

*Gas Shutter Closure for  
Sealing LOS Pipes*

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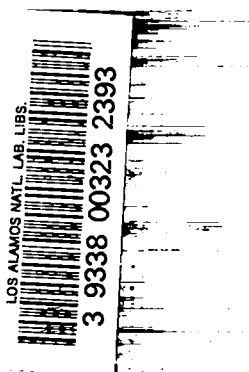
*Prepared by Laurene Wolfe, Group J-7*

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*Ronald A. Cosimi*



# **GAS SHUTTER CLOSURE FOR SEALING LOS PIPES**

**by**

**Ronald A. Cosimi**

## **ABSTRACT**

An extensive effort went into the design and development of an extremely reliable gas shutter closure for use in sealing a line of sight pipe between a nuclear explosion and an experiment array. The type of event that would require a gas shutter has been out of vogue for many years, but recently there has been a renewed interest in vertical line of sight testing. This report documents some of the unwritten history of the valves before this history is completely forgotten.

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## **I. INTRODUCTION**

The Los Alamos National Laboratory conducted, for many years, underground events called vertical lines of sight (VLOS). These events consisted of a nuclear device emplaced at the bottom of a vertical pipe to the surface. Closures were placed at numerous locations along the VLOS to ensure containment. One of the most frequently used closures was a fast-acting valve, or gas shutter, developed by Los Alamos in 1965. Over the years this valve has been modified and changed in size, but the basic concept has remained the same. The last 12-inch gas shutter closure was used by Los Alamos in 1972.

Los Alamos had a stockpile of gas shutters, but for several years there was no interest in using them. Recently however, several valves were given to Sandia Laboratories, Defense Nuclear Agency, and Lawrence Livermore National Laboratory. These were either used for local testing or in Nevada Test Site (NTS) events.

There does not exist any one piece of documentation that ties together the design concepts, operation, test methods, failures, successes, etc., for the gas shutter valve. This report presents this information for a 12-inch gas shutter that is the model from which all the other sizes evolved.

## II. DESIGN CONCEPT

Los Alamos designed the first gas shutter closure in 1965. The closure was designed to meet the following criteria:

Closing time: less than 100 ms

Preshot environment: 10 microns

Postshot environment: 1000 psig, 200-300°F

Mounting: tensile member of VLOS pipe; load 200,000 lb

LOS seal: to be protected from radiation as much as possible

Over the years from 1965 to 1980, 18 gas shutters were fabricated and used in underground tests, or were given to other labs. The basic design was also scaled up for closures of 16-, 18-, and 24-inch diameters.

The original valve concept evolved from that shown in Fig. 1<sup>1</sup> into that shown in Figs. 2 and 3.<sup>2</sup> The domed lid (A, Fig. 2) was held in the open position by a Conax latch pin (B, Fig. 2). Notice that the O-ring seal is on the lid and out of direct radiation. At zero time a signal fired the two redundant squibs (C) in the latch pin causing the pin to retract and release the domed lid. The lid was pulled to the closed position by two extension springs (D, Figs. 2 and 3). At the closed position, the lid was captured by the latches (E, Fig. 3) arrayed around the periphery of the valve seat (F, Fig. 3). The motion and closing time of the lid was monitored by the redundant micro switches (G, Figs. 2 and 3) mounted under the lid hinge.

As use and testing of the valve increased, two important changes were made in the basic design shown in Fig. 1. The first change was to reverse the domed lid, concave toward the working point, and to fabricate it from USS-T1 steel.

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1. Los Alamos drawing 34Y114055, 12-inch Gas Shutter.
  2. Los Alamos drawing 34Y114931, 12-inch Gas Shutter.

This change was made after an original lid failed during a hydrostatic test.<sup>3</sup> The new valve has consistently passed a 1250-psig hydro test. The second change was to replace the three Vlier pin latches (H, Fig. 1) with six leaf spring latches (E, Fig. 3). High speed filming of the closing lid, using Vlier latches, indicated a "bounce." The lid ultimately closed again but often took as long as 300 ms. By adding more latches and making them as shown in Fig. 3, the bounce of the lid was eliminated. This did take some amount of testing as described in the following section.

### III. VALVE TESTING

A typical sequence of events used to certify a valve for an NTS event was as follows.<sup>4,5</sup>

1. Hydrostatically test the closed valve to 1250 psig.
2. Remove the outer case and mount the seat/lid assembly in a test stand.
3. With the lid in the closed position and all latches engaged, set the lid-to-seat gap at 0.038 inches by adjusting latches and hinge. Dowel adjustable parts in place.
4. Adjust the closed micro switches.
5. Pull lid to the open position and install a Conax latch pin.  
Note: No springs are attached yet.
6. Adjust open micro switch.
7. Close lid and install springs. See discussion of springs in next section.
8. Pull lid open using a winch. A small boat winch was used.
9. Install a dummy Conax latch pin--one that can manually be retracted.
10. Using high speed film and/or micro switch monitors, manually release the lid.
11. If bounce is indicated, shim the space behind the latches to restrict their backward movement after being struck by the lid.

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3. Los Alamos Report J-7-70-185, Gas Shutter Valve Failure.

4. Los Alamos Report J-7-71-4, 12-inch Gas Shutter Test.

5. Los Alamos Report J-7-71-4 Supplement, 12-inch Gas Shutter Test.

12. Repeat #10 and #11 until lid closes with no bounce.
13. Test closing using live Conax latch pins and squibs.
14. Place inner assembly into outer case and complete wiring.
15. Vacuum check assembly.
16. Fire completed assembly while under vacuum. Repeat as required to build confidence level.

#### IV. OPERATION

The 12-inch gas shutter has been actuated and successfully closed and latched in more than 50 tests. The tests included a series for establishing closure reliability, pre-downhole testing, and operation during events at the NTS. Springs of 4.3 lb/inch each were used in almost all closure tests. These springs were chosen to give a closing time of  $100 \pm 10$  ms. The timing of the closures was based on the time from the squib fire signal to the actuation of the closed micro switches. Closing times of 75 to 105 ms were observed over the years. The variation in closing times was attributed to the positioning and adjustment of the closed micro switches because the springs and gas shutter designs were always the same.

If it is ever desired to change springs to either increase or decrease the closing time of the shutter, it would be wise to re-position the micro switches or use a different timing method. Furthermore, if the closing time of any particular shutter were changed radically (increased or decreased), it would probably be necessary to re-adjust the latches to prevent the lid from bouncing open.

#### V. SUMMARY

A short history and discussion of operating characteristics for the 12-inch gas shutter has been presented. This valve, and scaled-up versions of it, has been used successfully as part of the containment scheme for numerous Los Alamos VLOS events. Because there is a renewed interest in this closure and most of its history is fading with the memories of those that worked with it, this report ties together the information that future users might need to set up, test, and operate a 12-inch gas shutter.

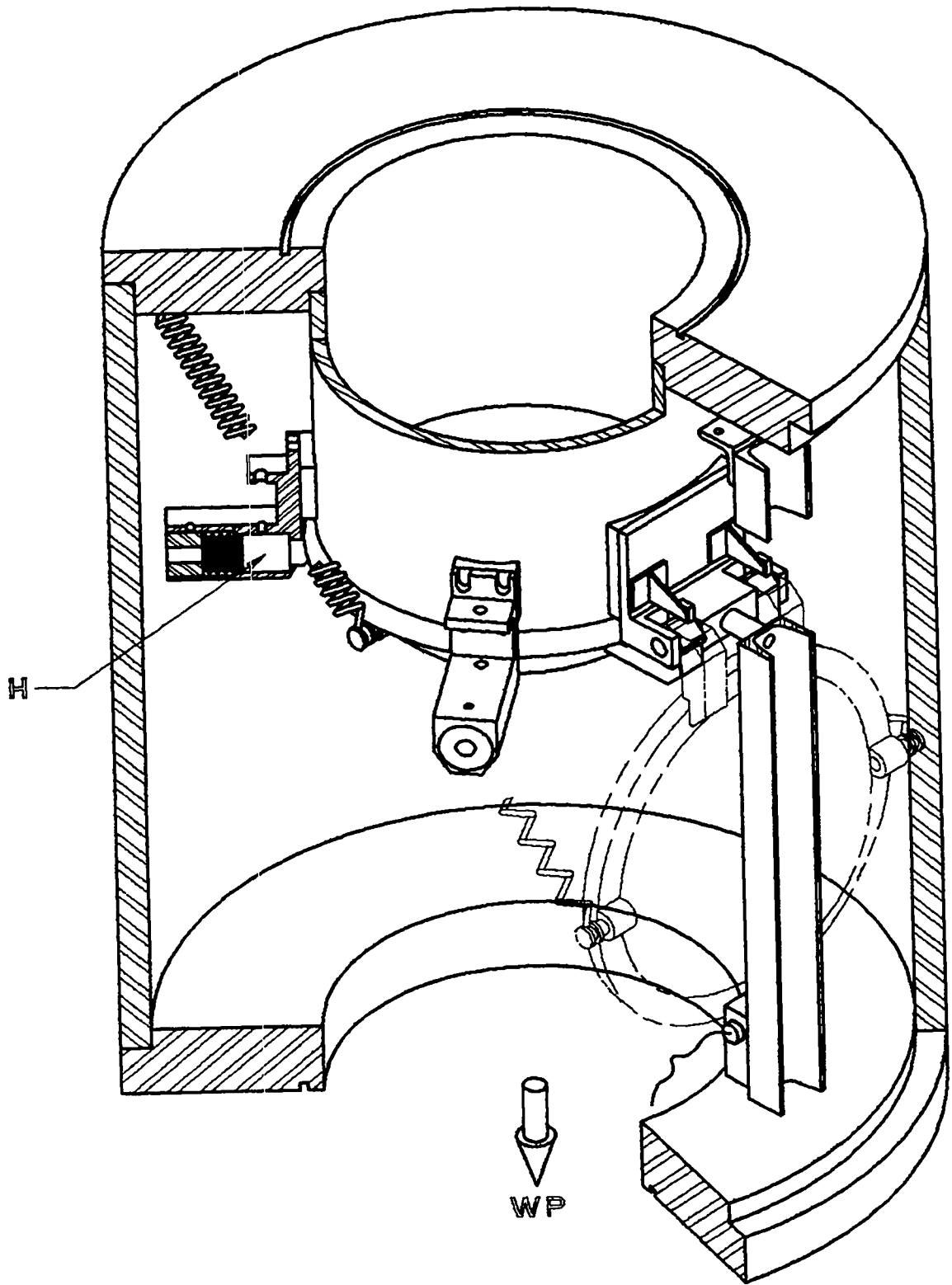


Fig. 1. 12-inch gas shutter, Vlier pin latches.



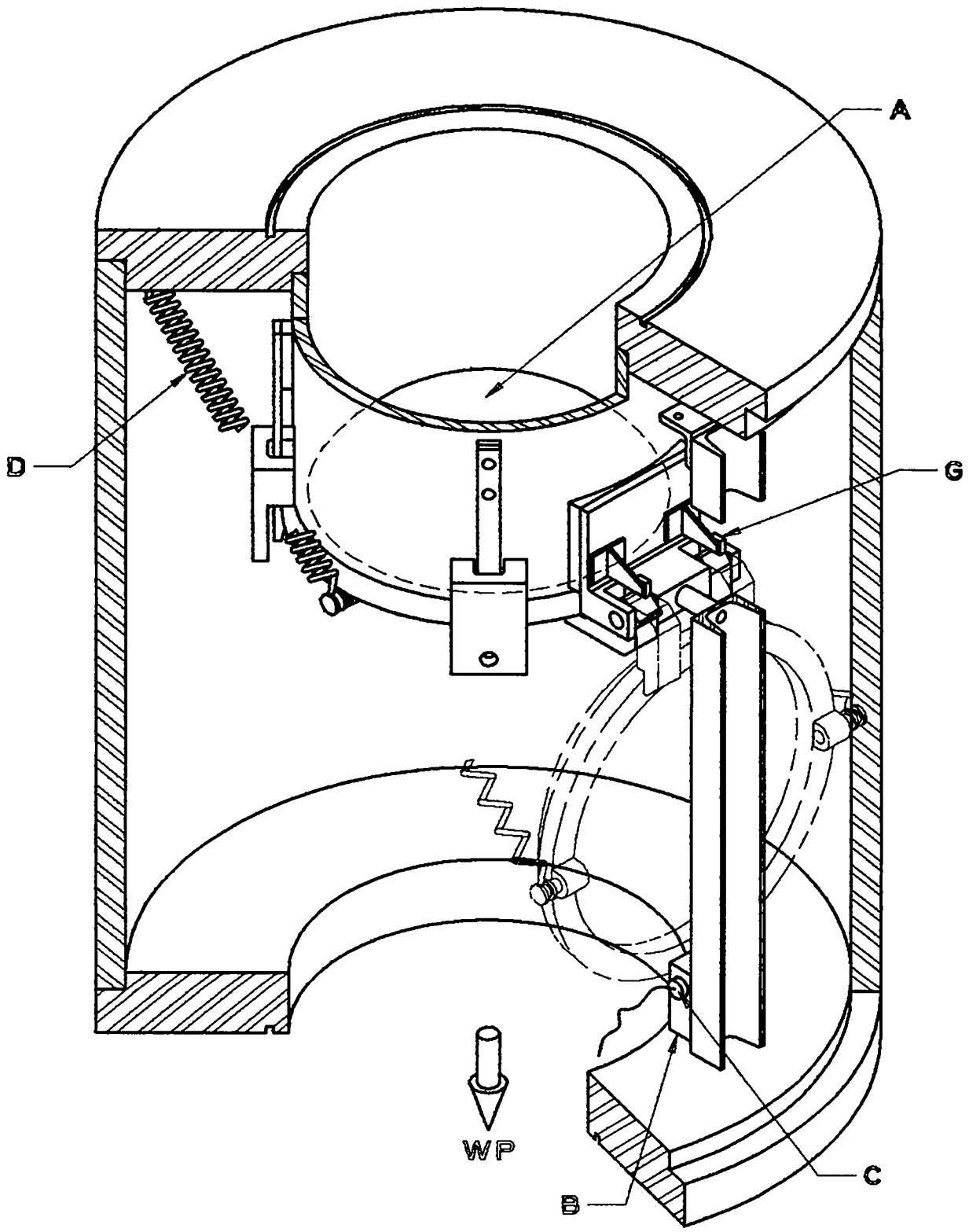


Fig. 2. 12-inch gas shutter, spring latches.

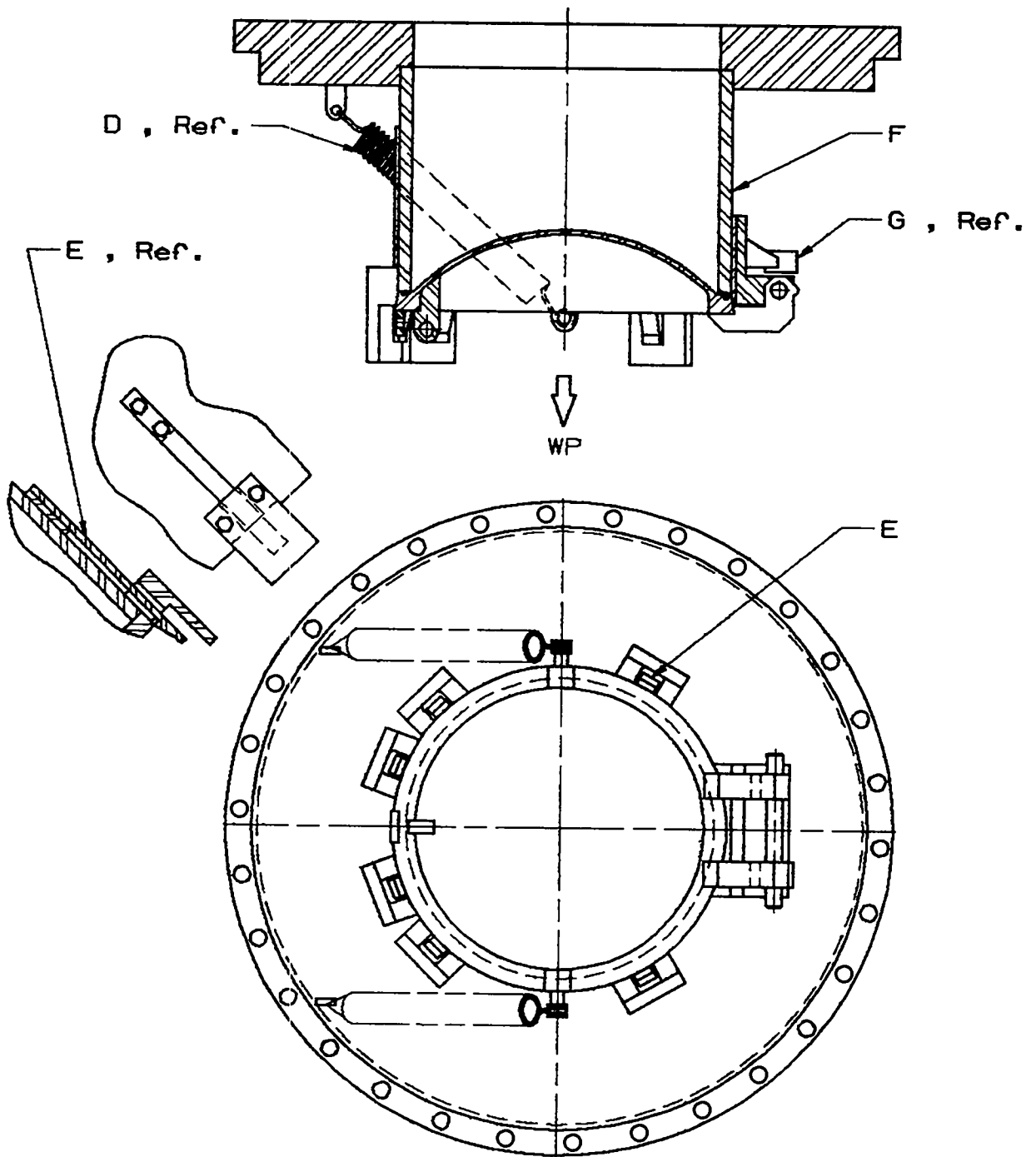


Fig. 3. 12-inch gas shutter, interior mechanism.

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