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ROCKETDYNE REMOTE WELDING FACILITY - TRIP REPORT

By

John M. Holmes

ABSTRACT

The Rocketdyne Division of North American Aviation Company at McGregor, Texas, is currently welding rocket motor cases containing solid fuel remotely. Details of the process are given and some recommendations made by Rocketdyne personnel on the welding procedure proposed for the ICPP Pot Calcination Pilot Plant are also included.

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1.0 INTRODUCTION

The Rocketdyne Division McGregor, Texas plant of the North American Aviation Company was visited on January 18, 1962, to inspect their remote welding facility and to confer with Rocketdyne personnel on remote welding techniques. Our interest in remote welding concerns the problem of providing an inexpensive, safe, and permanent closure for calcination pots to be produced in the ICPP Pot Calcination Pilot Plant. These pots will contain solid radioactive wastes that will generate considerable quantities of fission product heat and may build up in pressure over long periods of storage. They will be between 6 and 12 inches in diameter, approximately 8 feet in length and will be fabricated of type 347 or 304L stainless steel. The diameter of the welded closure will probably be about 4 inches. The design proposed (Fig. 1) would be heliarc fusion welded with a tungsten electrode and inert gas backup.

2.0 REMOTE WELDING OPERATION

Rocketdyne personnel contacted:

R. J. Martinelli, Manager of Manufacturing
W. B. Austin
E. F. French
A. C. Phelps

The Rocketdyne plant at McGregor, Texas, is concerned with the production of solid fuel rocket motor gas generators used as turbine starters for missiles. The rocket motors welded in the remote welding facility are 5-11/16 inches outside diameter and are fabricated of heat treated type AISI 4130 steel which has an average composition of 0.95% Cr, 0.50% Mn, 0.70% Mo and 0.3% C. Its domed head containing the igniter is slipped into position in the case containing the rocket fuel and then welded remotely using tungsten inert gas welding and filler metal. The reason for remote welding is apparent since the distance between the weld and the nearest explosive material is roughly 1 inch. A cooling jacket placed around the fuel section of the case and a copper jacket placed around the case at the weld to improve the heat distribution at the weld are adequate for preventing ignition of the fuel. A sketch of the fillet weld, tungsten electrode holder, filler metal feeder and rocket case positioned for welding is shown in Fig. 2.

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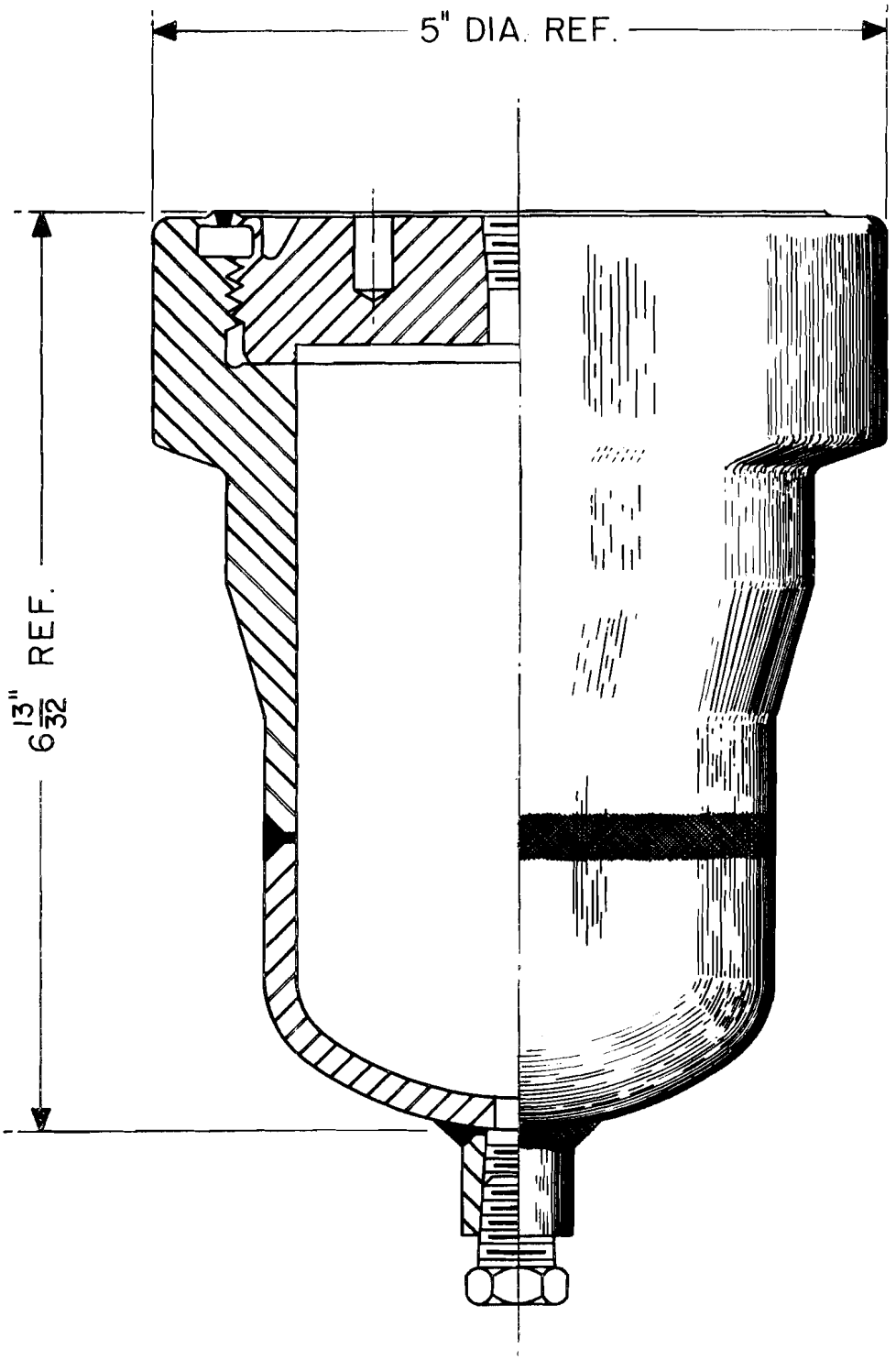

Fig. 1. Test Assembly

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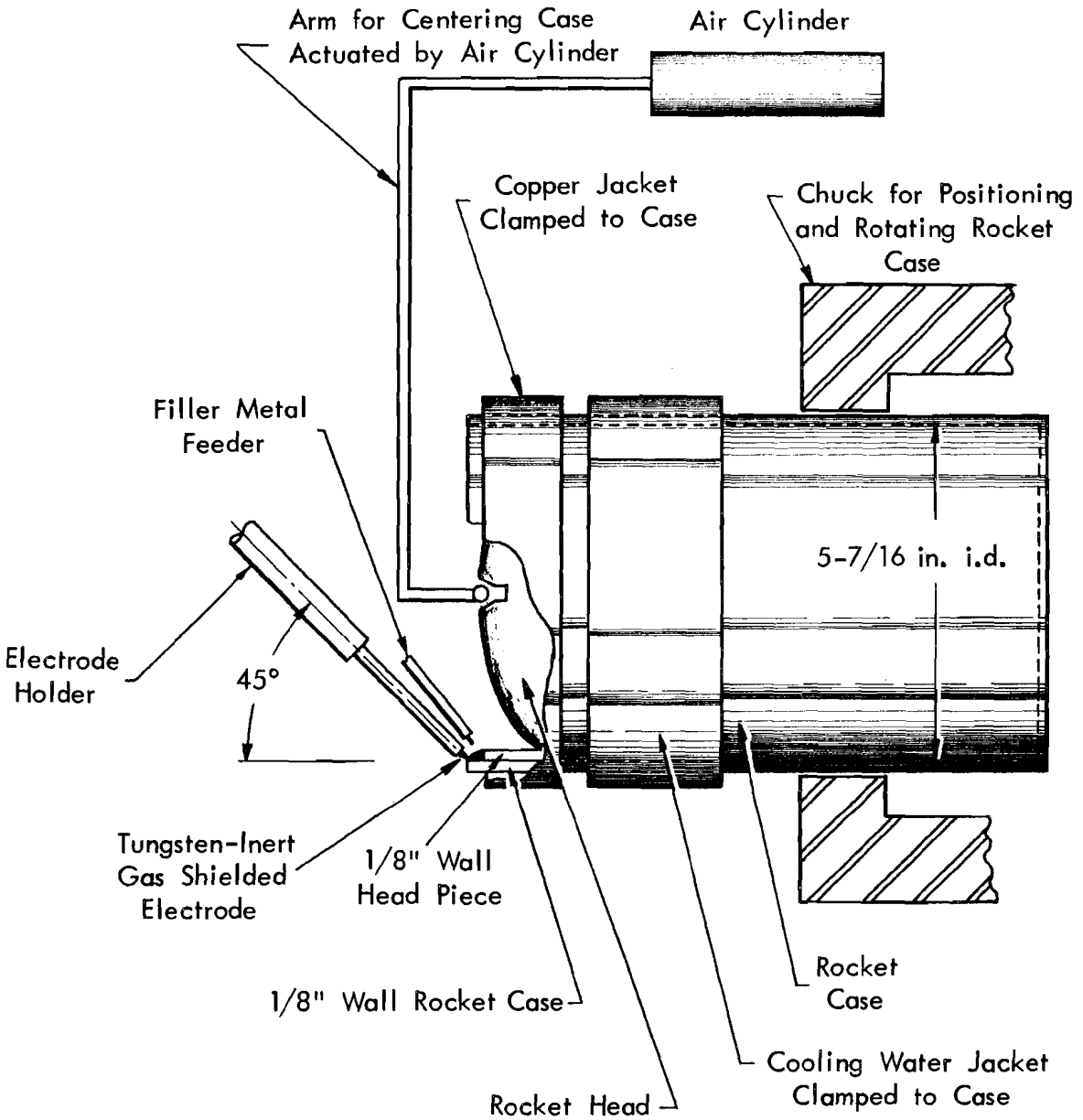

Fig. 2. Rocket motor case welding procedure.

The horizontally positioned rocket case is rotated at a constant speed of about three minutes per revolution. Exact centering of the revolving case is maintained by an air cylinder actuated arm containing a ball joint which fits into a socket in the rocket head piece. The electrode holder is maintained at a 45 degree angle to the horizontal and is mounted in an Airco heliweld welding head positioned by a hydraulically-operated ram manipulator. The entire assembly is lined up by direct handling before starting the welding operation. The welding head is then withdrawn from the weld and the operator takes a position behind a concrete wall where he can watch the welding operation remotely using a mirror.

In starting the weld, the welding head is moved towards the weld remotely; the arc is struck and its length is set automatically by electronic equipment which positions the welding head. Two passes are made. The first is a fusion pass at about 140 amperes and the second is made with Oxyweld 41 filler metal at about 175 amperes. Initially, just the filler metal pass was used until it was found that adding a fusion pass reduced the thermal stresses induced in the heat affected area next to the weld and improved the rocket case burst pressures. The two pass fillet welds have withstood hydraulic pressures of around 6000 psi. An additional improvement that Rocketdyne has made to prevent thermal shock at the start of the weld and to eliminate blow holes at the termination is the use of an electronic slope control on the amperage. This control automatically slopes the current between 30 and the required welding amperage over a period of 1-1/2 to 3-1/2 seconds when starting and completing the weld.

Rocketdyne has found that the tungsten electrode must be removed and sharpened after each 24 inches of weld, which usually means the completion of each case. They state that the high carbon content of the 4130 metal tends to erode away the electrode. With stainless steel this effect will not be as pronounced but it was recommended that provisions be made for sharpening, replacing, and repositioning the tungsten electrodes. This may present difficulties in the design of remote cell welding equipment.

The total cost of the Rocketdyne remote welding equipment was about $28,000. This included the welding equipment, special electronic

equipment, labor and installation costs. Although the machine for sealing pots in the ICPP may not need the special electronic equipment, it will require additional remote positioning gadgetry so this cost can probably be considered as a minimum.

3.0 RECOMMENDATIONS BY ROCKETDYNE PERSONNEL

In reviewing our proposed welding procedure for the pot calciners several recommendations and suggestions were made by Rocketdyne. Their primary concern was the difficulty that may be experienced in removing and maintaining the tungsten electrodes remotely. It was suggested that we consider the use of a consumable electrode, inert gas-shielded process for the following reasons:

1. The wire electrode could be maintained by clipping off a short piece after each weld using a pair of remote clippers. This would do away with tungsten electrode sharpening and positioning device. The consumable electrode would be positioned electrically similar to the Rocketdyne procedure.

2. If an error occurred during welding, the electrode could be clipped off remotely near the weld and the weld started over again.

3. The additional metal would add strength to the weld.

4. Welding speeds for consumable electrode processes are generally higher than for the tungsten electrode processes. Although this would not significantly increase pot production rates, it was thought that the faster welding speeds would produce less heating and pressure buildup of the gases in the closed pot and might prevent blow holes at the completion of the weld. We don't know yet if this will be a problem, but it will be investigated during the Lockheed mechanical program.

The Rocketdyne group was most cooperative during the visit and offered to send us detailed prints of their remote equipment. We will request these prints if the decision is made to proceed with the pot welding program.

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