

Duane Pearsall and the Most Important Fire Protection Breakthrough of the 20th Century

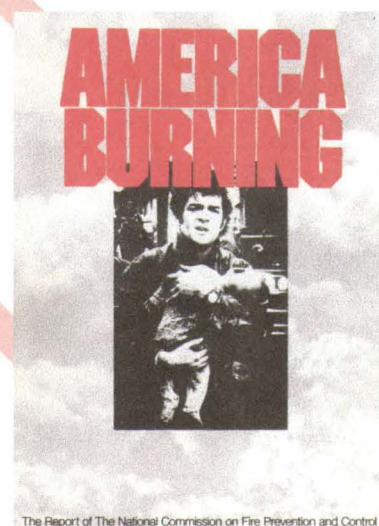
David A. Lucht

It was the 1960's. The United States Congress was holding hearings on the nation's fire record. At the conclusion of the hearings the Fire Research and Safety Act of 1968 was adopted into law, requiring the President of the United States to appoint a 20 member panel* to conduct a comprehensive study of the nation's fire problem and make recommendations for reducing fire losses. The panel would be known as the National Commission on Fire Prevention and Control.

Page one of the Commission's final report, titled *America Burning*, found:

“Appallingly the richest and most technologically advanced nation in the world leads all the major industrialized countries in per capita deaths and property loss from fire” [1]

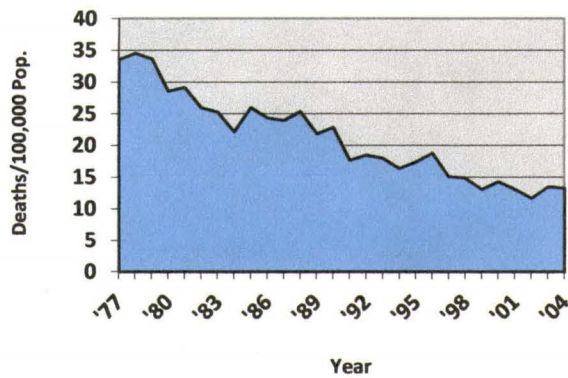
While differing reporting practices made international comparisons difficult, it is interesting to note the reported US fire death rate was twice that for second ranking Canada, 3 times higher than the UK, 4 times Japan and over 10 times France and Italy [2]. Upwards of 80% of fire deaths happened in people's own homes, most often at night when they were most vulnerable. Fire safety was a high profile public topic of the day.



The 1973 *America Burning* report proposed a goal of cutting US fire losses in half within the next generation. Now, looking back 40 years later, it's gratifying to see the goal was actually met.

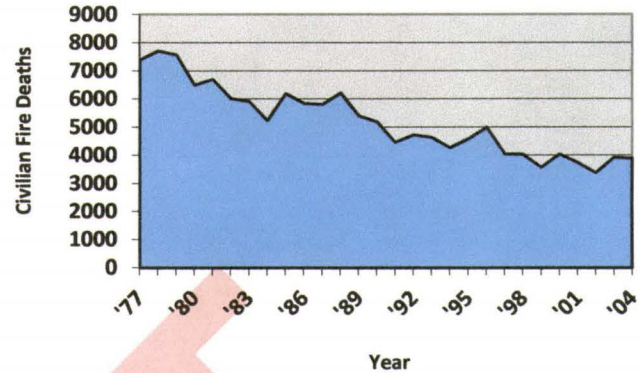
Of all the new technologies that emerged in the past 100 years, the affordable home smoke detector had the most profound and direct impact on fire deaths in the United States. Soon after the home smoke detector hit the marketplace in the mid 1970's, fire deaths began to decline. Thirty years later American fire deaths had dropped 50%. The per capita death rate had fallen by nearly two thirds – from 35 deaths per 100,000 population down to 13 (see figures). It's estimated that some 60,000 deaths did not occur that would have if the death rate had remained constant over these three decades.

*. Then NFPA Honorary Chairman Percy Bugbee was a member of the Commission.



■ Civilian Fire Death Rate

Source: NFPA



■ Civilian Fire Deaths in the US

Source: NFPA

While the decline in fire deaths can be attributed to a number of factors (like reductions in cigarette smoking), there can be little question the home smoke detector had major impact. Over the same thirty year period, the number of homes having smoke detectors increased from less than 4% to 94%.

Interestingly the man who developed the affordable home smoke detector was not a fire protection equipment manufacturer, fire protection engineer, member of the fire service or fire researcher. He was a small business person manufacturing electrostatic control equipment in Denver, Colorado. He stumbled on the idea by accident, developed a passion for saving lives and overcame untold obstacles to bring the innovation to the marketplace at a price homeowners could afford. This article will tell the story of the affordable home smoke detector and its unlikely entrepreneur developer, Mr. Duane Pearsall – a man who singularly did more to save lives from fire than anyone who lived in the 20th Century.

At the time the National Commission was doing its study, young entrepreneur Duane Pearsall was busily at work starting up his first successful manufacturing company called Statitrol Corporation. He had put everything at risk to start the new venture, including a second mortgage on his house.

The Statitrol product was designed to eliminate static electricity problems. This was of particular interest to industries like newspaper printing, photo and data processing operations. The operating principle was to discharge negative ions into rooms and spaces, thereby preventing static electricity discharges. The product was simply an ion generator.

Things were going well and the operation was starting to turn a profit. Then disaster loomed. Customers were complaining of product failures in the field. Something had to be done, and done fast. Nothing could have been further from Pearsall's attention than smoke detectors.

Pearsall called in his engineer/inventor friend Lyman Blackwell to help figure out why the ion generator was misbehaving. In Pearsall's words "Lyman kludged together" a makeshift lab experiment to measure the flow of ions in the airstream discharging from the generator.*

Not long after the experiment was powered up, the ion concentration meter began showing erratic readings that, at first, could not be explained. Soon, however, it was noticed that the strange readings only happened when Randy the lab technician was in the room. Randy was a compulsive chain smoker, sometimes lighting up at the most inappropriate times. It became clear the lab instruments were detecting invisible smoke particles. Someone jokingly remarked "we should be making smoke detectors!" According to Pearsall's memoir, this was the "point of discovery ...the embryonic beginning of the battery operated home smoke detector."

With no experience in the field, Pearsall set out to develop a smoke detection business. First to emerge was a new hard-wired commercial ionization smoke detection system which utilized an adapted version of Blackwell's experimental ion flow measuring device. Introduced in 1968, the Statitrol system only required a 24 volt power supply as opposed to the higher power requirements of the Cerberus systems then being produced in Switzerland (220 volts). Statitrol emerged as the first US manufacturer of ionization smoke detectors.

The low voltage, hard-wired systems were still too costly for the average homeowner, especially for retrofitting existing homes. Pearsall forged on to develop what would ultimately be a completely self-contained battery powered home smoke alarm system about the size of a coffee cup...that could easily be attached to the ceiling with two screws. Once again Blackwell contributed to the technological design. His use of the Complementary Metal Oxide Semiconductor (CMOS) invented in 1967 by Frank Wanlass at Fairchild Semiconductor further reduced electrical power requirements, helping to make the battery energy source feasible.

Finally, Pearsall was concerned about the possibility of the batteries going dead and disabling the detector, leaving dwelling occupants unprotected. To guard against this, Statitrol's staff engineer Paul Staby worked with Blackwell to develop self-monitoring circuitry that would cause an audible warning when the battery strength deteriorated. This would end up being a key feature for overcoming resistance to the self-powered concept.

Blackwell and Staby secured the patent on the battery powered home smoke detector on December 11, 1973 (US Patent Office #3,778,800).

Paul Staby continued refining the product to optimize manufacturability. He reports only a few years later Statitrol contracted with Motorola Corporation to replicate the electronics in an integrated circuit format, thereby further reducing production costs [2]. Further, Motorola was given license to sell the circuit board to any and all competitors beginning 12 months after the agreement, thereby opening the gates to commoditization and even lower pricing, easily reaching Pearsall's original goal of homeowner affordability. Today a frugal shopper can purchase a self-monitoring battery powered smoke detector for well under \$10.00

*, Quotes and other specific attributions to Duane Pearsall are taken from his memoir titled *My Life Unfolded*, published by the Pearsall family in 2009.

Pearsall had had the “ah-ha moment.” He had a vision. He had a prototype and team of experts at the ready. Now, using his considerable leadership skills in the business of product development, engineering, manufacturing, marketing, distribution and sales, he set out to make the low cost, self-contained battery powered smoke detection system a reality. He would call it the “SmokeGard”.*



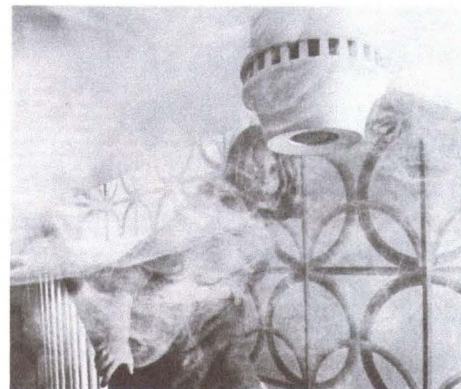
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Pearsall quickly learned that a labyrinth of hurdles lay ahead in the journey toward actual retail sales. These included:

- Laboratory Approval Before retail sales could begin, the mark of approval was needed from a recognized testing laboratory. Underwriters Laboratories declined to test the product since the consensus standards of the day did not permit single station battery-powered devices
- Consensus Standards NFPA Standard No. 74 *Household Fire Warning Equipment* did not allow the battery-powered device. Changes would have to be made.
- Fire Service Opposition Of surprise to Pearsall was opposition by many local, state and national fire service leaders. Concerns would have to be overcome.
- Code Requirements Very often sales of fire protection devices are heavily driven by state and local building and fire code requirements and the consensus model codes upon which they are based. None of the model codes recognized the battery power concept. Nor did they require detection systems in dwellings. Amendments would be needed.

With plenty of serious challenges to overcome, Pearsall set out to work within the system of codes and standards to make the product feasible. While he was personally involved every step of the way, part of his genius was an exceptional ability to harness the involvement of other enthusiastic talents – ranging from engineers and marketing professionals to dedicated rank and file factory workers and public service volunteers.

He assembled an ad hoc cluster of fire community members to help him promote understanding and resolve concerns among fire and building professionals. This included Rexford Wilson, consulting fire protection engineer, Denver Fire Chief Myrle Wise and John “Gus” Degenkolb, retired LAFD officer and code consultant. Together they talked up the idea, answered technical questions and distributed free prototypes of the detector to movers and shakers in the world of fire safety. Images of the SmokeGard appeared in the *America Burning* report submitted to the President and Congress.



SmokeGard in *America Burning* p.148

* Due to OEM agreements and corporate purchases and sales, over the years Statitrol technology has appeared under several names including Sears, Honeywell, Water Pik, Emerson Electric, Amway, BRK.

NFPA Standard

With ample support from national advocates for the low cost home smoke detector, speedy progress was made by the Technical Committee responsible for NFPA No. 74 *Household Fire Warning Equipment* [4]. The standard was amended in 1972 to accommodate the self-monitoring battery power. The new language read as follows:

2030. Primary Power Supply (Monitored Battery)

2031. Household fire warning equipment may be powered by a battery provided the battery be monitored to assure that the following conditions are met:

- (a) All power requirements are met for at least one year's life, including routine testing
- (b) A distinctive audible trouble signal shall be given before the battery is incapable of operating (from aging, terminal corrosion, etc.) the device(s) for alarm purposes
- (c) Following an alarm in which the battery(s) reaches its trouble point, the trouble signal shall operate for at least 7 consecutive days
- (d) The audible trouble signal is produced at least every minute for seven consecutive days.
- (e) The monitored batteries meeting these specifications shall be clearly identified on the unit or the battery compartment

Changes were also undertaken to modify the number of detectors required. At the time NFPA 74 required smoke detectors in the hallway outside bedrooms *and* heat detectors "in all rooms, all closets, and in all other areas where fires can occur". These requirements resulted in system costs that were prohibitive for the homeowner.

Richard Bright, a leading detection researcher at the National Bureau of Standards (now National Institute of Standards and Technology, NIST) estimated a cost of \$700 to \$1,200 to protect a typical three bedroom home in 1974 [5]. The cost factor helped define Pearsall's target... to develop an effective, affordable and easy to install smoke alarm system for installation in residences, or, in his words "to perfect a life-saving product every homeowner could afford."

By this time empirical fire research was beginning to show that smoke detectors alone provided a high rate of return in terms of lives saved vs. system costs compared to heat detectors. The 1972 edition of NFPA 74 gave a nod to this fact by acknowledging for the first time that heat detectors need not be mandatory in all rooms, closets and other areas:

2412. This standard recognizes that the use of partial protection can provide some degree of life safety for sleeping occupants when a basic smoke detector is installed in the immediate area(s) of, but outside of, the bedroom(s).

A few years later Bright reported "...the 1974 edition of NFPA No. 74, however, recognized the fact that smoke detector technology has advanced to the point where the judicious installation of one or two smoke detectors could be more effective than a house full of heat detectors in alerting dwelling occupants to fire [6]."

Laboratory Approvals

Interestingly the first laboratory approval of the battery powered home smoke detector came from Factory Mutual Laboratories (now known as FM Approvals), which had never in its 136 year history tested and approved a household product . FM had always focused exclusively on fire equipment for industrial and commercial applications.

Pearsall and his team would leave no stone unturned, approaching FM despite the fact the laboratory had no history of testing home safety products. As it turned out management took an interest, due in no small measure to altruistic motives of individual FM personnel. In a 1971 internal memorandum from Approvals Manager Eugene Cray to Vice President Jack Rhodes, Cray reported an increase in requests for fire alarm systems, in direct proportion to public and government officials' growing concern over the appalling loss of life resulting from home fires. Cray recommended that FM Approvals move into the home fire alarm certification business.

Within weeks a new residential approval category was authorized by management and, with technical assistance from Rexford Wilson, tests of the Statitrol SmokeGard Model 700 were undertaken. FM approval was achieved in 1972. At about the same time, SmokeGard made its retail debut in the Sears & Roebuck Spring Catalog at a list price of \$37.88.

Underwriters Laboratories tested and listed the SmokeGard in 1974.

Code Requirements

With support from the likes of Wilson and Degenkolb, Pearsall first concentrated on the western US region through the International Conference of Building Officials. ICBO was the first model code to incorporate requirements for smoke detectors in the hallways immediately outside the bedrooms. With additional advocacy nationwide, others followed:

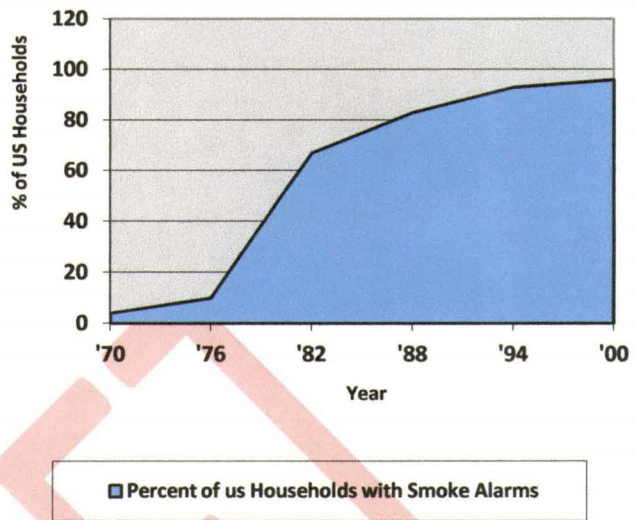
- 1973 – International Conference of Building Officials*, *ICBO Uniform Building Code*
- 1975 – Building Officials and Code Administrators*, *BOCA Basic Building Code*
- 1975 – Southern Building Code Congress*, *SBCCI Standard Building Code*
- 1975 – Council of American Building Officials, *CABO One- and Two-Family Dwelling Code*
- 1976 – National Fire Protection Association, *NFPA 101, Life Safety Code*

*. Later merged to form the International Code Council



Soon state and local governments started adopting the model codes for new construction. Some implemented self-standing home fire alarm laws and ordinances. Ohio adopted the first state-wide requirement in 1971. [7]

As time went on, lawmakers ventured into retroactive regulations for existing homes, usually requiring installation of smoke detectors at the time of a purchase and sale agreement. The easy to install battery operated device pioneered by Pearsall made it feasible to retrofit the nation's vast inventory of existing residential building stock. In thirty years 94% of US residences were equipped with home smoke detectors.



Source: NFPA

Much progress was made in a relatively short time – at its peak Statitrol had some 1,000 employees turning out smoke detectors. But Duane Pearsall would be the first to tell you he didn't do it alone. He had help from engineers, code advisors, public officials and a host of people of good will in the voluntary consensus establishment. But he brought the vision, the passion, dogged commitment, resources, diplomacy, and entrepreneurial skills to the cause. He was the point man who did more than anyone to bring about this sea change in fire protection.



*President Gerald Ford
Congratulates Pearsall, 1976*

In 1976, well before the real impact of this life saving device could have been known, President Gerald Ford honored Pearsall with the National Small Business Person of the Year Award in recognition of his wide-ranging leadership in the small business sector.

Described as a quiet and humble man, Pearsall was profoundly civic minded. He was a leader in the US Chamber of Commerce and cofounded its Small Business Council. He was frequently invited to speak on small business issues before Congressional committees, Federal agencies, and university and business groups.

After he sold Statitrol to Emerson Electric in 1977, he cofounded Columbine Venture Fund which he described as his "third career." His goal was to help other entrepreneurs and inventors advance technological innovations. To his last day he sought to give back to the community he always felt gave so much to him.

In 1980 the Society of Fire Protection Engineers recognized Pearsall with the prestigious Person of the Year Award. Worcester Polytechnic Institute bestowed Pearsall with the Honorary Doctor of Science degree in 1987; and in 2004, on the 25th anniversary of its fire protection engineering graduate program, WPI awarded him the Presidential Medal for his work as a Technological Humanist

Duane Pearsall died April 11, 2010 at the age of 88.

The Nader Bomb [Sidebar]

Just as Pearsall was beginning to see some light at the end of the tunnel, consumer advocate Ralph Nader threw up yet another roadblock. In 1976 Nader filed a complaint with the Nuclear Regulatory Commission (NRC) claiming the ionization smoke detectors produced radioactive emissions that were hazardous to the health of people in buildings. He petitioned the NRC to recall the detectors and ban further sales.

The SmokeGard did contain a harmless radioactive source for the purpose of creating ions in the detection chamber...as is the case for all ionization smoke detectors. Sensitive to the health concern, Pearsall had already changed the radioactive source from 0.5 microcuries of Radium 226 to 1.0 microcurie of Americium 241 which was deemed to be even more benign.

Nader was in the media spotlight in the wake of his complaint and Statitrol experienced immense concern about sales and product viability. The NRC dismissed the claim noting a person receives 100 times more background radiation due to high elevation flying round trip across the US. With a lot of public education effort, Pearsall was able to move forward and conquer yet another hurdle.

References

- [1] *America Burning: The Report of the National Commission on Fire Prevention and Control*, U.S. Government Printing Office, 1973
- [2] International Fire Statistics, 1972, *Fire Journal*, NFPA, November, 1973
- [3] Personal communication with Paul Staby
- [4] NFPA No. 74, *Household Fire Warning Equipment*, 1972 Ed., National Fire Protection Association
- [5] Bright, Richard G, *Fire Journal*, NFPA, November, 1974
- [6] Ibid
- [7] Lucht, David A., Legal Requirements for Fire Alarms in Ohio Dwellings, *Fire Journal*, NFPA, March, 1972

About the Author

Fire Journal published a 1972 article by David Lucht, advocating for affordable home fire alarms and reporting on the first statewide code requirements (Ohio).

Lucht was a research engineer at The Ohio State University, during which time he authored home smoke detector proposals which were adopted by the Ohio Building Code. He later authored and adopted similar requirements for the new Ohio Fire Code in his post as the Ohio State Fire Marshal.

Later he was appointed by President Gerald Ford as the first deputy administrator of the US Fire Administration whose mission was implementation of the *America Burning* report. Subsequently he served as the first head of the graduate degree fire protection engineering program at Worcester Polytechnic Institute. He retired from WPI in 2004 after serving there for over 25 years.

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