18. METEOROID-DETECTOR DEPLOYMENT AND PRESSURIZATION SYSTEMS

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SUMMARY

The Explorer 46 Meteoroid Technology Satellite (MTS) launched from Wallops Island, Va., on August 13, 1972, was configured to fit within the Scout heat shield, 86.36 cm (34 in.) in diameter. In order to package within this envelope, the meteoroid bumper detector panels had to be rolled up unpressurized and secured to the spacecraft main structure. After the spacecraft was placed in orbit the panels were unrolled by a deployment system and inflated by a pressurization system.

INTRODUCTION

The Explorer 46 Meteoroid Technology Satellite (MTS, fig. 1) was designed to collect data on the near-earth environment and its effect on spacecraft structures. The data will be utilized to evaluate the meteoroid protection provided by a typical bumper-protected multisheet spacecraft structure.

The spacecraft in its launch configuration (fig. 2) was designed to fit within the Scout heat shield, 86.36 cm (34 in.) in diameter. In order to do this the bumper detector panels were rolled up on spools, the telemetry system was packaged in two containers that were hinged down against the spacecraft structure, and the aft-facing solar cells and impact detectors were mounted on the flip-out panels. The Scout fourth stage motor case and upper "D" section were retained as part of the spacecraft.

The bumper detector panel consisted of two stainless-steel bumper target sheets 0.025 mm (0.001 in.) thick attached to the bumper detector panel, which is 0.051 mm (0.002 in.) thick, with belt loops, restraint bars, and standoffs (fig. 3). The standoffs were tack welded to the detector panel in the void areas between detectors. A restraint bar was passed through the loops in the ends of the standoffs and tack welded to the standoffs on the center line of the panel only. The same restraint bar also passed through belt loops tack welded to the bumper sheet. Along the panel center line the belt loops were attached to the bumper sheet on alternate sides of the standoffs as shown in figure 3. This method of attachment allowed the bumper sheet to float above the detector panel while being restrained along the center line of the panel.

The total bumper-protected area was 27.87 m^2 (300 ft^2). This area was subdivided into 12 panels 48.92 cm (19.26 in.) wide and 3.20 m (10.5 ft) long. Each detector panel had eight detectors, 5.03 cm (1.98 in.) wide by 3.20 m (10.5 ft) long, giving a total of 96 bumper-protected detectors. A pressurized-depressurized pressure sensing device utilizing two single-pole double-throw switches monitored the condition of each of the 96 detectors (fig. 4).

DEPLOYMENT SYSTEM

Two Spar Aerospace Products Ltd. "Bi-Stem" motorized actuator assemblies were used to deploy 12 rolled-up detector panels. Each assembly (see fig. 5) deployed six panels, two groups of three diametrically opposed.

Each of the two actuator assemblies had a master and a slave actuator coupled together with a shaft to insure synchronous extension of the booms 2.18 cm (0.86 in.) in diameter. The master actuator was motorized to provide an extension rate of 17.78 cm (7 in.) per second under a tip load of 11.12 N (2.5 lb) per boom.

The spreader bar was attached to the tip ends of the booms and carried three detector spools. A drag device was built into the spools to provide a tension load to eliminate any premature unrolling of the detectors as they were deployed.

Straps restrained the detector-spool assemblies and spreader bar to the cradles during launch. One end of the strap was pinned to the cradle with a tensioning device, which was secured by dual pyrotechnic pin-pullers. Release of a strap required only one pin-puller to function.

After the straps were released the motor was energized and the panels deployed. When the panels were fully deployed stops dropped into slots in the booms to limit the boom extension. Limit switches operated by the stops on the master actuator boom opened the motor circuit. The detector panels were then ready to be pressurized.

PRESSURIZATION SYSTEM

Since the detector panel had to be rolled up unpressurized during launch, it was necessary to provide a means for pressurizing the detectors after deployment. To do this a reservoir, with a valve to contain the pressurization gas in the reservoir, and a pressure sensing device to indicate the pressurized or depressurized state of the detector were designed. These two units made up the switch-reservoir assembly (see fig. 4). There was an assembly for each detector in a panel. The eight assemblies serving a panel (see fig. 6) were located in its cradle. Eight small-diameter tubes projected from the root end of each panel and were coupled to the switch-reservoir assembly detector pressurization tubes.

The valve in the switch-reservoir assembly was closed by pressurizing the bellows to 48.26 N/cm^2 (70 psig) through its pressurization tube. This seated the valve seal plate on an O-ring in the reservoir base, isolating the reservoir from the detector and switch.

The eight-valve-bellows pressurization tubes for a detector panel were manifolded together with two additional tubes. One of the additional tubes was used to pressurize the valve bellows. The other tube had a break-off element soldered to the end of it. This element was inserted in a pyrotechnic device that when

fired would break off the end of the element, thereby venting the gas in the valve bellows and allowing the bellows to open.

After all the valves were closed, each reservoir was pressurized individually to 44.32 N/cm^2 (65 psig) and its pressurization tube crimped and sealed with solder. After the detector panels were deployed and the valves opened, the gas from the reservoir pressurized the detector to between 6.21 N/cm^2 (9 psia) and 11.38 N/cm^2 (16.5 psia), depending upon the detector temperature.

When the valve was opened gas also passed into the pressure sensing device, deflecting the belleville spring to the position shown in figure 4 and causing the switch contacts to transfer and indicate a pressurized condition. When the detector was punctured by a meteoroid the gas leaked out, the belleville spring returned to its normal position and allowed the switch contacts to transfer back and indicate a no-pressure condition.

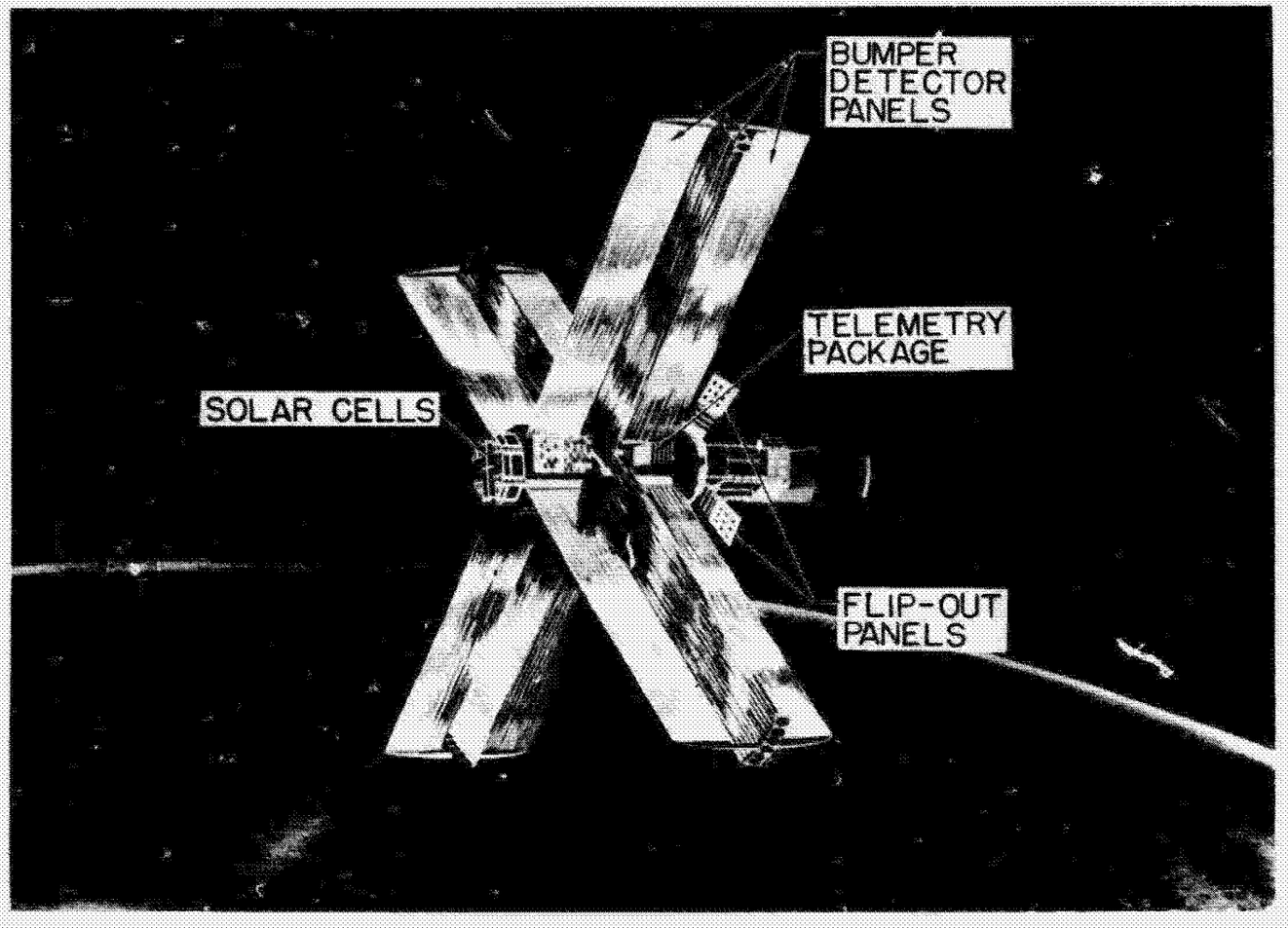

Figure 1.- Meteoroid Technology Satellite (MTS). Explorer 46.

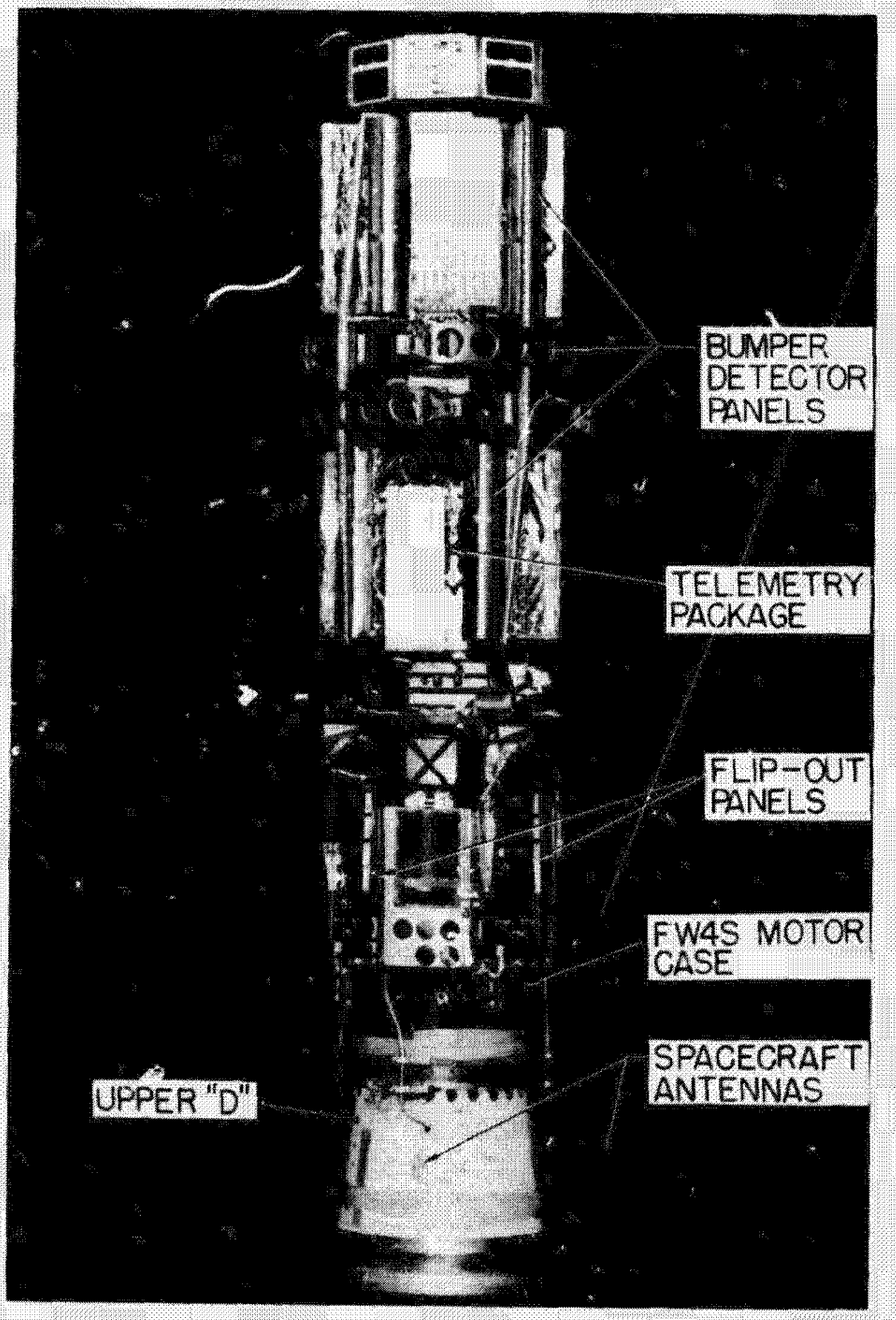

Figure 2. - MTS launch configuration.

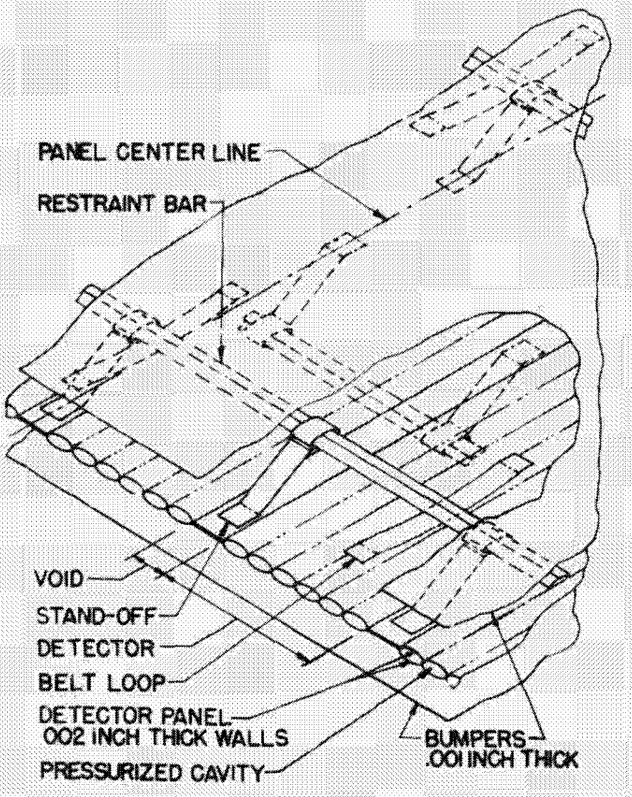

Figure 3.- Bumper detector panel.

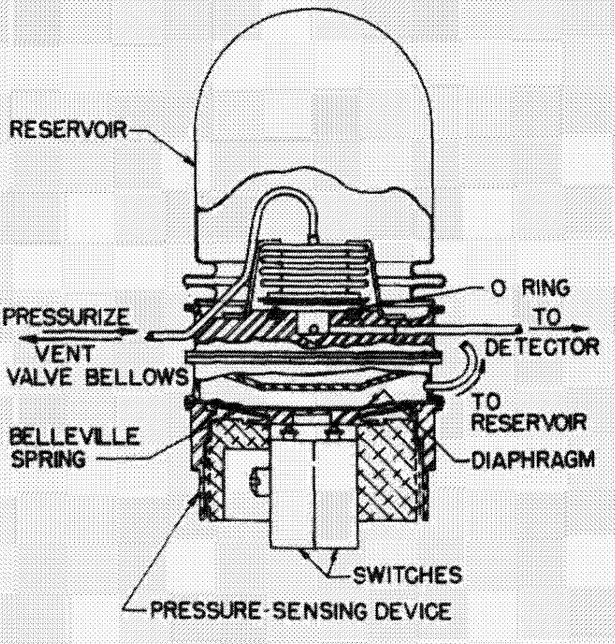

Figure 4.- Detector switch-reservoir assembly.

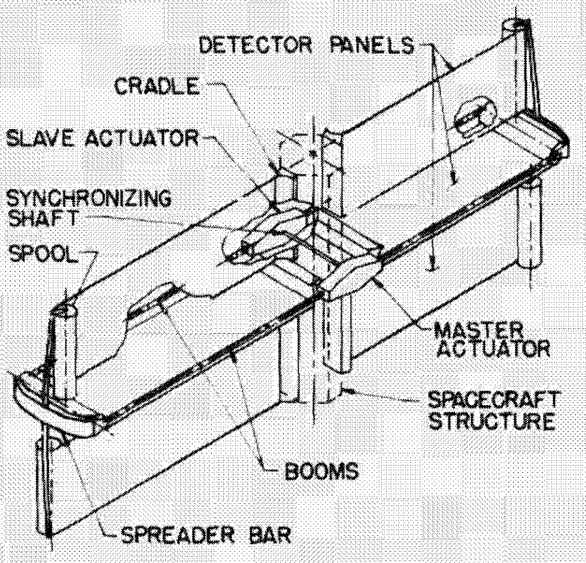

Figure 5.- Detector panel deployment system.

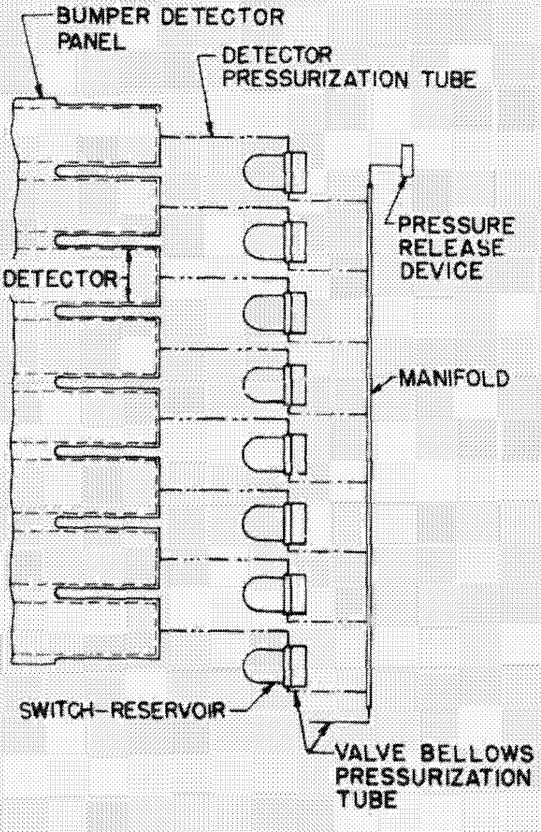

Figure 6.- Detector panel pressurization system.