	R - A-1174	

4.2 Metallurgical

- a. Two Speed Polisher, Buehler
- b. Spotweld Analyzer, Brush
- c. Specimen Mounting Press, Buehler
- d. Stereoptic Microscope, American Optical Co.
- e. Two Speed Two-Belt Sander
- f. Panphot Universal Camera Microscope (Ernst Leitz)
- g. Leak Detector, Consolidated Electro Dynamics, Model 24-101A
- h. Force Gauge, Webster
- i. Wet Sander, Duo Belt, Buehler

4.3 Photographic Equipment

- a. Enlarger, Omega D-II
- b. Developing Tanks
- c. Verifax Printer, Kodak
- d. Camera, Kine Exakta 35 MM

4.4 Shop Equipment

- a. Lathe, Reed-Prentice
- b. Lathe, South Bend
- c. Milling Machine, Browne and Sharpe
- d. Belt Sander, Abas-O-Brute
- e. Bandsaw, Do All Co.
- f. Shear Machine, Cincinatti, Series 1006
- g. Drill Press, Delta Mfg., Co.

5. *TOOLING

Special Tooling was fabricated as follows:

- a. Seamwelding Extension Hub.
- b. Seamweld Wheel (lower)
- c. Seamweld Wheel (upper)

* See Figure 6 for Tooling set-up used.

4.

Figure 6. Proposed Holding and Resistance Welding Fixture for Seamwelding of Zirconium Cans.

6. MATERIAL

60 pieces of 0.020 by 1.0 by 6-inch Zirconium, strip.
53 Zirconium end caps.
46 Zirconium cans (See Figure 5 for typical configuration).

7. PROCEDURE

7.1 Development of Welding Schedules

7.1.1 Flat Sheet - The initial development work was conducted on flat test coupons approximately 0.020 by 1.0 by 6-inches. Various combinations of welding parameters and magnitudes were investigated until a satisfactory welding schedule was obtained. A tabular presentation of the welding variables explored is given in Table 1.

7.1.2 Actual Can Assembly Development - The final stages of development was conducted on actual can assembly components. Various combinations of welding parameters and magnitudes were investigated. A tabular presentation of the welding variables is given in Table 2.

7.2 Surface Preparation

7.2.1 The parts were prepared for welding as follows:

- a. Pickling solution - Nitric Hydrofluoric
- b. Immersion Time - Five minutes
- c. Rinse Time - Fifteen minutes flowing tap water

7.3 Weld Quality

7.3.1 Representative welds were cross-sectioned and examined macroscopically for cracks, porosity and general weld quality.

7.4 Edge Margin

7.4.1 Minimum edge margin tests were conducted. (A typical edge margin specimen is shown in Figure 7).

7.5 Instrumentation

7.5.1 Oscillograph records were made with a Spotweld Analyzer to record the magnitude and duration of welding pressure and current static pressure checks were made with a Force Gauge to measure actual electrode force. A typical current force trace is shown in Figure 3.

TABLE I
WELDING SCHEDULE

Test Number	Weld Phase Shift (Percent)	Weld Vernier (Percent)	Weld Pressure (Pounds)	Drive	Constant Pressure	Heat (Cycles)	Weld Interval (Cycle)	Impulses	Cool (Cycles)	Squeeze (Cycles)	Hold (Cycles)	Arm (Inches)	Throat (Inches)	Motor Speed	Motor Rotation Run Time
1-A	43	0	950	Continuous	C	3	1	S	1	50	0-3, 50	5-1/4	43	99	0
1-B	40	0	1150	Continuous	C	3	1	S	1	50	0-3, 50	5-1/4	43	99	0
1-C	38	0	1150	Continuous	C	3	1	S	56	50	0-3, 50	5-1/4	43	99	0
1-D	40	0	1150	Continuous	C	3	1	S	56	50	0-3, 50	5-1/4	43	99	0
1-E	40	0	1150	Continuous	C	3	1	S	10	50	0-3, 50	5-1/4	43	99	0
1-F	41	0	1125	Continuous	C	3	1	S	10	50	0-3, 50	5-1/4	43	99	0
1-G	45	50	1125	Continuous	C	3	1	S	10	50	0-3, 50	5-1/4	43	99	0
1-H	45	0	1125	Continuous	C	3	1	S	10	50	0-3, 50	5-1/4	43	99	0
1-I	44	50	1125	Continuous	C	3	1	S	10	50	0-3, 50	5-1/4	43	99	0
1-J	44	0	1125	Continuous	C	3	1	S	10	50	0-3, 50	5-1/4	43	99	0
1-K	43	50	1125	Continuous	C	3	1	S	10	50	0-3, 50	5-1/4	43	99	0
1-L	43	0	1125	Continuous	C	3	1	S	10	50	0-3, 50	5-1/4	43	99	0
1-M	42	50	1125	Continuous	C	3	1	S	10	50	0-3, 50	5-1/4	43	99	0
1-N	42	0	1125	Continuous	C	3	1	S	10	50	0-3, 50	5-1/4	43	99	0
1-O	41	50	1125	Continuous	C	3	1	S	10	50	0-3, 50	5-1/4	43	99	0
1-P	41	0	1125	Continuous	C	3	1	S	10	50	0-3, 50	5-1/4	43	99	0
1-Q	40	50	1125	Continuous	C	3	1	S	10	50	0-3, 50	5-1/4	43	99	0
1-R	40	0	1125	Continuous	C	3	1	S	10	50	0-3, 50	5-1/4	43	99	0
1-S	39	50	1125	Continuous	C	3	1	S	10	50	0-3, 50	5-1/4	43	99	0
1-T	39	0	1125	Continuous	C	3	1	S	10	50	0-3, 50	5-1/4	43	99	0
1-U	38	50	1125	Continuous	C	3	1	S	10	50	0-3, 50	5-1/4	43	99	0
1-V	38	0		Continuous	C	3	1	S	6	50	0-3, 50	5-1/4	43	90	0
1-W	36	0		Continuous	C	3	1	S	6	50	0-3, 50	5-1/4	43	90	0
1-X	38	50		Continuous	C	4	1	S	6	50	0-3, 50	5-1/4	43	90	0
1-Y	38	0		Continuous	C	4	1	S	6	50	0-3, 50	5-1/4	43	90	0
1-Z	38	0		Intermittent	C	3	11	S	6	50	0-3, 50	5-1/4	43	90	15
2-A	38	0		Intermittent	C	3	11	S	6	50	0-3, 50	5-1/4	43	90	12
2-B	38	0		Intermittent	C	3	11	S	6	50	0-3, 50	5-1/4	43	90	11
2-C	38	0		Intermittent	C	3	11	S	6	50	0-3, 50	5-1/4	43	73	12
2-D	36	50		Intermittent	C	3	11	S	6	50	0-3, 50	5-1/4	43	90	12

TABLE I - Continued

WELDING SCHEDULE

Test Number	Electrodes				Spots Per Inch	Penetration Minimum (Percent)	Penetration Maximum (Percent)	Nugget Diameter (Inches)	Flood Cooling	Parallel or Series	Inches Per Minute	REMARKS*
	Upper Diameter	Radius	Lower Diameter	Radius								
1-A	1-1/2	2	15-7/8	6					Yes	S		Penetration deep.
1-B	1-1/2	2	15-7/8	6		85	95	.105 .125	Yes	S		Penetration High, Spacing Close.
1-C	1-1/2	2	15-7/8	6		75	85	.082 .090	Yes	S		Intermittent Welds.
1-D	1-1/2	2	15-7/8	6		85	95	.145 .155	Yes	S		Penetration High.
1-E	1-1/2	2	15-7/8	6		90	95	.110 .120	Yes	S		Penetration High.
1-F	1-1/2	2	15-7/8	6		90	95	.090 .095	Yes	S		Penetration High.
1-G	1-1/2	2	15-7/8	6	22	90	95	.125 .140	Yes	S		Penetration High, Spacing Close.
1-H	1-1/2	2	15-7/8	6		95	95	.100 .115	Yes	S		
1-I	1-1/2	2	15-7/8	6		95	95	.115 .120	Yes	S		
1-J	1-1/2	2	15-7/8	6		90	95	.105 .130	Yes	S		
1-K	1-1/2	2	15-7/8	6		95	95	.120 .130	Yes	S		
1-L	1-1/2	2	15-7/8	6		85	95	.120 .125	Yes	S		
1-M	1-1/2	2	15-7/8	6					Yes	S		
1-N	1-1/2	2	15-7/8	6					Yes	S		
1-O	1-1/2	2	15-7/8	6					Yes	S		
1-P	1-1/2	2	15-7/8	6					Yes	S		
1-Q	1-1/2	2	15-7/8	6					Yes	S		
1-R	1-1/2	2	15-7/8	6					Yes	S		
1-S	1-1/2	2	15-7/8	6					Yes	S		
1-T	1-1/2	2	15-7/8	6					Yes	S		
1-U	1-1/2	2	15-7/8	6					Yes	S		
1-V	1-1/2	2	15-7/8	6		80	80	.100 .100	Yes	S		Overlap interval Ir
1-W	1-1/2	2	15-7/8	6					Yes	S		
1-X	1-1/2	2	15-7/8	6					Yes	S		
1-Y	1-1/2	2	15-7/8	6					Yes	S		
1-Z	1-1/2	2	15-7/8	6	22				No	S	4.5	Insufficient in Overlap
2-A	1-1/2	2	15-7/8	6	27				No	S	4.4	
2-B	1-1/2	2	15-7/8	6	27	80	85	.090 .095	No	S	4.4	
2-C	1-1/2	2	15-7/8	6					No	S		
2-D	1-1/2	2	15-7/8	6	27				No	S	4.4	

*NOTE: Strips vary in thickness from .0185 to .0215.

TABLE 2

Test No.	Weld Phase Shift (%)	Weld Force	Intermittent Drive	Heat (cycles)	Weld Interval (cycles)	Impulses	Cool (cycles)	Squeeze (cycles)	Recompression Delay	Hold (cycles)	Arm (inches)	Throat (inches)	Motor Speed	Motor Rotation	Electrodes				Class Wheel	Spots/inch	Penetration Minimum (%)	Penetration Maximum (%)	Nugget Dia. (inches)	Remarks:
															Upper		Lower							
															Diameter	Radius	Diameter	Radius						
2-F	41	410	Yes	3	0	1	6	50	0	50	5 1/4	43	90	11	1 1/2	2	157/8	6	II	27				No Pen.
2-F	48	410	Yes	3	0	1	6	50	0	50	5 1/4	43	90	11	1 1/2	2	157/8	6	II	27				Pen low
2-G	53	410	Yes	3	0	1	6	50	0	50	5 1/4	43	70	20	1 1/2	2	157/8	6	II	27	85	90	0.030	Pen Hi.
2-H	38	410	Yes	3	11	3	2	50	0	50	5 1/4	43	70	13	1 1/2	2	157/8	6	II	27				No Pen
2-I	43	410	Yes	3	11	3	2	50	0	50	5 1/4	43	70	13	1 1/2	2	157/8	6	II	27	45	45	0.055	Pen Low-Spacing Wide
2-J	45	410	Yes	3	11	3	2	50	0	50	5 1/4	43	68	13	1 1/2	2	157/8	6	II	40				Pen Hi.-Spacing, OK weld sound
2-K	41	410	Yes	3	11	3	2	50	0	50	5 1/4	43	68	13	1 1/2	2	157/8	6	II	40	55	60	0.040	Leak tested satisfactorily
2-K	41	410	Yes	3	11	3	2	50	0	50	5 1/4	43	68	13	1 1/2	2	157/8	6	II	40	55	60	0.040	
2-K	41	410	Yes	3	11	3	2	50	0	50	5 1/4	43	68	13	1 1/2	2	157/8	6	II	40

Figure 7. Typical Edge Margin Specimen

No. BD BL 924 T (BL 924)

PRINTED IN U.S.A.

P

No. BD BL 924 T (BL 924)

PRINTED IN U.S.A.

P

Figure 3. Typical Current Force Traces

7.6 Leak Testing

7.6.1 Helium leak tests were conducted during the development of the welding technique on one end cap of each final tests assembly (See Figure 8 for photograph on leak test tooling and equipment).

7.7 Fabrication of Test Assemblies

7.7.1 The following assemblies were welded and submitted to the customer for further testing and evaluation. The assemblies are classified according to the fit-up of the component parts as poor fit and fair fit. For the purposes of this report, poor fit is defined as any gap greater than 0.004-inches. Fair fit is defined as any gap less than 0.004.

Poor Fit Assy.

PF - 1
PF - 2
PF - 3
PF - 4
PF - 5
PF - 6
PF - 7
PF - 8
PF - 9

Fair Fit Assy.

FF - 21
FF - 22
FF - 23
FF - 24
FF - 25
FF - 26
FF - 27
FF - 28

7.7.2 Sequence of Assembly - Tack

7.7.2.1 Each end cap is spotwelded on the seamwelder at four equally spaced points around the circumferential of the can. This is to facilitate holding the can end in proper location with respect to the can body while seamwelding is accomplished.

7.7.3 The second step in the assembly sequence is to seamweld one end cap only. This allows accessibility for helium leak testing prior to locating and tack welding the second end cap.

7.7.4 The final step in the assembly sequence is to locate and tack weld the second end cap and subsequently to seamweld.

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7.8 Protective Atmosphere

7.8.1 A Semi-inert helium atmosphere was used while welding the following end caps PF No. 4,-6,8,-9 and FF No. 23,24, 25 and 26. This was accomplished by directing a jet of helium toward the area where the lower electrode wheel contacted the outside of the can. The nature of the test is crude and was employed only to obtain indications as to what may be expected from seamwelding in an inert atmosphere.

7.8.2 The contract does not provide for development of extensive tooling for welding in an inert atmosphere.

8. RESULTS

8.1 Weld Quality

8.1.1 Macroscopic examination of polished and etched longitudinal cross-sections revealed a metallurgical sound weld structure that was continuous and uniform. No indentation was observed using a two power optical comparator.

8.1.2 Nugget geometry and configuration are tabulated below:
(See Figure 2 for typical seamweld structure).

Nugget Diameter (in.)	0.040
Average Penetration Can (%)	45
Average Penetrations End Cap (%)	45
Nugget Overlap (%)	30

8.1.3 Micro hardness tests indicated that no appreciable atmospheric contamination had occurred in the weld since comparable indentations were obtained in parent metal and weld nugget (Knoop Hardness No. was 237 using 1.0 Kg., load).

8.1.4 Edge Margin

8.1.4.1 The minimum edge margin (distance from center of weld to nearest tangent point) developed for the application investigated herein was 0.125-inches as indicated by tests conducted on tapered specimens. A typical edge margin specimen used is shown in Figure 7.

8.2 Helium Leak Test

8.2.1 The sampling probe method of leak detection was employed. All welds were leak free when subjected to a leak magnitude of 2 by 10^{-8} cc/sec., on a Leak Detector.

Mag. 9X

Figure 2. Macrophotograph of Typical Seamweld Structure

D

8.2.2 Each end cap subjected to the helium leak test is so identified.

8.3 Final Welding Schedules

8.3.1 The combination of welding parameters developed for welding two thicknesses of 0.020-inch Zirconium sheet stock is as follows:

<u>Parameter</u>	<u>Setting</u>
Weld Phase Shift (%)	38
Welding Force (constant, lbs)	410
Intermittent Drive	On
Heat Time (cycles)	3
Weld Interval Time (cycles)	11
Impulse	Single
Cool Time (cycles)	6
Squeeze Time (cycles)	30
Hold Time (cycles)	90
Motor Speed	90
Motor Rotation	11
Upper Electrode Tip (wheel diameter, in.)	1-1/4
Upper Electrode Tip (face, in.)	1/8
Upper Electrode Tip (radii, in.)	2
Upper Electrode Wheel Class	RWMA 2
Lower Electrode Tip (wheel diameter, in.)	16
Lower Electrode Tip (face, in.)	5/6
Lower Electrode Tip (radii, in.)	6
Lower Electrode Wheel Class	RWMA 2
Arm Spacing (inches)	5-1/4
Throat Depth (inches)	43
Transformer Arrangement	Series

8.3.2 The most satisfactory welding schedule developed for seamwelding actual Zirconium can assemblies is as follows:

<u>Parameter</u>	<u>Setting</u>
Weld Phase Shift (%)	44
Welding Force (constant, lbs)	410
Intermittent Drive	On
Heat Time (cycles)	3
Weld Interval Time (cycles)	11
Impulses	3
Cool Time (cycles)	6
Squeeze Time (cycles)	30
Hold Time (cycles)	90
Motor Speed	68
Motor Rotation	13
Upper Electrode Tip (wheel diameter, in.)	1-1/4
Upper Electrode Tip (face, in.)	1/8
Upper Electrode Tip (radii, in.)	2
Upper Electrode Wheel Class	RWMA 2
Lower Electrode Tip (wheel diameter, in.)	16
Lower Electrode Tip (face, in.)	5/16
Lower Electrode Tip (radii, in.)	6
Lower Electrode Wheel Class	RWMA 2
Arm Spacing (in.)	5-1/4
Throat Depth (in.)	43
Transformer Arrangement	Series

9. CONCLUSIONS

9.1 Zirconium can assemblies are readily joined by the resistance seamwelding process and results show a quality leak-tight joints.

9.2 This investigation indicates that leak-tight welds may be achieved over a gap range of 0-0.012-inches between end caps and cans. However, where a gap occurs greater than a conventional slip fit (0-0.001) certain defects are noted such as surface indentation, distortion of the detail parts, surface expulsion and shunting. The Magnitude of the defects increases correspondingly as the gap increases.

9.3 An inert helium atmosphere will minimize surface discoloration of the weld.

9.4 A welding rate of one end cap per minute is feasible with equipment designed for the application investigated herein.

9.5 Excellent electrode life is obtained with RWMA Class 2 electrodes.

9.6 Edge margin requirements developed herein are comparable to design requirements for corrosion and heat resistant alloys and carbon steels.

10. RECOMMENDATIONS

10.1 The welding equipment recommended as a tool for producing quality seamwelding of Zirconium cans on a production basis is as follows:

A Sciaky PMR.1T-75-36 (Three-Phase) Electric Resistance Rocker Arm Seam Welder, rated 75-kva at 50 per cent duty cycles, and in accordance with the following specifications:

10.2 General:

The machine shall be capable of resistance seam welding the following metal gauges in accordance with MIL-W-6858:

<u>Material</u>	<u>Minimum</u>	<u>Maximum</u>
Stainless Steels 18-8 (302, 321 and 347)	0.012" plus 0.012"	0.051" plus 0.051"
Clean Mild Steel	0.016" plus 0.016"	0.070" plus 0.070"
Titanium and Titanium Alloys	0.016" plus 0.016"	0.051" plus 0.051"
Zirconium	0.016" plus 0.016"	0.051" plus 0.051"

10.3 The machine shall be capable of welding can assemblies of 1-1/4-inch diameter and greater.

18.

10.4 Mechanical Construction:

All parts shall be so constructed that longevity and easy maintenance are insured. The frame and base of the welding machine shall be a rigid box construction of welded steel, sufficiently ribbed to maintain original alignment. Access to the interior shall be provided to permit making adjustments and repairs to the equipment.

10.5 The machine shall be completely assembled in all details, ready for operation with conveniently located connections for water, air and an electrical power supply. An essentially frictionless type air pressure system, operating from an air line pressure of 80-psi shall permit an electrode force adjustable from 250-pounds to a maximum of 2,000-pounds. A wide range of electrode force shall be obtained by means of adequate air pressure regulating valves. An air cushion shall be provided for the UP stroke and an air speed valve for the DOWN stroke. A means of lowering the upper electrode with low pressure shall be provided for cleaning and alignment. The welder shall be furnished complete with adequate air-pressure regulators, air gauges, speed control valve, air line lubricator and air filter. Air pressure gauges shall be calibrated to tip pressure.

10.6 The machine shall be equipped with necessary equipment for flood cooling.

10.7 The machine shall have a throat depth of 36-inches.

10.8 The working stroke at electrode wheels shall be 1-1/4-inch; the retraction stroke 4-inch; and the downward stroke of retraction stroke shall be 2-inch per second. Foot switches shall accomplish the following:

- a. Raising and lowering of upper electrode through the retraction stroke distances. This switching shall operate independently of the working control switch and shall be interlocked to prevent raising the electrode during the working cycles.
- b. The working stroke switch shall be a two-position type to prevent immediate welding upon closing of electrodes (first position shall close electrodes; second position shall initiate the welding cycles).

10.9 Drive Assembly:

The wheel drive shall be located on the lower arm, and shall permit a range of speeds adjustable from 0.55 to 3.12-rpm. All motor speed controls shall be accessible from the outside of the machine.

10.10 Lower Arm Assembly:

10.10.1 The lower arm shall be of sufficient strength so as not to require a brace and shall be adjustable vertically over a range of inches.

10.10.2 Two interchangeable horns, hub and wheel assemblies shall be provided for the lower arm. One for use when welding can assemblies 1-1/4-inch diameter and greater; and one for use when welding can assemblies of greater diameters. The horn shall protrude sufficiently to allow at least 1-inch reach of electrode wheels into can ends.

10.10.3 Electrode wheels (one each as required) shall be provided, suitable for use when welding the following diameter cans 1-1/4, inches in diameter.

10.11 Upper Arm Assembly:

10.11.1 The upper arm shall incorporate the rocker-arm feature, and shall be equipped with an idling wheel which will ride around the outside of the cans being welded.

10.11.2 The upper horn and head assembly shall be adjustable in and out of the upper arm socket through loosening of socket-head cap screws and manual adjustment. (See Optional Item 10.15.1).

10.12 Water Cooling

10.12.1 Water cooling for power ignitron tubes shall be connected directly to source. Water cooling to the welding transformer shall be controlled by means of a thermostat and solenoid valve, in order to prevent condensation. The control panels shall be adequately cooled with room air by means of a connection or blower arrangement, as required. All flood cooling water shall flow simultaneously throughout the machine, controlled by the foot switch. The upper arm shall be equipped with flexible tubing to enable directing flood cooling water on part as required.

10.13. Electrical Construction

10.13.1 Transformer

10.13.1.1 The transformer shall be rated 75-kva at 50-percent duty cycles and shall be capable of delivering a maximum of 45,000 short-circuit secondary amperes for a maximum duration of 5-cycles without saturation, and shall have balanced primary loading on the three-phase power supply at 85 per cent minimum power factor. The transformer shall be suitable for operation from a 440 to 480-volt, three-phase 60-cycles power supply.

10.13.2 Centrols

10.13.2.1 The machine shall be equipped with fully electronic synchronous control which shall insure each cycle of secondary current being uniform. Heat control shall be by stepless phase-shifting. Machine shall be equipped with the following timers, adjustable within the ranges specified for each:

- a. Squeeze timer : Adjustable from approximately 0 to 72-cycles
- b. Weld Interval Timer : Adjustable from 1 to 110-cycles
- c. Weld Timer : Adjustable from 1 to 10-cycles
- d. Cool Timer : Adjustable from 1 to 20-cycles
- e. Current Decay Timer : Adjustable from 1 to 10-cycles
- f. Hold Timer : Adjustable from approximately 0 to 72-cycles
- g. Motor Rotation Timer: Adjustable from 1 to 110-cycles
- h. Forge Timer : Adjustable from 1 to 330-cycles

All times are based on 60-cycles per second. The control shall also permit the use of 1,2,3 or more heat cycles in the making of a given weld.

10.13.3 Other Electrical Requirements

- a. Design and construction shall comply with the applicable specifications of AIEE, NACA, NEMA and RWMA, excepting in such cases where the components exceed the requirements of these specifications.
- b. All wiring in both machine and controls shall be color coded and shall be in accordance with the best commercial practice.
- c. Wiring and small components shall be grouped and mounted or connected to terminal strips using lugs and screws except where good reason can be shown for soldered connections.
- d. All wiring and components shall exhibit maximum accessibility and ease of servicing with all components clearly identified.
- e. Electrical control circuit panels shall be shock mounted to reduce vibration disturbances from welding operations.
- f. The controls shall be constructed integrally with the machine.

10.13.4 Equipment Data

An equipment manual shall be furnished with the machine or prior to its delivery. This shall include complete operating instructions, installation and maintenance instructions, spare parts list, mechanical-water-pneumatic system prints, composite and elementary schematic wiring diagrams.

10.14 Net Weight: 7,500-pounds (approximately)-Shipping Weight: 9,250-pounds (approximately).

NOTE

When machine is ready for installation in your plant, we shall send one of our qualified engineers to assist in this installation and familiarize your personnel with the proper operation and maintenance of the equipment.

PRICE: This machine complete, in accordance with the specifications outlined shown and substantially as shown on our Drawing No. D-75142 attached.

Net f.o.b. our factory, Chicago, Illinois\$23,536.00

10.15 Optional

10.15.1 To provide mechanical means of adjusting upper horn and head assembly in and over a range of 0.8750-inch (or 0.4375-inch either side of center) through suitable rack and pinion gear and hand-wheel\$720.00

10.15.2 To provide this machine with a Predetermined Electronic Dekatron Counting System which shall count cycles of line frequency for timing functions and impulses of secondary current for interval periods instead of system described in this quotation\$5,307.00

10.15.3 For addition of Preheat, Quench and Postheat Sequences by plug-in units to machine when Dekatron System, is ordered per optional Item 2 above ..\$1,116.00

10.15.4 Delivery: Approximately 12 weeks after date of receipt of your order. Approximately 16 weeks, with Dekatron System after date of receipt of your order.

10.16 Poke Gun - Sciaky PWO.1 portable electronic resistance spot welding unit for use with hand pressure guns in tack welding, rated 50-kva complete with 10-feet of secondary cable, weld timer, heat control by means of 8-step tap switch, and a air cooled hand pressure gun. Shipping weight: 800-pounds. Total price, net f.o.b. our factory, Chicago, Illinois\$1574 (approx.)

10.16.1 Delivery - Four to five weeks after receipt of your purchase order.

10.17 Sequence of Assembly

Parts will be located in an assembly fixture and tack welded with a poke gun to facilitate assembly. The parts are then removed from the assembly tool and inserted in the seamwelding machine. A guiding fixture may be provided on the seamwelding machine to hold the parts in proper location with respect to the electrode wheels. (See Figures 4 and 6 for proposed method of assembly)

11. Quality Control Considerations

11.1 Periodic Helium Leak Tests may be conducted subsequent to welding the first end cap into a given assembly. Experience on similar applications has proven that the percentage of rejections is nill when periodic non-destructive tests are made in conjunction with destructive quick tests (cross sections).

The production quick tests may be limited to a frequency of every four hours and possibly at much less frequent intervals as productions technique develops.

Figure 4. Proposed Steps for Fabricating Zirconium Cans

A-1175

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IS DEVOTING ITS ENTIRE FACILITIES TO . . .

- The study of resistance welding processes for the advancement of welding equipment.
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- The gathering of data, records, literature, and the establishment of a specialized resistance welding library for industry.
- The publishing of research data through trade papers, bulletins and technical manuals.
- The sponsoring of conferences and meetings for the exchange of knowledge related to resistance welding.
- The establishment of training courses and lecture programs for the use of industry.

PLANT	LOCATION	DATE
Sciaky Bros. Inc.	5301	703 JUN 19 1958
Wm Mathis	1705	3703 JUN 26 1958

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French Plant Sciaky S.A., 13, 15 Rue Charles Fourier, Paris, France

British Plant Sciaky Electric Welding Machines, Ltd., Slough, Bucks, England

Research Plant 2311 Purdue Ave., Los Angeles 64, Calif., Bradshaw 2-9513

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