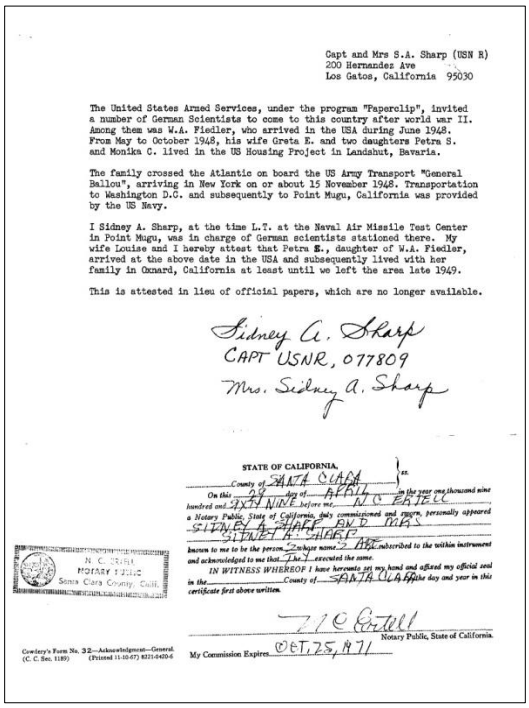
THE LIFE AND WORK OF WILLY ACHIM FIEDLER,

Designer, test pilot, aeronautical and missile engineer

1908-1998

by Rit Staalman and Monica Wagner-Staalman

2. The United States



Capt and Mrs S.A. Sharp (USN R)
200 Hernandez Ave
Los Gatos, California 95030

The United States Armed Services, under the program "Paperclip", invited a number of German Scientists to come to this country after world war II. Among them was W.A. Fiedler, who arrived in the USA during June 1948. From May to October 1948, his wife Greta E. and two daughters Petra S. and Monika C. lived in the US Housing Project in Landahut, Bavaria.

The family crossed the Atlantic on board the US Army Transport "General Ballou", arriving in New York on or about 15 November 1948. Transportation to Washington D.C. and subsequently to Point Mugu, California was provided by the US Navy.

I Sidney A. Sharp, at the time L.T. at the Naval Air Missile Test Center in Point Mugu, was in charge of German scientists stationed there. My wife Louise and I hereby attest that Petra E., daughter of W.A. Fiedler, arrived at the above date in the USA and subsequently lived with her family in Oxnard, California at least until we left the area late 1949.

This is attested in lieu of official papers, which are no longer available.

Sidney A. Sharp
CAPT USNR, 077809
Mrs. Sidney A. Sharp

STATE OF CALIFORNIA,
County of SANTA CLARA } ss.
On this 29 day of APRIL in the year one thousand nine hundred and SIXTY NINE before me, N C BAIELL
a Notary Public, State of California, duly commissioned and sworn, personally appeared
SIDNEY A. SHARP AND
SIDNEY A. SHARP
known to me to be the person whose name subscribed to the within instrument and acknowledged to me that executed the same.
IN WITNESS WHEREOF I have hereunto set my hand and affixed my official seal in the County of SANTA CLARA the day and year in this certificate first above written.

N. C. BAIELL
NOTARY PUBLIC
Santa Clara County, Calif.

Notary Public, State of California.
My Commission Expires OCT. 25, 1971

Cowlery's Form No. 32—Acknowledgment—General. (C. C. Sec. 1189) (Printed 11-10-67) 8321-0420-6

In **1948** *Willy Fiedler* and his family moved to California. He went to work for the US Navy Missile Test Center at *Point Mugu*, on the Pacific coast, not far from Los Angeles.
Point Mugu is to this day a Navy facility. Near the entry of the camp an open air exhibit gives an overview of the development of various weaponry of the missile kind between the end of the Second World War and 1960. The last missile shown is the Polaris, which was the first missile that could be launched vertically from a submerged submarine.
At the entrance of the so-called "Missile Park" a real life F-4 Phantom jet fighter functions as a gate keeper. This airplane played a role in following and observing the flight path of the missiles. According to Willie Fiedler he flew on occasion the mighty machine himself.

Instrumental in the move from Germany had been *Dr. Herbert Wagner*, leading German scientist on the development of guided missiles, who himself was employed at the Naval test facility. Wagner and Fiedler had known each other in Germany during the war at the test center in Peenemünde where Fiedler had been chief of the test program of the V1. Wagner had been director of missile development at Henschel. Noticing the troubles of the *Loon* testing program, which were very similar to the tribulations in Peenemúnde, he had recommended calling in Willie Fiedler.

Martin Hollmann writes: [1]

[1] in 'SCIENTISTS AND FRIENDS", a periodic publication of Martin Hollmann, Monterey CA.
http://www.scientistsandfriends.com/

"….In June of 1948, *Willy Fielder* came to the US with his family under "Operation Paperclip." They moved to Oxnard, California so that Willy could easily commute to work at the Pt. Mugu Air Missile Test Center. Eleven other scientists including *Dr. Hans E. Hollmann, Dr. Herbert Wagner and Robert Lusser* were among these Paperclip scientists. In Germany, Fiedler had been in charge of the flight testing of the Reichenberg (V-1) cruise missile or "Buzz bomb," as it was often called, at the Fieseler Aircraft Co. and in charge of the design of the Natter at the Bachem-Werke. Robert Lusser, who was also one of the Paperclip scientists, designed the V-1 in 1942 [while working for the Fieseler Company]."

Point Mugu CA, Missile Park; Loon missile [photo rs]

The Navy was especially interested in Dipl.-Ing. Fiedler's extensive experience with testing (and flying) the Fieseler Fi-103 or "V-1" Flying Bomb. The Navy had plans to adapt its own flying bomb, *the Loon missile*, for launching from submarines. The Loon was a straight derivative of the V-1 and was intended to be used against the Japanese. Development of the Loon had started in 1944 and 1200 had been built by Republic Aviation in New York. Obviously the experience of *Dipl.-Ing. Robert Lusser*, the original designer of the V-1 and Dipl.-Ing. Willy Fiedler, its Chief Director of Testing, were of special interest to the Navy program.[2]

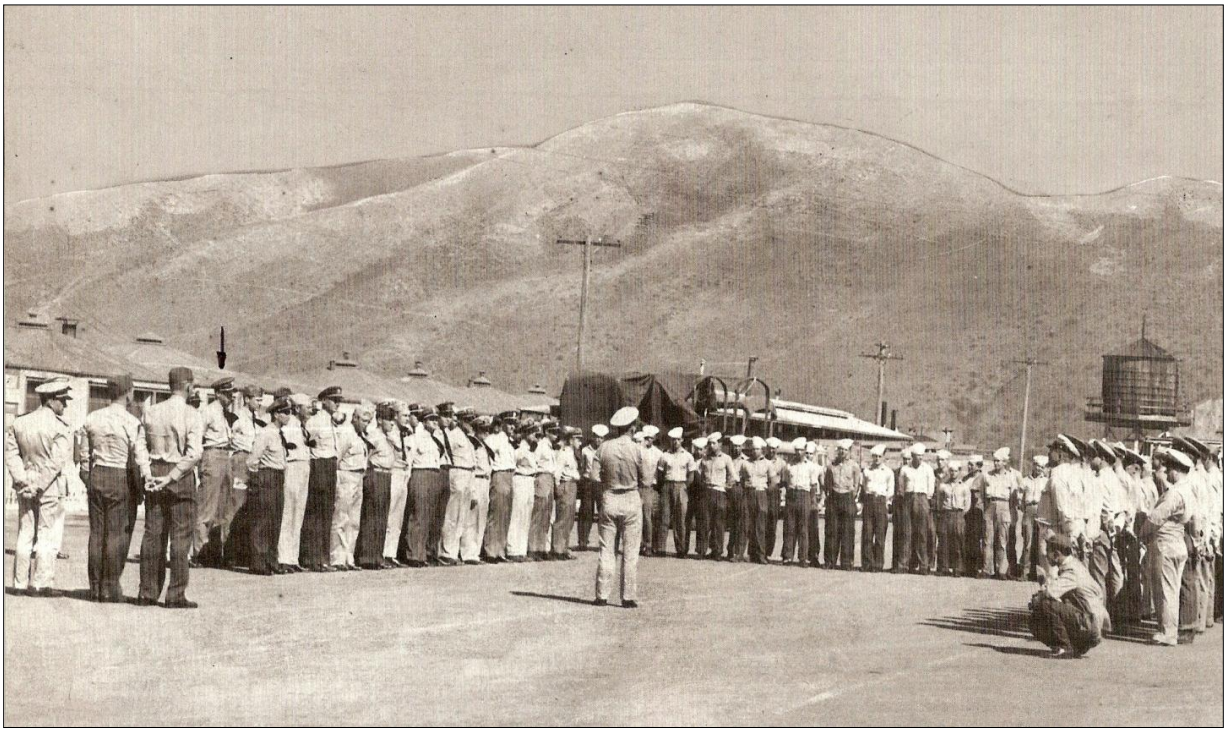
***A recently published article: "EARLY MISSILE LAUNCHES FROM SUBMARINES", by LeRoy E. Day, Cdr USNR Ret, gives a fascinating insight in the progress of the Navy project and of the contributions of Willy Fiedler therein.*[3]**

The following text consists largely of an extensive quotation of the aforementioned article, with the kind permission of the author:

....." On the cool foggy morning of 1 October 1946, all Navy personnel of the Pilotless Aircraft Unit at Pt. Mugu, California, were assembled for a short ceremony to mark the commissioning of the new US Naval Missile Test Center. I am identified on the end of one rank. On my left is Ensign Philip Hasell, one of my class-

[2] see Part 1 of this paper for the role of Robert Lusser and Willy Fiedler in the development of the V-1 in Germany.
[3] "EARLY MISSILE LAUNCHES FROM SUBMARINES", by LeRoy E. Day, Cdr USNR Ret, May 25, 2012

mates from Georgia Tech, also an aeronautical engineer. At that time Pt. Mugu more resembled a "prisoner of war camp" than a Navy installation. The few buildings were a combination of metal Quonset huts, temporary beach buildings left from the days when Pt. Mugu was a fishing camp and a few newly constructed wooden structures. The one landing strip was made of Marsten mat, the metal "grid" used by the SeaBees to construct landing strips on the Pacific islands in WW II."…..



Commissioning of the Naval Missile Test Center, Pt. Mugu, CA, Oct 1, 1946 [Navy photo]

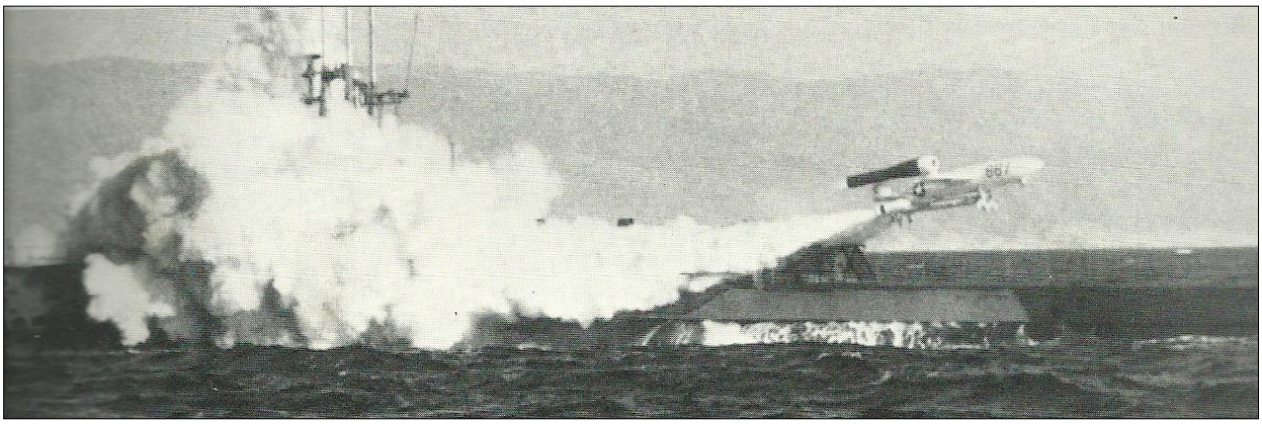
……"The Navy was developing a sea test range for guided missiles at Pt. Mugu. Pt. Mugu had been selected because of its location on the coast of California, some 50 miles north of Los Angeles. There were also several islands offshore (the Channel Islands) which could serve as targets and tracking stations.

The initial concentration was on the development of ship-launched missiles, particularly from submarines. The Navy had contracted with Republic Aviation toward the end of WW II in Europe to make a number of copies of the German V-1 "Buzz Bomb." The Navy hoped to be able to use them in the Pacific War. However, the war in the Pacific ended before they were able to do so. The CNO had approved a plan that a missile test facility be established at Pt. Mugu in January 1945. However, it wasn't until November 1945 that a small detachment under Cdr. Jack Shoenhair actually arrived at Mugu and began preparations to test launch the V-1 which the Navy had designated the LOON.

Initial launchings of the LOON were made using a catapult. In the six months from January 1946 to June 1946, 21 launches were made with no successes. The causes of the failures were multiple. Gradually the launches were more successful over the next year. A milestone was reached on November 5, 1946 when LOON No.38 was successfully launched with the catapult and flew a controlled flight of 48 miles. The objective of the Navy was to demonstrate a launch from a surfaced submarine and a catapult was not deemed practical for the sub application. So, the next method attempted was a rocket launch.

The LOON was launched atop a cradle with four JATO rockets. Each of these rockets had to be carefully aligned by an optical system, with close tolerances, through the center of gravity of the assembled LOON-cradle. Although the alignment could be done accurately, albeit time consuming, once the rockets fired, there were deflections in the cradle which resulted in the thrust line deviating from its static position. The result was often a trajectory that put the missile in an attitude at burnout that was impossible for it to recover. The LOON might be in a steep bank or pitched up at an angle impossible to correct before impact in the ocean. Burnout of the rockets was at about 250 miles per hour. In the first six months of 1947, the success rate for LOON launches

was about 10 percent. Among these were some rocket launches using the four JATO bottles. Despite the poor success record, one of these launches was a significant milestone: a successful launch from a surfaced submarine, the USS Cusk commanded by LCDR Fredrick "B" Clarke USN, in February 1947.



First launch of the LOON missile from a submarine USS Cusk (1947) [Navy photo]

At about this time, twelve German scientists arrived at Pt. Mugu. They were part of Project Paperclip which brought a large number of captured German engineers and scientists to the U.S. after the end of the war in Europe. They were dispersed to several military facilities: Wright Field, Fort Bliss, Pt. Mugu and others.

Prof. Herbert A. Wagner

Those assigned to Mugu were from the "small missile" side of Peenemünde, the secret German missile test site on an [peninsula] in the Baltic Sea, [in] northern Germany. Dr. Herbert Wagner was the senior man of the group assigned to Pt. Mugu. A large contingent of several hundred associated with the V-2 program under Dr. Wernher von Braun were sent to Fort Bliss, Texas.

Three of these men who came to Mugu were assigned to the Guidance Laboratory at Mugu where I worked. At the time, I was on active duty as an Ensign. I worked closely with one man, Reinhard Lahde. We were testing and analyzing the autopilot of the LOON trying to determine why there were so many launch failures. Both Lahde and I became quite familiar with the flight control of the LOON. The LOON was steered by a rudder; it had no ailerons for roll control. One task we worked on was to incorporate a single aileron which later showed an improvement in the recovery from severe roll attitudes at burnout of the booster rockets.

Meanwhile, in the Propulsion Division of our department, they were working on the problem of improving the method of launching the LOON from a submarine. Working in that division was another German scientist named ***Willy Fiedler***. Fiedler had had an interesting career in Germany during WW II. He was [chief] test pilot for the [license] production [at Fieseler] of the famed German fighter, the Messerschmitt BF-109. He was also one of two [?} pilots who flew a manned version of the V-1 "Buzz Bomb".[In fact he was in charge of the complete test program of the V-1][4] during its development at Peenemünde.

U.S. Loon missile at test base (1948) [Navy photo]

While in Germany, Fiedler had invented a device called the Jetevator.[5] It was a ring shroud, gimbaled in two axes, which could be mounted at the exit plane of a rocket nozzle to alter the direction of the thrust line. If the Jetevator was driven by servo motors, it could change the thrust line a maximum of about 7 degrees in both pitch and yaw. He had verified this with tests on several rockets in the test pits at Pt. Mugu. Fiedler had the idea that the way to launch the LOON was to sling a single large rocket under it and have a Jetevator controlled by the autopilot. The result would be thrust vector control. The autopilot would control the thrust line during rocket burn and avoid the earlier launch mishaps. He was also working on a design for a "zero length launcher" which would be more practical for sub launches.

Fiedler knew he needed a flight demonstration to gain acceptance of his idea. With the help of Robert Helmholz, a senior manager at Mugu, he was able to convince the Navy brass to give him a surplus rocket large enough to launch the LOON. He came down to our division one day and asked if I could perform an analysis of a LOON launch with the single rocket using his Jetevator controlled by the LOON autopilot. I was quite flattered and proceeded to apply my knowledge of aerodynamics and stability and control of aircraft. The boost phase lasted only a few seconds, accelerating the vehicle from zero to about 250 miles per hour. Only toward the end of the boost was the LOON flying fast enough for there to be any aerodynamic effects. In other words, I found that the task was to stabilize the 5,000 pound LOON and have its attitude at burnout such that it could fly a safe trajectory. All the aerodynamic terms were reduced to second order effects, leaving the mass and in-

[4] notes between **[ ]** are added by R. Staalman. For more details about the German career of Willy Fiedler, see Part 1 of this paper.

[5] Willy Fiedler was familiar with various forms of "jet steering" as used on the large A-4 (V-1) missile and on the Bachem Ba-349 Natter rocket plane. [note rs]

ertia of the vehicle as the controlling factors. I was amazed at the simple solution and had my results checked by Reinhard Lahde, an experienced aeronautical engineer. I determined the "gearing" between the LOON attitude and the Jetevator controlling the thrust line such that the system was stable. Fiedler took my results, rigged up the autopilot and Jetevator and proceeded to plan for a launch.

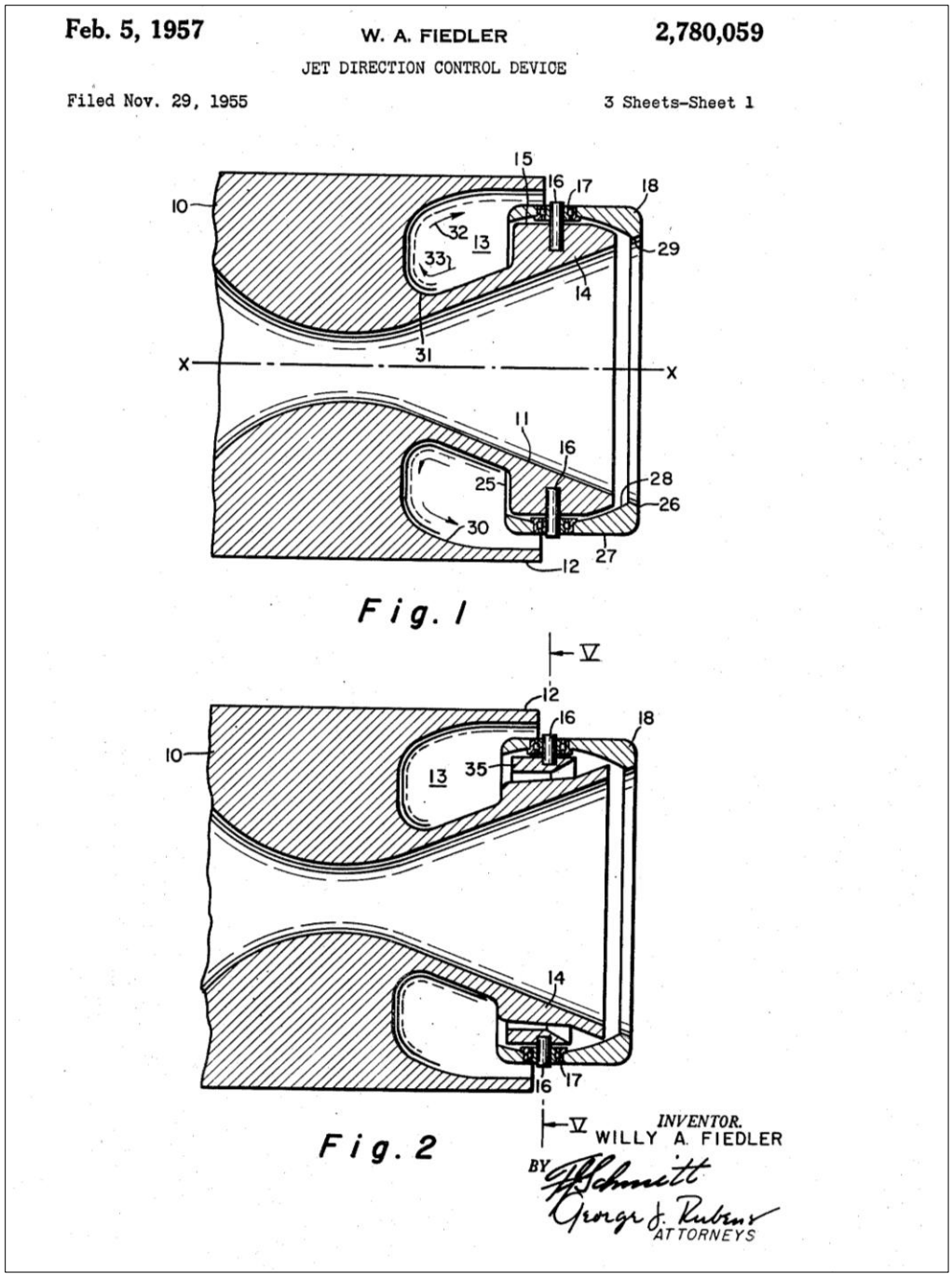


Illustration from Willy Fiedler's patent on the Jetevator

To download full text of patent click here

With the help of senior management at Mugu, top Navy brass and civilians from Washington were invited for the test launch. The combined rocket-LOON was planned to be launched from a short-ramp launcher of Fiedler's design. If successful, the test would demonstrate the feasibility of a thrust vector controlled launch from a zero-length launcher which Fiedler was designing. It's applicability to launch from a surfaced sub was obvious.

A large crowd assembled at the LOON launch site on the beach on the day of the planned launch. A dozen chairs were set up for the most senior Navy and civilian visitors. Willy Fiedler was introduced to describe the test and its implications. Fiedler was an excellent speaker and exuded calm confidence. I was standing behind the crowd and more than a little bit nervous, wondering if my simplified study had correctly analyzed the problem.

Fiedler gave the background of the many LOON failures and then described the test they were to see. He explained, "However careful we have been in aligning the four Jato rocket launches, it's never been good enough. The static alignment can be right through the c.g. (center of gravity) but when those rockets fire, each one is a little different, and the cradle bends just a little and that's enough to cause a misalignment. What it does is pitches the missile into some bad attitude and the LOON hits the water before it can recover. What is needed is some way to have the autopilot control the thrust line to keep it right through the c.g. during the entire boost period. That's what we have today, using the Jetevator which I described to you earlier."

Fiedler paused, took a few questions and continued, "Now, I have set up this launch so it will be a real test of the effectiveness of the Jetevator in providing thrust control. The rocket nozzle is aligned so that the thrust line will be 1 inch above the c.g., not through the c.g. If the Jetevator cannot correct the thrust line, the missile will be pitched downward, take a ballistic trajectory and will impact the ocean about 500 yards from the beach. We've done this to provide a good test of the autopilot controlling the thrust line during boost. If there are no further questions, we will begin the countdown."

I was astonished to realize that Fiedler had rigged the launch to really demonstrate the effectiveness of his thrust control. I wasn't sure that the Jetevator could provide enough change in the thrust angle to overcome this "intentional misalignment." In the few seconds of the countdown, I became very nervous that I was about to become a "party to a failed launch." ---- 5,4,3,2,1 Fire! The LOON lifted from its short-ramp launcher with a tremendous roar and a great cloud of exhaust smoke! In fact, the exhaust plume from the rocket partially obscured the missile from where I stood and I couldn't tell if it was climbing on its intended flight path or not. Seconds later the LOON was in the clear and climbing toward the western sky at the correct angle. In fact, it looked like it was on a rail in the sky—climbing exactly as planned. The assembled crowd gave a shout and there was much clapping. The ranking admiral stepped forward and heartily shook Fiedler's hand.

Fiedler had made his point. Later, the first zero length rocket launch of the LOON using the Jetevator was made on January 26, 1949 from the USS NORTON SOUND, a surface ship. Launches from surfaced submarines followed.

The Navy had originally planned to use cruise missiles launched from surfaced submarines. Thus there followed the development of the Regulus I and II missiles. However, it became apparent that launching a cruise missile from a submarine on the surface had serious strategic drawbacks. The submarine was very vulnerable during the time required to prepare and launch the missile. The difficulty of launching in rough seas was another problem. Therefore the decision was made in 1955 to develop a missile system that could be launched from a submerged submarine. The Navy established a high priority organization known as the SP Project under Admiral Raborn. Based on his earlier work with launching the LOON, Willy Fiedler was invited to join the SP Project in the development of the Polaris missile which was to be launched from a submerged submarine. Fiedler worked in the SP Project for some time and then relocated to Lockheed Missiles in California. Lockheed was the contractor for building the solid rocket Polaris. Fiedler became the Chief Scientist for Lockheed. I remember visiting Willy once in the 1970's when I was at Lockheed on NASA Space Shuttle business

The SP Project reached its first major milestone July 20, 1960 with the launch of a Polaris missile from the USS George Washington submerged off the coast of Florida. In a little over a decade, the Navy had progressed from the rudimentary surface launching of the LOON to a long range nuclear missile launched from a submerged submarine……"

[End of fragment with kind permission of ***LeRoy E. Day CDR. USNR Ret.*** *November 20, 2012]*

Regulus II at Pt Mugu Missile Park [photo rs]

WILLY FIEDLER'S INVENTIONS at PT MUGU [6] and LOCKHEED

In all the things WF produced he showed himself a master of simple, efficient design.

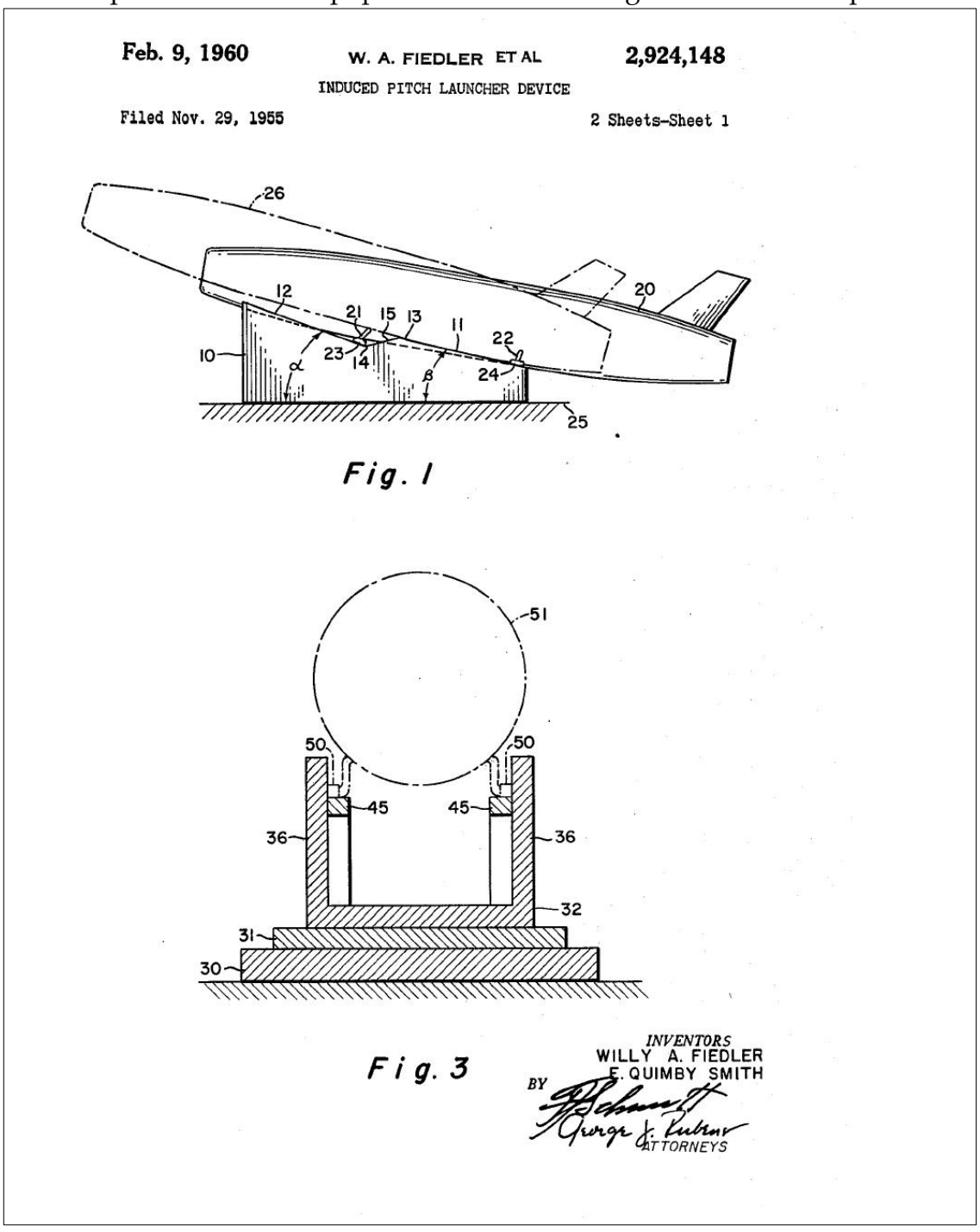
"I am a hardware man", he told Monica, his second wife, more than once and he had his work-shop at home to prove it. The home, in Los Altos Hills, was designed and built by himself. It is strikingly simple: Schwarzwald traits are unmistakable, combined with very practical features.

He not only designed houses and rocket planes, but also affordable wooden furniture. His first sailplane that he built when he was in his twenties had had an amazing lightweight rump (27 kg) and a very subtle wing form. Instead of a vertical tail rudder it had movable, vertical wing tips.

His fame in rocketry was grounded in the test work he supervised for the German flying bomb the V-1. He spent very frustrating months and years at Peenemünde developing this German unmanned flying machine into a reliable vehicle that could transport a 900 kg bomb over 250 km (160 miles) at a

[6] http://www.usna.com/NC/History/SeaStories/1934/PointMugu.htm (on Herbert Wagner and Willy Fiedler)
The Birth and Boyhood of Point Mugu
by CAPT Grayson Merrill, USN (Ret.)
http://www.usna.com/page.aspx?pid=599
http://www.usna.com/page.aspx?pid=599#LookingAstern
http://alumweb.mit.edu/classes/1941/aerospace_memoirs.html

maximum speed of 600 km/h. [7]To him it was a technical task and a challenge of the first order. It is not known in how far he allowed himself to realize the weapon would spread death and misery and mean terror to the unprotected civilian populations of South England and Antwerp.



Feb. 9, 1960 W. A. FIEDLER ET AL 2,924,148

INDUCED PITCH LAUNCHER DEVICE

Filed Nov. 29, 1955 2 Sheets-Sheet 1

Fig. 1

Fig. 3

INVENTORS
WILLY A. FIEDLER
E. QUIMBY SMITH
BY
ATTORNEYS

Application November 29, 1955 / Feb. 9, 1960 W. A. FIEDLER ET AL

INDUCED PITCH LAUNCHER DEVICE PATENT 2,924,148

To download full text of patent click here

[7] see: Wilhelm Hellmold: "DIE V1 Eine Dokumentation", Bechtle

US 2,924,148 "The present invention may be utilized for launching any type of aircraft but is especially adapted for use in launching guided missiles from naval ships. The invention device is particularly efficacious for launching relatively large guided missiles wherein it may be desired to launch the missile such that it has a pitch angle of approximately 30 degrees or greater upon leaving the launcher. " (patent application is the result of work at Point Mugu.)

WF's principle American patents go back to this first (German) stage of his life. The launching of a relatively heavy airplane from standstill to operational speed required either a catapult or a booster rocket and with both approaches WF had his encounters. The catapult apparatus was heavy, long and cumbersome. The 30 some meters (90 feet), parallel rail assembly had to be lined up precisely; the sudden forward acceleration by the Walter machine caused deformations in the missile that was hurled into the air. When the speed was sufficient for the V-1's own power source to take over, the attitude of the missile was often so far off the desired course that the Askania autopilot could not bring it under control. Many test flights ended in failure. It was WF's task to recognize the various forms and causes of failure and to devise improvements in the bomb's construction and launching procedures.

Booster rockets that are temporarily attached to the missile for the start offer important advantages. Launching ramps could be made much shorter and with that an important source of error could be eliminated. The directional thrust of boosters could also be steered in some way. And this led to two of WFs most important contributions in missile technology. By the time he was finished he had reduced the launching ramp to a structure of about the same length as the missile itself. The advantages were enormous: instead of cumbersome deployment (on often unleveled rural terrain) the positioning of the launcher now took a minimal time. And the US Navy got its first practical device for launching V-1 type, Cruise like missiles at sea, even on board of submarines.

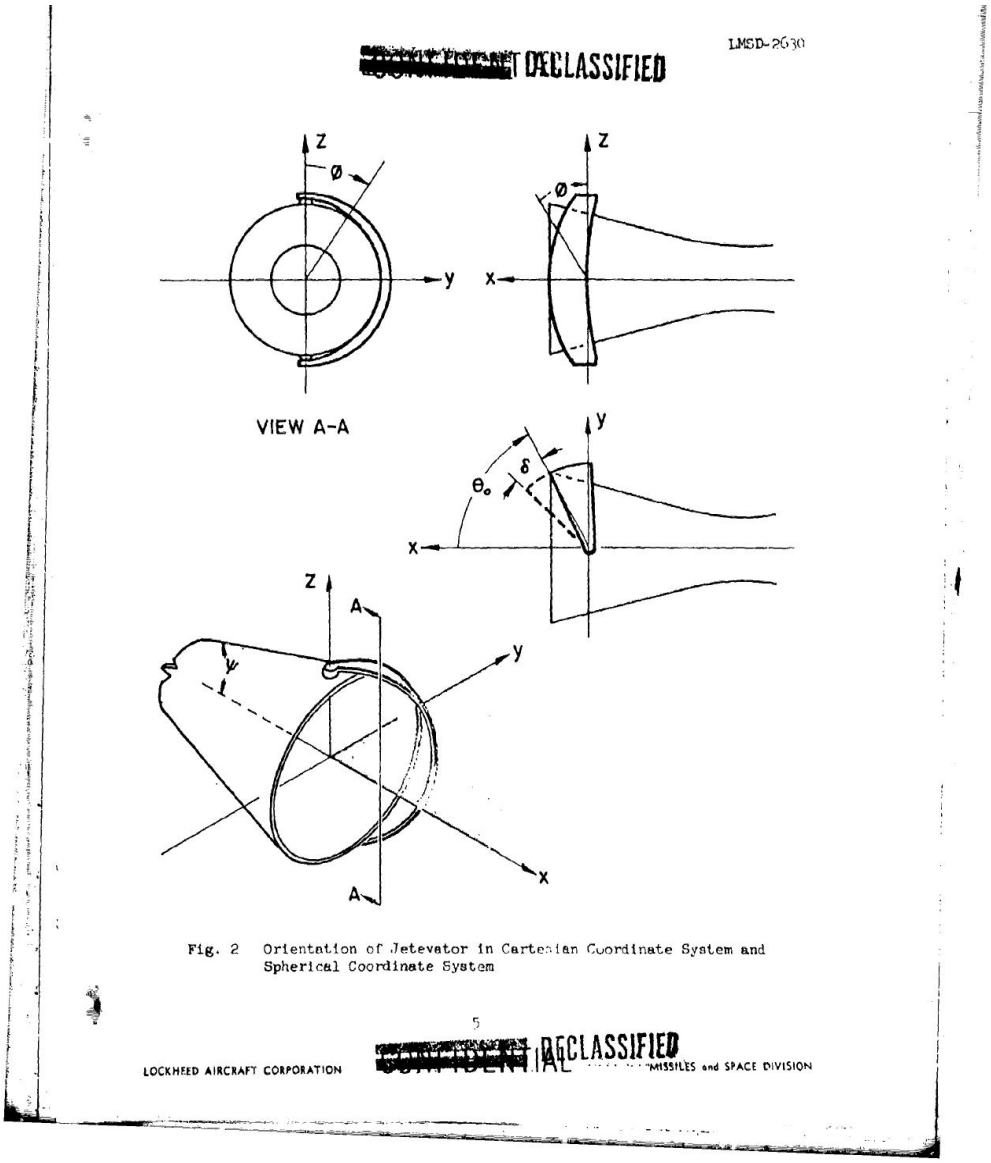
Booster rockets however, introduced their own source of error in the launching process. As they are attached off-center with respect to the center line of the missile, their forceful action introduces a turning moment on the flying mass. WF thought of a way to incorporate guiding rails in his launcher that would introduce a counter torque, thus hurling the missile not in a straight line but in a slightly curved motion. WF called this his ***Induced Pitch*** method of launching and he took a patent on it (and explained it in a lecture he held in Stuttgart in 1958).
see: https://ritstaalman.files.wordpress/wflecture1958.pdf

Another means to control movement he devised in his ***Jetevator***: a device attached to the jet nozzle of a rocket or jet engine that enables a vane or 'tab' to enter the jet stream from one side, thereby deflecting the stream. Now the idea of steering a jet stream is not new by itself. The enormous V-2 (A-4) rocket of Wernher von Braun that was developed at the same time as Willy's work at Peenemünde, employed a rudder in the exhaust stream. Also the Bachem Natter that WF helped develop at the end of the war and that started with zero length launch ramp (i.e. straight up) had a means of steering the jet. Willy's unique idea was to keep the steering rudder *outside the stream* and only introduce it into the stream (from the side) at the time that a correction of course would be needed. (One might try this oneself when watering the lawn with a garden hose. Touching the water stream with your hand, from above, will deflect the water jet upward.[8]) The great advantage of this method is that the steering surface or "tab"is not in the stream continuously. In the case of a rocket this means of course that

[8] The handbook: "Rocket Propulsion Elements" states: "A tab that blocks 16 % of the nozzle exit area is equivalent to a thrust vector angle of 9 degrees."

there is less danger of melting the tab. Also no energy is lost because of the presence of a permanent obstacle in the flow.

The invention worked brilliantly on the Loon in Point Mugu as told in Roy Day's article and by Fiedler's own account[9]. Its exact construction is described in the patent text that is shown on page 46 and is well worth reading. The Navy commended WF for his invention and after he started to work for Lockheed his new principals adopted it gladly. They subjected it to a long analysis that resulted in some unwieldly mathematical expressions that would certainly have amused WF (see page 52) .



From: S.S.Edwards and G.H.Parker: "Än Investigation of the JETEVATOR as a means of Thrust Vector Control" Lockheed Missiles and Space Division, Sunnyvale CA, Februari 1958:

> "Several advantages for Jetevator control'can be cited. First, for conditions in which no control is required, the jetevator is retracted from the exhaust flow. As a result, neither degradation of thrust nor thermal erosion of the Jetevator materials occurs. Secondly,

[9] W. A. Fiedler, "Thrust Direction Control by Jetevator", Progress Summary Report No. 15, USNAMTC, Point Mugu, Calif., May 1956

hinge moments and the moment of inertia can be held to low values by utilizing jetevators of spherical curvature.
Two problems exist in the development of jetevators. First, the obvious difficulty of obtaining material that will withstand the extreme heat, Secondly, the problem of the aerodynamic design with the objective of arriving at configurations having maximum effectiveness with compatible values of associated thrust decrement. This paper is concerned, primarily with the second."

The total frictional hinge moment is

$$M_f = 2 C_{D_f} q_\infty R^3 \int_{\sin^{-1}\frac{\cos\theta_0}{\cos(\theta_0-\delta)}}^{\frac{\pi}{2}} \int_{(\theta_0-\delta)}^{\cos^{-1}\frac{\cos\theta_0}{\sin\varphi}} \sin^2\varphi \, d\theta \, d\varphi \qquad (10)$$

or

$$M_f = 2 C_{D_f} q_\infty R^3 \left\{ \int_{\sin^{-1}\frac{\cos\theta_0}{\cos(\theta_0-\delta)}}^{\frac{\pi}{2}} \left[\cos^{-1}\left(\frac{\cos\theta_0}{\sin\varphi}\right)\right] \sin^2\varphi \, d\varphi - (\theta_0-\delta) \int_{\sin^{-1}\frac{\cos\theta_0}{\cos(\theta_0-\delta)}}^{\frac{\pi}{2}} \sin^2\varphi \, d\varphi \right\} \qquad (10)$$

The first term in Eq. 10 was expanded in powers of $\sin\varphi$ and terms up to and including the seventh power were retained. After integrating term by term the following expression is obtained.

$$J_{M_f} = \frac{M_f}{q_\infty R^3} = C_{D_f} \left\{ \left[\frac{\pi}{2} - (\theta_0-\delta)\right]\left[\frac{\pi}{2} - \bar{\lambda} + m\cos\bar{\lambda}\right] - 2a\cos\bar{\lambda} \right. \qquad (11)$$
$$\left. - \frac{\cos\bar{\lambda}}{m^2} k_1 - k_2 \frac{\cos\bar{\lambda}}{m} + k_3 \log_e\left(\frac{1-\cos\bar{\lambda}}{m}\right) \right\}$$

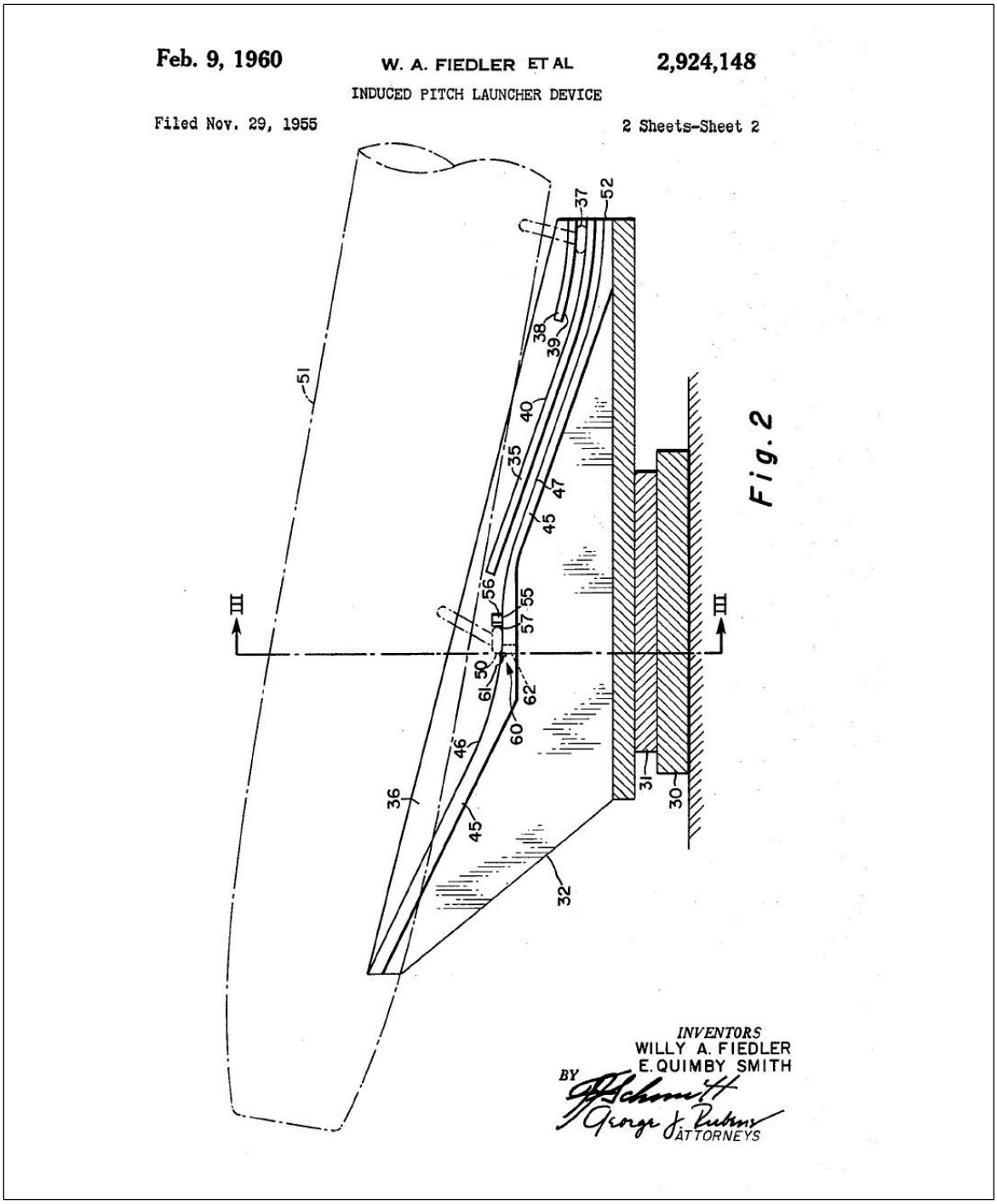
where

$$\bar{\lambda} = \sin^{-1}\frac{\cos\theta_0}{\cos(\theta_0-\delta)}$$

$$m = \frac{\cos\theta_0}{\cos(\theta_0-\delta)}$$

Fierce calculations in the Lockheed paper

Indeed, jet actuaters were also to be employed in the ***Polaris Missile***. Actually,the launching method of the Polaris from submerged submarines was WF's next great achievement. Again, his inspiration came from Germany were test rockets had been launched in this way at Peenemünde during the war. Thanks to WF's efforts and ingenuity the idea was turned into a perfectly working system (see fragment from ***w.Allen***, page 62)



INDUCED PITCH LAUNCHER DEVICE PATENT 2,924,148, page 2

Application November 29, 1955 / Feb. 9, 1960 W. A. FIEDLER ET AL

To download full text of patent click here

Work from Willy Fiedler and E. Quimby at Point Mugu.

US 2,924,148 "Prior art devices for launching such missile utilize substantially planar guide rails, and the missiles are placed on the launchers while in a horizontal position….

…. A rotational energy is induced into the missile such that after the missile leaves the launcher the pitch attitude thereof increases to a level commensurate with that produced by a conventional launcher."

DEPARTMENT OF THE NAVY
OFFICE OF THE SECRETARY
WASHINGTON

My dear Mr. Fiedler:

It is a pleasure to inform you that the Navy Incentive Awards Board has reviewed your contribution with respect to your design of a new type dummy missile, and has approved an additional award of five hundred ninety-five dollars. This award is in addition to the initial award of three hundred dollars previously granted by the Naval Air Station, Point Mugu.

On behalf of the Navy, I wish to commend you for the resourcefulness and initiative which you have displayed in this achievement. The Navy appreciates your valuable contribution which constitutes a significant improvement in the Navy's operations. I hope you will continue your endeavors and develop other constructive ideas leading to superior accomplishment.

A copy of this letter will be placed in your personnel folder.

Sincerely yours,

Charles S. Thomas

Mr. Willy A. Fiedler
c/o Commanding Officer
U. S. Naval Air Station
U. S. Naval Air Missile Test Center
Point Mugu, California

Monica Wagner-Staalman tells the following anecdote about the initial launch of the Polaris concept:

“I've been told on many sides how the idea of under-water launches came about.
Seems Willy was asked to come to a meeting in Washington. The question was a vertical launch of rockets from submarines from the surface. At that point, it was not deemed feasible to launch underwater. I believe the drag imposed by water was thought to be insurmountable. I think he was sitting next to *Lt. Sidney Sharp*, and whispered to him, ‘Oh, that's no problem. The compartment could be filled with air, and the missile would launch with its rise to the surface...’
Sid said, "Raise your hand, go on up! Tell them!!"
"Oh, no... I couldn't."
"Oh, yes, you could," was Sid's reply and he raised Willy's hand for him.
So Willy, who was still working at Pt. Mugu at the time, was offered the job at Lockheed to head the Polaris project. At the time Lockheed was in Burbank, as you most likely know. Willy hesitated at first. "I'll have to discuss it with my wife," was his reply. This was partly true, but he also wanted to play just a little "hard to get." He'd made up his mind then and there, and just had to come up with a plan to broach the subject with Greta.

I am in personal possession of the letter sent by *Adm. Rayborn* to Willy, thanking him for the work he did on the Polaris. For some reason, his children didn't want it. I have the booklet prepared by Lockheed at his retirement as well."

Martin Hollmann describes this incident and its aftermath as follows:

Solid fuel rockets had already been launched from the submerged submarine U-511 at Peenemünde in 1942. However, the idea was dormant for 13 years until Willy Fielder suggested how it could be done to the US Navy.[10]

In the summer of 1955, Willy attended a joint military/industry conference with his good friend, Sydney Sharp. At the meeting the Navy proposed to develop a larger submarine from which a number of guided missiles could be launched. The topic of launching these from the submerged submarine was raised but no one thought that this could be done. Willy told Sydney Sharp that he knew how to by using pressurized air to shoot the missile vertically out of a tube and then igniting its rocket motor once it had breached. Sharp said "go up there and tell them!" And that is just what Willy did. So the seeds for the birth of the submarine launched ballistic missile (SLBM) had been sown.

Fielder became the chief scientist at Lockheed Missiles and Space Co. in 1958 and helped design the Polaris and Poseidon missiles for the Fleet Ballistic Missile System.

By 1962, eight Polaris submarines with 16 missiles each had been commissioned. Eventually there were 41 submarines. It was the most significant Cold War deterrent against the Soviet threat and most likely prevented WWIII.

[10] In 1951 Willy Fiedler was in Freudenstadt for a short stay from June to July
This is stated in the report of the background check that was done on him by Naval Intelligence in 1954. He was cleared for employment on secret Navy projects at Lockheed. He became a US citizen in the same year.

United States Navy

CERTIFICATE OF AWARD

In appreciation of
Distinguished Civilian Service
to the United States Navy

The Secretary of the Navy

takes pleasure in presenting the

DISTINGUISHED CIVILIAN SERVICE AWARD

to MR. WILLY A. FIEDLER

for services set forth in the following

CITATION

In recognition of distinguished service to the United States Navy. By virtue of your exceptional initiative, originality and technical ability in originating and developing devices and improvements for launchers, launching configurations and missile structure, great improvements have resulted in the reliability and effective use of guided missiles. Through these truly significant contributions in the field of guided missiles, you have distinguished yourself in a manner richly deserving of the Navy's highest civilian award.

27 January 1954
Date

R. B. Anderson
Secretary of the Navy

LOCKHEED AND MISSILES

[This chronology is to a large extent based on *Walter J. Boyne's*: "Beyond the Horizons"- The Lockheed Story – 1998, St. Martin's Press, NY]

1954

LMSD **Lockheed *Missile Systems Division*** is formed. First project is the X-17 rocket for USAF to study reentry problems. The concept comes from *Irv Culver*, who had been in the first group of Lockheed engineers to move from airplanes to missiles. *Dan Tellep*[11] directs and analyzes the reentry body data (telemetry)

1955

National Security Council recommends that part of the Intermediate Range Ballistic Missile force (IRBM) shall be *sea-based*; the program to achieve this shall be called ***Fleet Ballistic Missile FBM*** program.
Navy gets the task of adapting the Army developed JUPITER IRBM for use at sea.
Admiral Burke[12] gives absolute priority to the project.
A special project office (SPO) is created. *Rear admiral William F. ("Red") Rayborn* (an aviator, aerial gunnery expert, veteran of war in Pacific) gets the command. He gets all support from Burke. Rayborn picks 40 civilian and military people for his team. He then selects within twenty days the major FBM contractors on the basis of one-day presentations.
Rayborn's team's initial task is to develop the JUPITER into a 1,500 mile range missile to be fired from shipboard – to be operational Jan. 1, 1960. Launch from submarine 5 years later: Jan. 1965.
JUPITER used cryogenic liquids, very hazardous and possibly lethal in submarine. Also a stable platform is needed for launching; a ship is not stable. Fortunately a series of technical developments occur that give a far better alternative than the JUPITER. Among them, it is learned from *Edward Teller* of the AEC, that future warheads would weigh only 30% of the JUPITER payload. *Dr. Charles Draper* develops a guidance system that is 85% lighter than the JUPITER's. Then there is the discovery that solid-propellant fuel can deliver more power if metallic aluminum is added.

1956

WillyFiedler joins the Lockheed Missile and Space Division as Manager Scientific Staff. Some of his work is re-examined by Lockheed staff (see page 52).
Lockheed starts building its facilities at *Sunnyvale, CA*.
The Navy charges *Captain Levering Smith* with the design of a new missile. Working with Lockheed and other contractors, he produces in one week's time the essential details of a two-stage solid-propellant missile with a 1,500 mile range. The missile is approved by the Secretary of Defense in December 1956 and Admiral Raburn names it *POLARIS*. Because of the now simpler design and also because of external political pressures (the surprising appearance of Soviet Sputnik), the deadlines for completion are moved forward, The interim launching capability from subs is put at January 1st, 1961 and the full operational POLARIS Model B is to be ready June 1963.

1957

The size of the missile is set by the dimensions of the available submarine. It is agreed that the diameter will be 54 inch, the length 28.5 ft and the weight (ultimately) 28,500 lb. The Navy's "*Special Task Group*" meets for the first time on January 7, 1957. Lockheed LMSD submits a "POLARIS Master Development Plan", presented by

---

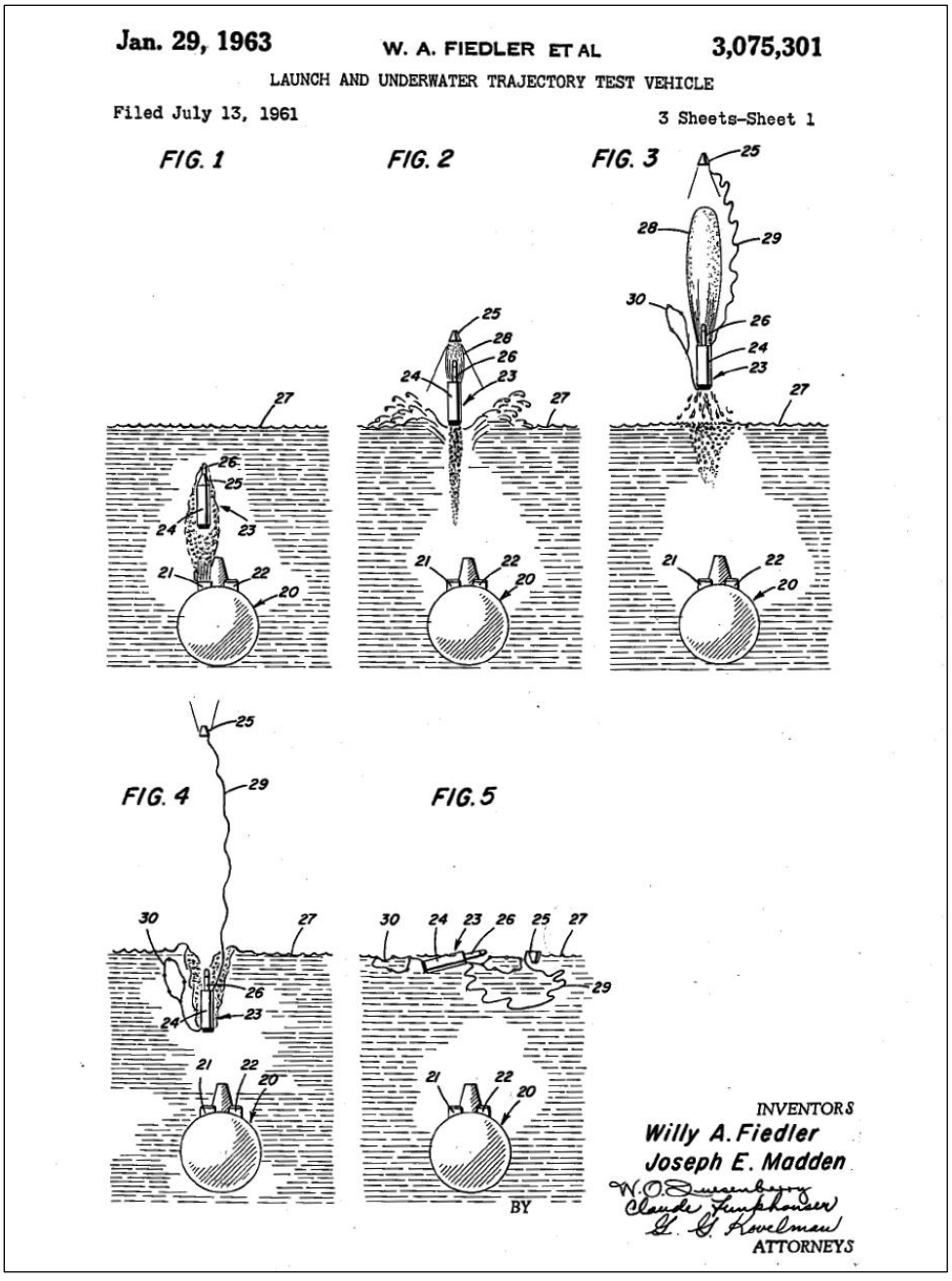
[11] After obtaining his master's degree in mechanical engineering at UC Berkeley, *Dan Tellep(1931)* would join the Lockheed company in 1955. He eventually would become President of Lockheed Missiles & Space Company from 1984 to 1988. He became CEO and Chairman of the board of Lockheed Corporation from 1989 to 1995 and CEO of Lockheed Martin in 1996. [Wikipaedia]

[12] *Admiral Arleigh Albert '31-knot' Burke (October 19, 1901 – January 1, 1996)* admiral of the United States Navy, who distinguished himself during World War II and the Korean War, and who served as Chief of Naval Operations during the Eisenhower and Kennedy administrations. [Wikipaedia]

Willis Hawkins, Stan Burris, Frank Bednarz, Dr. Louis Ridenour (head of Lockheed's Research Lab), *Sid Brown* and ***Willy Fiedler***, "one of our German scientists", who managed the German V-1 pilotless bomb testing program in WWII.

The problems in ballistic missile development are many: general configuration, nozzle design, thrust and vector control, terminating thrust. Use on submarines adds to this the problems of storage, maintenance, underwater launch[13] and first-stage ignition.

LMSD expands again, this time with test facilities at *Santa Cruz*. Under the direction of *Art Hubbard* the POLARIS is tested in more than three hundred captive firings.



LAUNCH AND UNDERWATER TRAJECTORY TEST VEHICLE 3,075,301

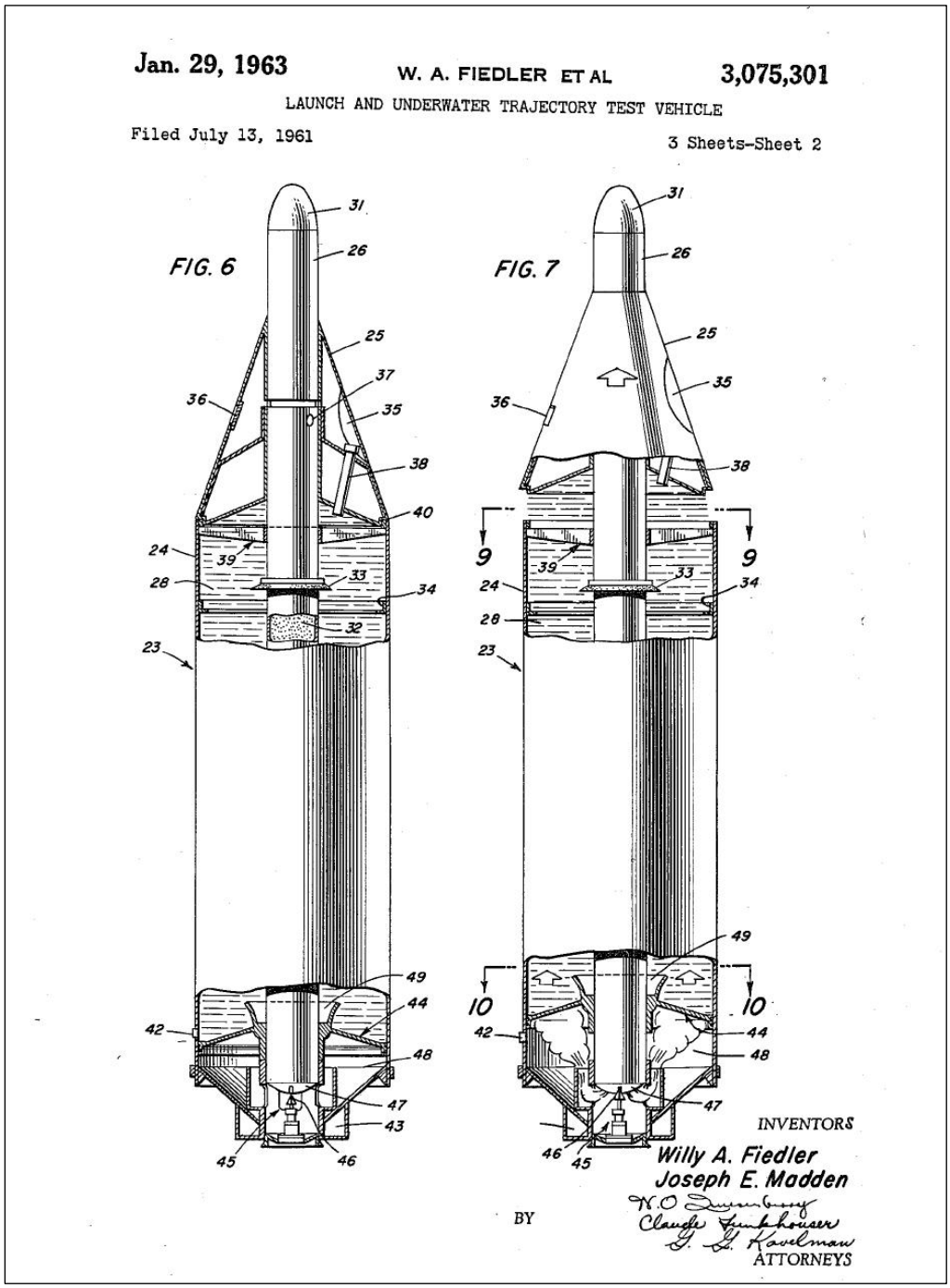
To download full text of patent click here

13) As it turns out, underwater launch provides the sought after stable platform.

Previous page: **US PATENT 3,075,301** “The present invention relates to missile exercise and test vehicles and more particularly to an underwater launched vehicle for checking submerged missile launcher equipment and obtaining underwater missile trajectory data…

…. In the course of developing underwater launched missiles, a need has arisen for an economical and reusable *exercise and test vehicle*, whose cost is only a small fraction of the tactical vehicle being simulated, and which possesses the same weight, center of gravity, pitch and yaw movements of inertia, and external configuration of the tactical propulsive missile. Such a “dummy” missile or dolphin should be useful for underwater launcher check-out, underwater missile trajectory testing, and personnel training.

”



LAUNCH AND UNDERWATER TRAJECTORY TEST VEHICLE 3,075,301

To download full text of patent click here

Fragment concerning the *Polaris missile,* from the book of aerospace engineer **Art Lowell**:
http://alumweb.mit.edu/classes/1941/aerospace_memoirs.html

Aerospace Memoirs by Art Lowell
2001

allowell@juno.com

….But first, how had the **FBM** program been doing during my 9-year absence? Quite well, thank you! Let me explain the long term plan SSPO and all its contractors had been working on. The first and most challenging element was the development and operational deployment of the *Polaris A1* within the 3-1/2 year.time span allotted, creating new state of the art at every step, simultaneously developing all the elements, (or major subsystems).from lengthened submarines, launch systems, navigation, checkout, and fire control systems, testing and assembly facilities, logistic plans and logistic pipelines and everything else the missile itself had to be compatible with. This was accomplished, but the needed missile range fell short, by 300 nautical miles. 30 inches in the launch tube had been reserved for an elevator, in case underwater launch hadn't worked. But vertical, underwater launching, as advocated staunchly by ***Willy Fiedler***, did work. Willy also was the inventor of the jetavator, our first device to control the rocket's direction. This is the same German who was wartime Chief Engineer of the pulsejet-powered V-1. For most of the years I worked at Lockheed, Willy was a principal innovator in our FBM work, and retired as MSD's Chief Scientist.

…..

.**WILLY FIEDLER**

In the rewriting of my memoirs, the story of this remarkable ex-German engineer got compressed..

Willy A Fiedler, who died in 1999, made at least two program make-or-break contributions to the early development of Polaris and its match with the submarine. He also had an effect on my own work and career that started 10 years before I ever met him at our first Bay-area temporary quarters in San Jose, and that lasted for the ensuing 25 years or so that I worked with him. Here's how it all happened:

In Oct.1946, I left the (formerly) Army Air Corps R facility at Wright Field to take a position as head of the aerodynamics and thermodynamics dept. of the new Missile Engineering Division of the McDonnell Aircraft Corp. I found the place a hotbed of work on pulsejet engines and on applications of these engines.

I don't know who invented the pulsejet engine but ***Willy*** was the guy who hooked it to a bomb and made the V-1, the first terror weapon to bomb London. It's said that Willy even fitted a cockpit to an experimental version and did some test flying. He never denied doing such a dumb thing.

Getting back to MAC[14] in St. Louis, the company had already developed a target drone, (that the customer didn't order into production) using a scaled-down version of the V-1's 14in diameter original, and had built these relatively simple, reed-valve propulsion devices in sizes from 8 inches to 17 inches.

Where we came a cropper was when we promised to develop and build for the Navy an air launched, 500knot!, anti-ship missile, powered by a semi-submerged, 11 inch diameter pulsejet engine. What we didn't know was that the pulsejet was limited by its acoustic compression cycle, to about 150 knots for useful thrust production. The higher the airflow over the tail pipe, the lower the thrust, until finally, 0.

[14] MAC = McDonnell Aircraft Corp. which later merged with Douglas Aircraft Corp.

How we discovered this, and the gyrations we went thru to try to overcome this phenomenon make an exciting and sometimes hilarious, story, but I have covered that in my memoir.

……

Back to ***Willy Fiedler***--He was picked up from the Germans in Operation Paperclip and put to work for the Navy at Pt. Mugu. I understand that he started preaching vertical underwater launching of missiles, even in the early 50s, so in late 56 he was sent to work for Lockheed, where I first met him.

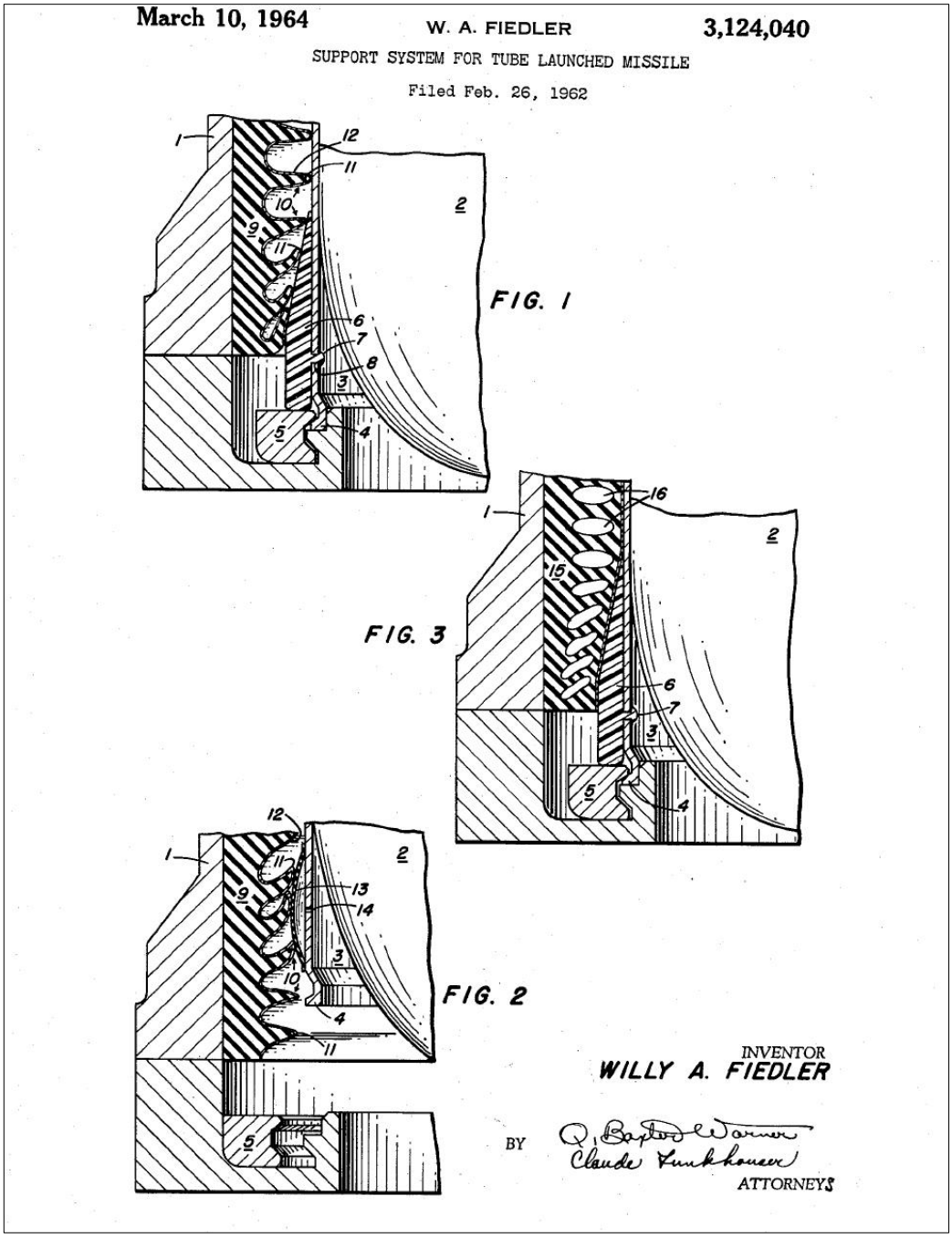
Some folks in the Navy doubted that underwater launching would work, so 30 inches were left below the missile in the launch tube design, just in case an elevator were needed to permit surface launching.(which would have been the kiss of death for the project.) We were able to use those 30 inches later, in the Polaris A-2, to get the full 1500 n.mile range we had promised .

Willy and his idea prevailed, with a aid of much analytical work, model launches from his LUMF tank. (Lockheed Underwater Model Facility, and a tube in the sand off San Clemente Island. Using that, we fired a dummy missile with a full- scale, "cut grain" motor through the wave produced by a heavy cruiser steaming off shore at 30 knots. . The Navy also installed a gimbaled launch tube in the sand at Cape Canaveral, and two surface- launch tubes in the USNS Observation Island.

Willy's other main contribution was the "jetavator", sleeve -like devices that projected into the stream of each of the 4 rocket nozzles, to give a means of thrust -vector control without extending beyond the circular contour of the missile. They gave us problems, but they enabled the program to go on, while more complex and effective rotating nozzles were developed.

I could go on and on with the output of Willy's brilliant mind, persuasiveness, and stubbornness, even to his "Turtle" idea, a sea bottom dwelling launch facility, which mercifully was killed by an international treaty not to place nuclear weapons on the sea floor, but that would take another book Another time, perhaps.

Thank you, Art Lowell



Filed Feb. 26, 1962 / March 10, 1964 W. A. FIEDLER

SUPPORT SYSTEM FOR TUBE LAUNCHED MISSILE 3,124,040

To download full text of patent click here

"US PATENT 3,124,040….This invention relates to a cylinder that is utilized to contain a missile during logistic, pre-launch and launch phases, and more particularly it relates to a container lined with a fexible mat. The complete missile package consists of an outer tube containing a suspension system which supports an inner tube, which latter tube directly contains the missile. The present invention deals primarily with the inner tube of this missile package. This inner tube, usually of non-corrosive aluminum alloy, must be protected from direct contact with the missile. The method most prominently utilized is to surround the missile at a plurality of points along its vertical exterior with hand rubber stowage and launching supports or adapters…

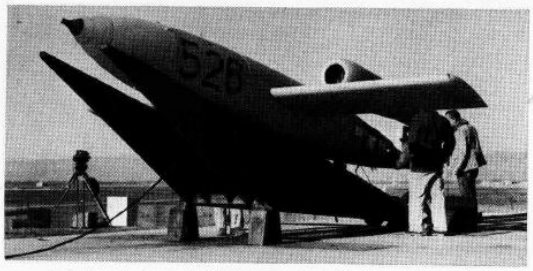


Fig. 1. Early missile-booster-launcher combination. LOON/V1 - Single JATO - Short rail launcher.

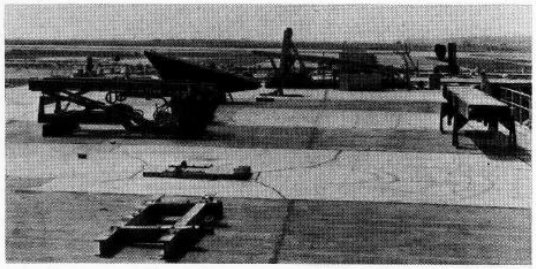


Fig. 2. Launch pad at PMR, Point Mugu, California. Three launcher types for Vought-Regulus I missile and one dummy missile.

Missile launchers, for large and small missiles alike, are either of the zero length or of the short travel type, the latter providing initial missile guidance up to one second. Ballistic and guided winged missiles with thrust vector control during the boost phase gain little from rails over two feet long. Without such control longer rails are preferable because the permissible thrust misalignment is markedly increased. The optimum length of the (three or four) launcher rails is often determined by practical considerations of missile loading, missile accessibility and clearance.

If front and rear missile slippers separate from independent rails simultaneously, "tip-off" (effect of gravity moment after front slipper separation) will be avoided. The rail elevation should be slightly above the launch flight path angle to prevent both slipper chatter and separation shock. Structural simplicity and lightness of weight are essential in launcher design.

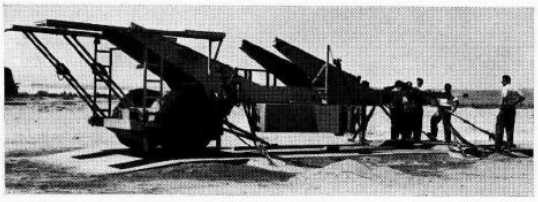


Fig. 3. Typical short rail launcher for winged missiles. Regulus II missile.

Loads on the launcher are produced by the following forces: Gravity, inertia, wind forces, thrust reactions and jet pressure forces. Load analyses must include the missile in battery position during launcher travel and at launcher separation.

4. LAUNCH SYSTEM DESIGN

While the launch system is a servant to the missile system both designs must be initiated and developed simultaneously to obtain the most successful weapon system. Assignment of the design responsibilities to a single organization with experienced engineers results in greatly reduced development time and cost.

Let us quickly survey the design approach of a large winged surface to air missile which, mainly because of the required mobility is to be launched with solid propellant boosters from a trailer compatible with existing roads. Desired missile motion, acceleration, guidance and aerodynamic limits, location of missile bulkheads and protuberances, are a few factors which influence the launch system design. Some of the first questions to be raised will be on the number and arrangement of boosters, their availability or the development effort required and on the available missile attach points for the booster.

A large single booster unit is usually the best choice if it can be located on the missile underside. Equipped with a canted nozzle it can be placed sufficiently forward to carry the missile pick-a-back before and during launch. Using the parameters of rocket thrust and the location of nozzle cant point and c.g., the flight path angle can be determined. Performance calculations start with the impulse required to achieve a minimum launch speed. The maximum booster thrust is mainly determined by missile strength while the minimum thrust is determined by the low or operational temperature limits and tail wind effects on launch performance, and by the angle between thrust line and flight path. The burning time is determined from total impulse and thrust. The shift of center of gravity during booster propellant consumption is noticeable for boosters using canted nozzles but usually does not present difficult problems.

Optimization studies begin after selection of a missile-booster combination. They must include the following parameters: Missile weight, missile engine thrust, guidance and control effects, acceleration variations (affecting structural weight and trajectories) and variations of the vertical booster thrust component. Later studies must investigate flight trajectories, pitch motions and angles of attack for various misalignments, and include rolling and lateral motions.

Launcher design studies continue during the analytical investigations. In our example the slippers which ride on the launcher rails can be fixed to the boosters. Clearance requirements and missile stability on the launcher can be assured during launch by careful selection of slipper locations. Clearance design study results and booster dimensions will influence launcher rail length and elevation. The booster jet must be analyzed to reduce forces on the missile and prevent flow reversals dangerous to it. The need for holdbacks and missile loading procedures must also be studied.

The above outlined design approach cannot be carried further without introduction of definite objectives and numbers which would be outside of the scope of this paper.

5. LAUNCH SYSTEM TESTING

5.1. *Test Program and Instrumentation*

In addition to the numerous laboratory tests covering detailed aspects, many types of open air tests such as the ones listed below are required in a launch system development program.

page 3 Willy Fiedle lecture Stuttgart 1958

1958

On September 24 the flight tests begin at *Cape Canaveral*. As is not unusual, problems manifest themselves. At higher elevations and speeds, a backflow of hot gases disrupts the airflow around the missile and damages equipment. It is determined that the rocket thrust can be controlled by "thrust vectoring", using **Willy Fiedler**-designed "jetevators", metal quadrants activated in the rocket exhaust.

Two years after joining Lockheed *Willy Fiedler* is promoted to Chief Scientist. He visits Germany where he lectures on his specialty: "The Launching of Large Rockets" at the Deutsche Wissenschaftliche Gesellschaft für Luft- und Raumfahrt, meeting in Stuttgart.[15]

For a copy of his lecture in PDF format (6 pages), click here.

1959

The first truly successful POLARIS flight is on April 20, by the AX-6 missile. By August 27 the POLARIS is successfully launched from a ship: the *Observation Island.*

Lockheed's Dan Tellep explains the Polaris to a group of visitors. Standing behind him (with glasses) Willy Fiedler

First submarine launch, July 20,1960

1960

The next series of prototypes is tested exhaustively during the next year. Out of forty flights, only twenty-eight are completely successful; twelve are partly successful. As time is running out, the decision is made to launch the first operational POLARIS A1

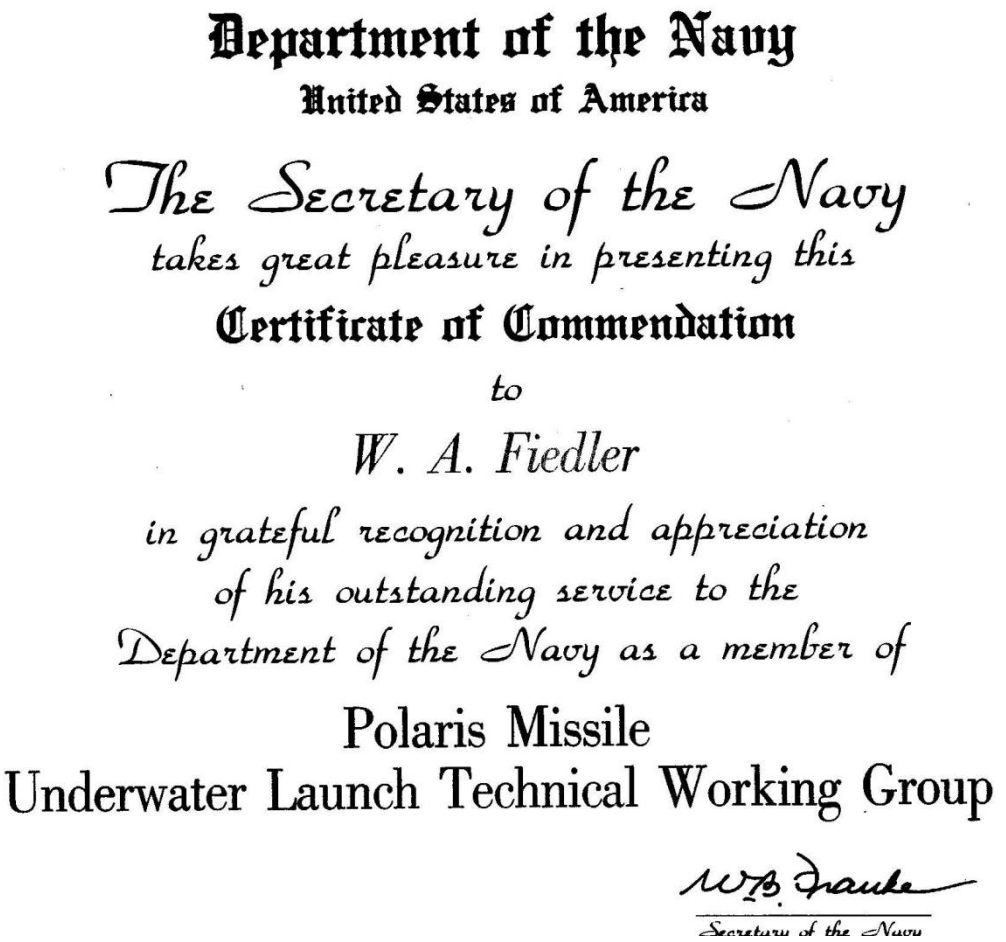
[15] **W. A. Fiedler, "The launching of large missiles" in:**

Jahrbuch 1958 der Wissenschaftlichen Gesellschaft für Luftfahrt e.V. (WGL)

Blenk, Hermann (Herausgeber): Braunschweig 1959 Fried. Vieweg & Sohn

Mit den Vorträgen der WGL-Tagung in Stuttgart vom 8. bis 11. Oktober 1958

missile from the submarine *George Washington*, on July 20, cruising of the coast of Cape Canaveral.
"The 1,000-mile flight down the range was a success, and in what some called bravado but was really well earned confidence, a second missile was launched three hours later. Admiral Raburn sent "success "messages from the submarine to the president and to Navy officials".[Walter Boyne].



Department of the Navy
United States of America

The Secretary of the Navy
takes great pleasure in presenting this
Certificate of Commendation
to
W. A. Fiedler
in grateful recognition and appreciation
of his outstanding service to the
Department of the Navy as a member of
Polaris Missile
Underwater Launch Technical Working Group

W B Franke
Secretary of the Navy

1961 [16]
LMSD is now *called Lockheed Missiles and Space Company* or *LMSC* with two divisions, the *Missiles System Division MSD* and a *Space Systems Division SSD*.
By the deployment date, January 1, the POLARIS A1 has met all the interim requirements, including the initially demanded 1,200 nautical-mile range.
The first launch of a POLARIS A2 test vehicle from a submerged submarine takes place on 23 October 1961.
The missile is successfully launched from the USS Ethan Allen off the coast of Cape Canaveral, FL.

1963
The first launch of a *POLARIS A3* missile from a submerged submarine takes place on 26 October. The missile is launched from USS Andrew Jackson while cruising submerged about 20 miles off the coast of Cape Canaveral, FL. The completely successful test is followed by a successful launch of an A2 missile from the same submarine on 16 November 1963, witnessed by President Kennedy from USS Observation Island.
POLARIS A3 represents a significantly greater technological advancement over A2, than that of A2 over A1. In terms of hardware design, POLARIS A3 is approximately an 85 percent new missile. The increase in range

[16] The following chronological account is partly based on http://www.ssp.navy.mil/fb101/themissiles.shtml

provided by A3 leaves *no land target inaccessible* and at the same time gives the submarines an enormous increase in sea room. Sixty percent increase in range to 2500 miles implied a requirement for greater accuracy. Advanced engineering introduces new thrust-vector controls, revised reentry-body materials, new ablative shield and more powerful propellants. [Boyne]

1964

POLARIS A3 becomes operational on September 28, one year ahead of schedule.

V-1 Rocket Developer

Pioneer Praises Polaris

The Polaris missile is probably the best war-deterrent in the world today, Willy A. Fiedler, a founding father of modern - day rocketry, said here last night.

And, he added, Charleston is playing a vital role in the Polaris program.

Mr. Fiedler, manager of the scientific staff of the missile systems division of Lockheed Missiles and Space Co., was one of the Germans who helped develop the V-1 rocket for Adolph Hitler. He came here yesterday to address approximately 250 Lowcountry engineers at their annual banquet, a highlight in the local observance of National Engineers Week.

The people in the Charleston area should be proud of the fact that Charleston is playing such an important part in the overall fleet ballistic missile program, Mr. Fielder continued.

WILLY A. FIEDLER
Addresses Engineers

THE UNITED STATES' only shore facility for Polaris missile assembly is located north of Charleston on the upper reaches of the Cooper River.

There, at the Naval Weapons Annex of the Naval Ammunition Depot, employes of Lockheed, many of whom are local people, and naval personnel test, assemble and load the lethal weapons in the rapidly growing Polaris submarine fleet.

Charleston has also become the primary supply point and one of the primary training centers for Polaris missile submarine personnel, and in the near future this port will become home for two nuclear-powered Polaris sub squadrons.

MR. FIEDLER described the Polaris missile as an interesting weapon politically. Not being stationary it can be pulled back, for example, along a line if this is politically expedient.

Polaris is not a provocative weapon, he added.

"By that I mean it is not like an airfield. It doesn't invite, by its very nature, to be hit."

The German-born scientist worked at the U. S. Naval Air Missile Test Center in Point Mugu, Calif., from 1945 until he joined Lockheed in 1956. He has been associated with Polaris from its earliest experimentation stage.

He said Polaris and the V-1 were hardly comparable and added that the U.S. weapon is infinitely more complicated.

BECAUSE OF the complexity of this weapon, many tests are required, to iron out the bugs.

He added that these tests, in his opinion, are given too much publicity.

"I don't think our failures should be publicized so much," he said. "Too many people don't understand. It is a rare failure that doesn't teach us something.

"In Germany, we learned by failures. We had no publicity at all."

Mr. Fiedler said efforts are going forward now to make the Polaris even more reliable than it already is.

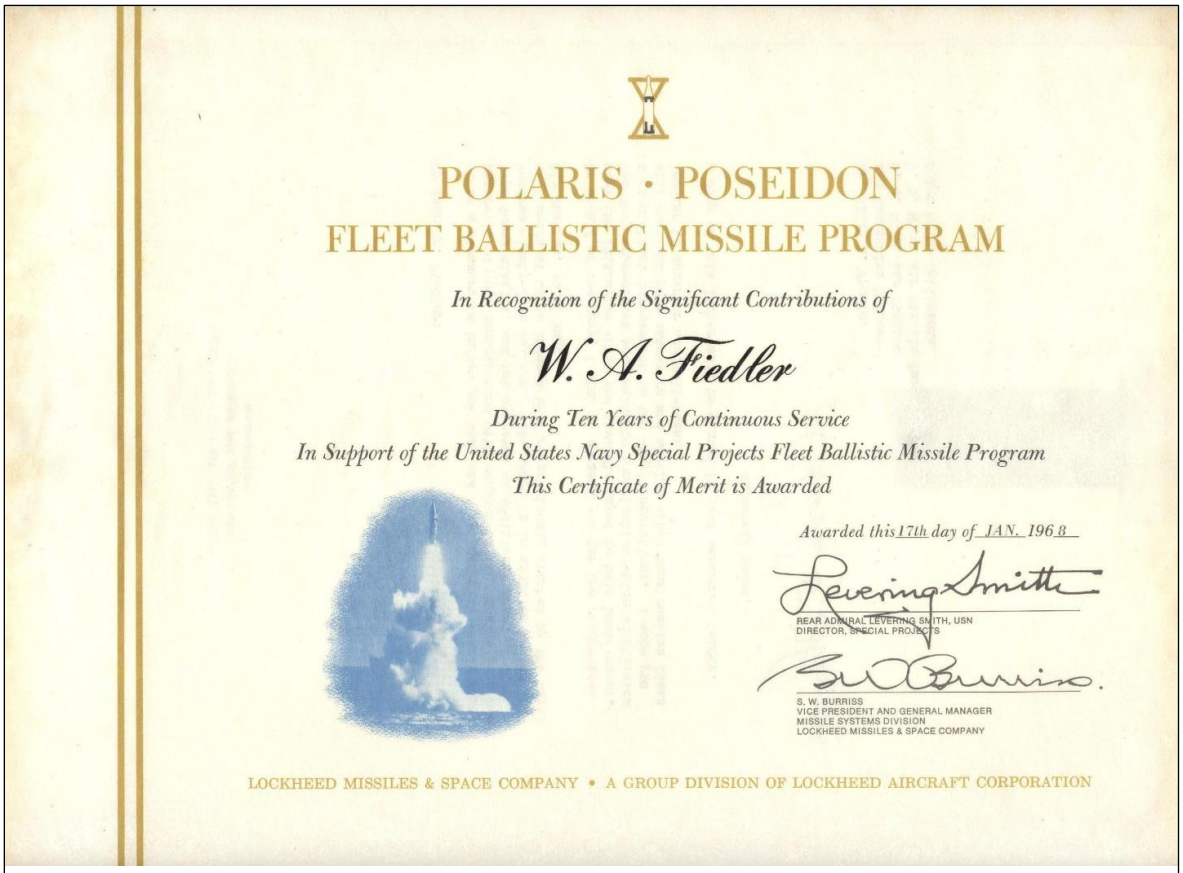
Now an American citizen and holder of the U.S. Navy's Distinguished Civilian Service Award, the Navy's highest civilian service award, Mr. Fiedler's headquarters are in Sunny Vale, Calif.

The meeting last night at the Francis Marion Hotel was sponsored by the National Society of Professional Engineers.

1964 speech at meeting in Charleston SC of the National Society of Professional Engineers

1965

POLARIS A1 is officially retired from active duty when USS Abraham Lincoln, the last of the first five submarines to carry it, returns to the U.S. on 14 October 1965 for her initial overhaul *Willy Fiedler was a great inventor, who considered himself "a hardware man" as opposed to working only in theory. He wanted literally to get his hands on the project before him. He was an excellent man with machine tools.* [Monica Fiedler]



POLARIS · POSEIDON

FLEET BALLISTIC MISSILE PROGRAM

In Recognition of the Significant Contributions of

W. A. Fiedler

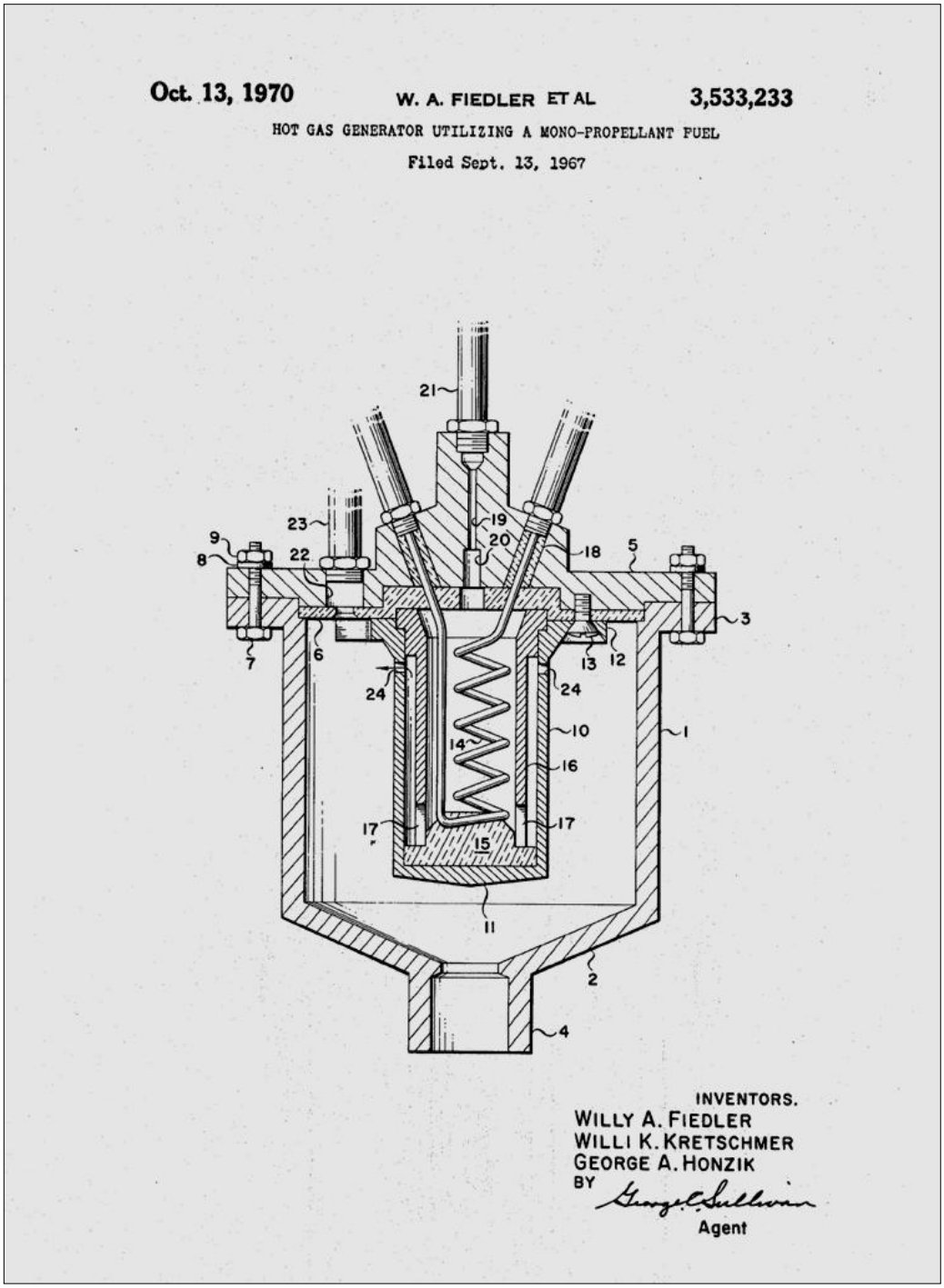
During Ten Years of Continuous Service
In Support of the United States Navy Special Projects Fleet Ballistic Missile Program
This Certificate of Merit is Awarded

Awarded this 17th day of JAN. 1968

REAR ADMIRAL LEVERING SMITH, USN
DIRECTOR, SPECIAL PROJECTS

S. W. BURRISS
VICE PRESIDENT AND GENERAL MANAGER
MISSILE SYSTEMS DIVISION
LOCKHEED MISSILES & SPACE COMPANY

LOCKHEED MISSILES & SPACE COMPANY • A GROUP DIVISION OF LOCKHEED AIRCRAFT CORPORATION

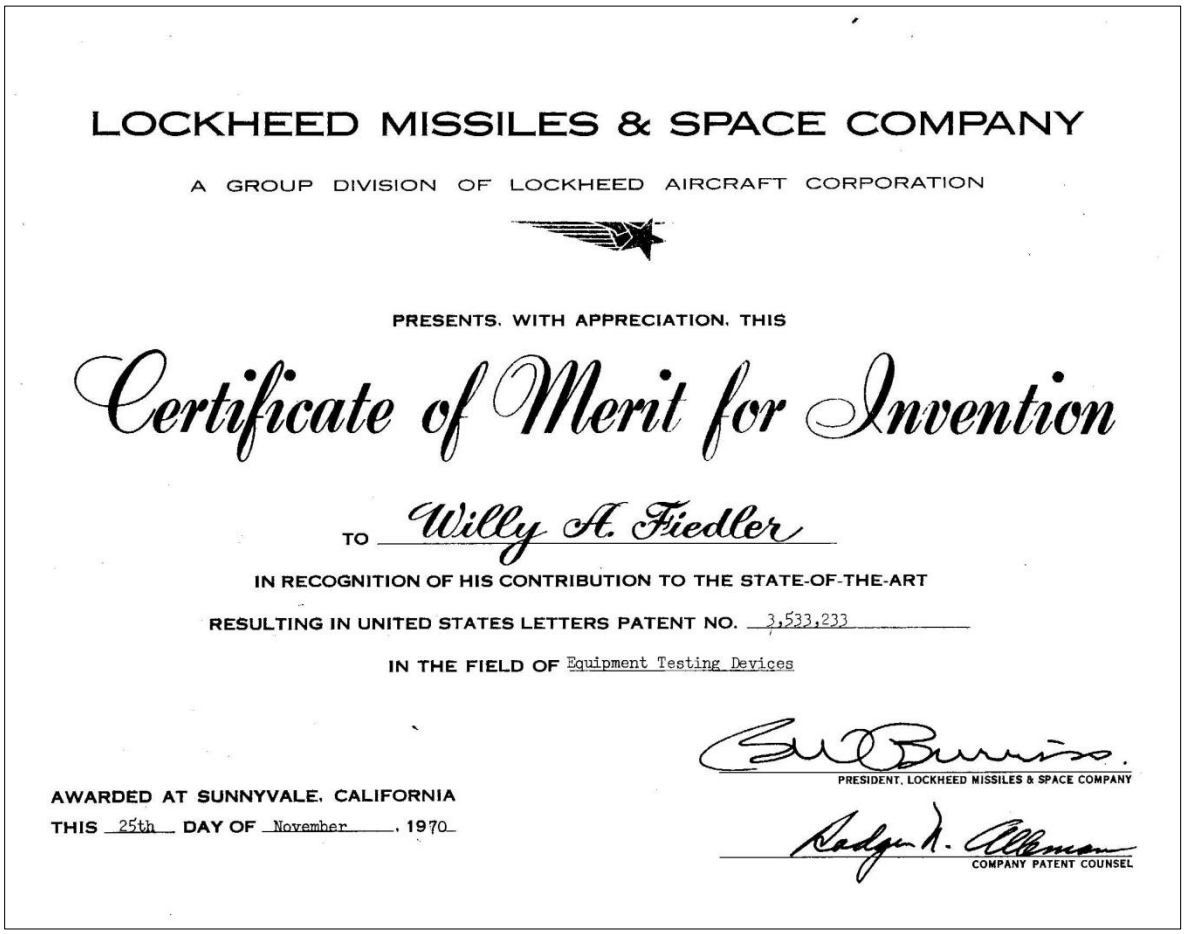


Filed Sept. 13, 1967 / Oct. 13, 1970 W.A. FIEDLER ET AL

HOT GAS GENERATOR UNTILIZING A MONO-PROPELLANT FUEL

To download full text of patent click here

US 3,533,233"…This invention relates to improvements in apparatus for igniting and burning a liquid mono-propellant in a combustion chamber. The igniting and burning apparatus referred to is employed in connection with gas generators, reaction motors, or the like so that the combustion can be terminated or restarted at will. More particularly, this apparatus uses a pilot combustion chamber to ignite a main combustion chamber and utilizes a mono-propellant fuel…"



LOCKHEED MISSILES & SPACE COMPANY

A GROUP DIVISION OF LOCKHEED AIRCRAFT CORPORATION

PRESENTS, WITH APPRECIATION, THIS

Certificate of Merit for Invention

TO Willy A. Fiedler

IN RECOGNITION OF HIS CONTRIBUTION TO THE STATE-OF-THE-ART

RESULTING IN UNITED STATES LETTERS PATENT NO. 3,533,233

IN THE FIELD OF Equipment Testing Devices

PRESIDENT, LOCKHEED MISSILES & SPACE COMPANY

COMPANY PATENT COUNSEL

AWARDED AT SUNNYVALE, CALIFORNIA

THIS 25th DAY OF November, 1970

1970

POSEIDON, which had its roots in POLARIS technology, is a two-stage, solid propellant missile capable of being launched from a submerged FBM submarine. It is only 2 feet longer than the 32-foot POLARIS A3 missile, but has a much larger diameter, 74 versus 54 inches, and is 30,000 pounds heavier. Despite this increase in size, the growth potential of the FBM submarines allows POSEIDON missiles to fit into the same 16 missile launch tubes that carry POLARIS. POSEIDON is also a 2500 nautical (2880 statute) mile range missile; however, it is outfitted with multiple warheads, each of which can be targeted separately. This capability, known as MIRV, enables POSEIDON to cover an increasing number of targets.

The first launch of a POSEIDON missile from a submerged submarine is successfully conducted on 3 August 1970. The missile is launched from USS James Madison as she cruises submerged off the coast of Florida near Cape Canaveral.

1971

The POSEIDON C3 becomes operational on 31 March 1971, when USS James Madison begins her initial operational patrol, carrying 16 tactical POSEIDON C3 missiles.

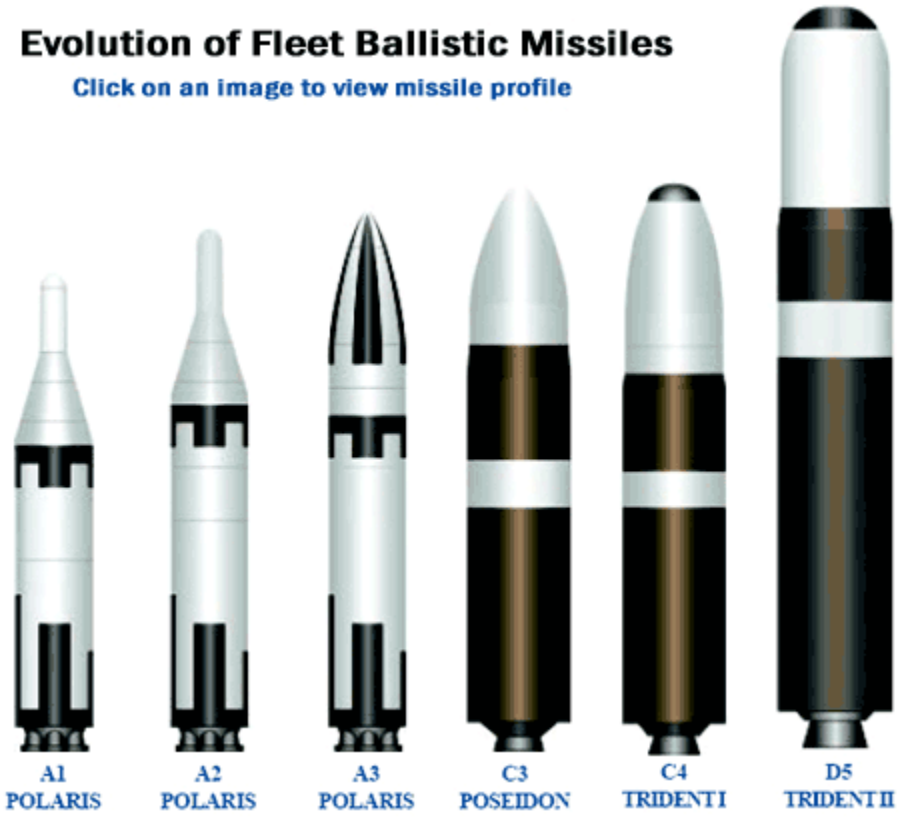
1972

The TRIDENT program is started. This missile has a more powerful three-stage engine, decreased inert weight and more efficient energy management. More propellant is carried, doubling the range to almost 5000 miles with the same payload and accuracy. Advances in electronics permit the installation of *a stellar-inertial guidance system* and improved navigation and fire control systems. Composite graphite-epoxy materials reduce the weight of structures to 40 percent compared with aluminum. The science of aerodynamics contributes an unusual and unexpected improvement with the invention of a deployable *aerospike*, a needlelike extension that extends shortly after launch and *reduces the frontal drag of the missile by 50 percent*. [Boyne]

1977 and later

The C4 missile development flight test program commences on 18 January 1977 when C4X-1 is launched from a flat pad at Cape Canaveral, FL.

The first tactical patrol of a back fitted POSEIDON submarine is in October 1979, and the first TRIDENT submarine deploys in September 1982 from Bangor, WA. The TRIDENT/Ohio Class submarines are quieter, more capable, and more difficult to detect than their predecessors.



[http://www.ssp.navy.mil/fb101/themissiles.shtml]:

The FBM program was an unqualified success. It was executed with great dedication and diligence by the Navy and its major contractor Lockheed Missile Systems Division. At both ends, teams of highly skilled personnel worked in good cooperation for years on end on the various projects, meeting in all cases the design goals and deadlines.[17]

As Walter Boyne writes: "The Fleet Ballistic Missile Program was an almost miraculous accomplishment, squeezed into a time table that any sensible manager would have deemed impossible. And it was due to the incredible cooperation – and ability – of the Navy-Lockheed team, who had not addressed but assaulted problems to insure their solution."

Willy Fielder fitted like a glove into this organization. His experience in testing missiles of all sorts was unsurpassed. He had an intuitive grasp of the problems at hand. He could rally people to the task with his enthusiasm, leading to solutions

[17] In order to supervise the timely completion of the myriad subtasks, new computer techniques were implemented around the 1960s (PERT).

that were often original. His relations with his peers as well as with his superiors were equally positive due to his expertise, cheerful nature and optimistic outlook. [Monica W.-S.]

A favorite story about Fiedler occurred during the celebration of the first successful Polaris missile launched. Everyone was celebrating and throwing each other in a pool. The pool treatment was given only to respected leaders said chief engineer Frank Bednarz, who expected to be next and handed Willy
his wallet and eyeglasses.

The revelers walked right past Bednarz and flopped Willy - with Bednarz's valuables - into the pool. [Martin Hollmann]

LEVERING SMITH, Rear Admiral, U.S. Navy

DEPARTMENT OF THE NAVY
STRATEGIC SYSTEMS PROJECT OFFICE
WASHINGTON, D. C. 20360

Dr. Willy A. Fiedler, Chief Scientist
Missile Systems Division
Lockheed Missiles & Space Co., Inc.
P.O. Box 504
Sunnyvale, CA 94088

Dear Dr. Fiedler:

On the occasion of your retirement after a distinguished career in aeronautical and ordnance engineering capped by seventeen years in which you and I have been associated in the Fleet Ballistic Missile Program, I wish to express officially the gratitude of the Navy and the Special Projects Office for the invaluable service you have rendered, as well as to extend to you my personal thanks and best wishes.

Your participation in our program and your dedication to the task have been constant. Your contributions, especially in thrust vector controls and underwater launch, were essential to success in the early and very critical development of the Fleet Ballistic Missile System. Throughout the years, your inventiveness and critical analysis have been of continuing and substantial value.

As we move ahead to maintain the effectiveness of the deterrent system in which your energies were so valuable, your daily presence on the FBM team will be sorely missed.

Thank you and smooth sailing.

Sincerely yours,

Levering Smith

LEVERING SMITH
Rear Admiral, U. S. Navy
Director, Strategic Systems Projects

W. F. RABORN
VICE ADMIRAL, USN (RET.)
1606 Crestwood Lane
McLEAN, VIRGINIA. 22101

March 18, 1974

Dear Willy:

It surely was a heart-warming letter which you wrote under the date of 28 February and in return please let me say that I know of no one in the whole POLARIS family who was more innovative and productive than you!

So in return let me assure you that your dedicated efforts have affected the lives of millions of Americans because of the resounding success of the POLARIS weapons system to which you made such a major contribution.

I thank you so much for your thoughtful invitation to spend an evening with you and there is nothing which I would like better to do than that. Perhaps on one of my periodic (quarterly) visits to LMSC by pre-arrangement we could do just that.

In the meantime may I wish you and your nice wife Greta all of the wonderful benefits and happiness which you both richly deserve.

Sincerely,

"Red"

W. F. Raborn

Dr. Willy Fiedler
12758 Leander Drive
Los Altos Hills, Calif. 94022

o Willy Fiedler, with warm appreciation

Your shipmate, W. Red Raborn

Vice Admiral USN

DEPARTMENT OF THE NAVY
STRATEGIC SYSTEMS PROJECT OFFICE
WASHINGTON, D.C. 20376

IN REPLY REFER TO

14 OCT 1975

Dr. W. A. Fieldler
12758 Leander Drive
Los Altos Hills, CA 94022

Dear ~~Dr. Fieldler,~~ Willie:

As our Navy celebrates its 200th Birthday and our Country prepares to celebrate its Bicentennial, we in the Strategic Systems Project Office find ourselves preparing to celebrate the Twentieth Anniversary of the POLARIS/POSEIDON/TRIDENT Programs.

The outstanding team which began this program, came into being on 17 November 1955. The enthusiasm and perseverance of these pioneers established the basis for the dedication and uncompromising excellence which still imbues the contractors, laboratories, and military activities which remain dedicated to strategic system excellence.

It seems appropriate, then, that all of those individuals, past and present, who have labored so successfully and selflessly for the success of POLARIS, POSEIDON and TRIDENT Programs should join together to mark this Twentieth Anniversary. To that end a Commemorative Committee has been established and with traditional Special Projects vigor has organized a dinner/dance to be held on 15 November 1975.

Individual invitations have been sent to as many as space, time and records would permit us to contact. We plan to make the evening a team affair and seat the celebrants accordingly. Tables will be arranged so as to mingle old timers, present contractors and SSPO employees on the basis of common interest and common goals. Although some degree of solemnity is inevitable, our purpose is to enjoy the company of old friends and present participants in our common effort.

14 OCT 1975

By separate mail I have sent your invitation and supporting information about the party. I hope you will be able to accept and I look forward to seeing you on the 15th of November.

Sincerely yours,

Levering

LEVERING SMITH
Rear Admiral, U.S. Navy
Director, Strategic Systems Projects

Willy Fiedler (seen on the back) talking to Dan Tellep,
(CEO of Lockheed at the time of the merger with Martin)

Willie Fiedler lecturing about the Polaris

Tribute to German-American scientists (at the occasion of the Lockheed celebration?)

source: Roy Day

In retirement Willie Fiedler visits Missile Park Point Mugu

Willy Fiedler on the front steps of his house shortly before going on a vacation to Europe (1995?)

According to a newspaper clipping Willy visited München Germany in August 1995.[18]

… In those years (1994?) he also made a glider flight at Santa Ynez CA (near Santa Barbara) where he piloted himself. In 1996 Willy enjoyed a last glider flight at Hollester CA where he flew for 45 minutes with a lady-instructor. On return the woman stated she was highly impressed by the flying skills of her 87-year old co-pilot.
"He has such delicate touch", she said.
[source: M. W.-S]

[18] **On the next page: Willy Fiedler's house in Los Altos Hills, designed and built by himself.**

Willy Fiedler, before his last flight at Hollister CA, fall 1996

In 1997 he made a last trip to Europe (with the Chrystal Harmony, a cruise ship) to visit his daughters.

Willie died shortly before his 90th birth date, on the 17th of January 1998.

WILLY A. FIEDLER
12758 LEANDER DRIVE
LOS ALTOS HILLS, CA 94022

AIRCRAFT TYPES FLOWN

KLEMM	L20, L25
MESSERSCHMITT	Me 109, Me 25, Me 108, Me 110
FOCKE WULF	Canard, Stösser, Stieglitz, Weihe
HEINKEL	Kadett, He 111, He 77
GERNER	Biplane
LOON / V1	Fi 103 – Reichenberg
FIESELER	Fi 167, Fi 156, Fi 256, Fi 99, Fi 158, Spatz
DOUGLAS	DC-3
JUNKERS	Ju 52, Ju 88, Ju 188, F13, W33, Junior
DORNIER	Do 17
CALBRON	C 21
ARADO	Four types incl. '65 and '66
HAVILLAND	Moth
RUHRTALER	R3
BACHEM	Lark
+	
GLIDERS	Incl. F1

SUM: 37 types

HOOVER INSTITUTION
ON WAR, REVOLUTION AND PEACE

HOOVER INSTITUTION ARCHIVES

February 16, 1995

Answer Febr. 22

Mr. Willy A. Fiedler
12758 Leander Drive
Los Altos Hills, CA 94022

Dear Mr. Fiedler:

It was such a pleasure to meet with you and your daughter at the Hoover Institution Archives. The materials that you have donated on the development of missiles will add to our understanding of the role of technology in postwar defense policy. Beyond security issues, your own life story is fascinating and a wonderful addition to our holdings. I hope that you and your secretary continue to work on the oral history project. As you complete tapes and also as you run across other materials, perhaps from Germany, I hope that you continue to add to your collection at the Hoover Institution.

There is one housekeeping chore to take care of. As I mentioned, we need to have a deed of gift to finalize the transaction. I am enclosing two deeds for your consideration. If the wording meets with your approval, kindly sign and return one copy. The other copy is for your records.

I very much enjoyed looking at the photograph album from your retirement party. Your daughter suggested that we return the album to you so that you can also enjoy it.

The xeroxes with this letter come from the Wiegand collection that I mentioned to you. In the collection are photographs of Dipl. Eng. Rudolph Nebel, the director of the Raketenflugplatz in Berlin.

Best wishes,

Sincerely,

Elena S. Danielson

Elena S. Danielson
Associate Archivist

ESD:gt
Enclosures