

# **ENGINEERING THE EVERYDAY AND THE EXTRAORDINARY**

*Milestones in Innovation*

By The American Society of Mechanical Engineers

Foreword by Henry Petroski

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This Book is dedicated to engineers,  
past, present and future.



# TABLE OF CONTENTS

06 Foreword

08 Introduction

## 10 COMMUNICATION

**12** Internet | **14** Television | **16** Universal Product Code | **18** Linotype Machine | **21** Cloud Computing | **22** Mobile Phone | **24** RFID | **26** Radio | **28** Telegraph

## 30 ENERGY/POWER

**32** Jet Engine | **34** Incandescent Light Bulb | **36** Itaipu Dam | **39** Transformer | **40** SolarWall | **42** Electric Generators | **44** Internal Combustion Engine | **46** Alta Wind Energy Center | **48** Steam Engine

## 50 ENVIRONMENT

**52** Holland Tunnel | **56** LEED | **58** Catalytic Converters | **60** Eco-Friendly Stadium | **62** Air Conditioning | **64** Thermoplastic Composites | **66** Experimental Electromechanical Module | **68** Nest Learning Thermostat

## 70 EXPLORATION

**72** Space Shuttle | **74** Hubble Space Telescope | **76** Ambrose Swasey | **79** Sputnik 1 | **80** Mars Rovers | **82** Steamboat | **84** International Space Station | **86** Submarines

## 88 FOOD

**90** Frozen Foods | **92** Pop-Top Aluminum Can | **94** Solar Cookers | **95** Can Opener | **96** Combine Harvester | **99** Crawler Tractor | **100** Canning Food | **102** Anupam Pathak

## 104 HEALTH

**106** Winfred M. Phillips | **108** X-Ray Machine | **110** Contact Lenses | **112** Regenerative Medicine | **114** Artificial Heart | **116** Robot Hand | **118** Benjamin Franklin | **120** Rapid Diagnostic Tests | **122** Hearing Aids

## 124 MANUFACTURING

**126** Kate Gleason | **128** Industrial Robots | **130** Frank & Lillian Gilbreth | **132** Sewing Machine | **133** Microprocessor | **134** Conveyor Belt | **137** Cotton Gin | **138** Clean Room | **140** Assembly Line | **142** 3D Printing

## 144 SAFETY

**146** ASME Boiler and Pressure Vessel Code | **148** Ceramic Water Filters | **150** Backpack Parachute | **153** Kevlar Bulletproof Vests | **154** Gas Mask | **156** Safety Helmets | **158** Three-Point Lap and Shoulder Seat Belt | **160** Traffic Signals | **162** Humanitarian Mine Clearance | **164** Water Tube Steam Boiler

## 166 TRANSPORTATION

**168** George Westinghouse | **170** Container Ships | **172** Panama Canal | **174** Global Positioning System (GPS) | **176** Brooklyn Bridge | **180** London Underground | **182** Japan's Shinkansen Bullet Trains | **184** Bicycle | **186** Safety Elevator

## FOREWORD

This book is a celebration of engineering. Its pages remind us of how thoroughly the fruits of engineering imagination and accomplishment touch us as we go about our daily activities in an advanced technological society. Throughout the day — and the night — we interact with and benefit from the things that engineering design and development have made possible: the morning's warm shower, automatically made coffee, and the daily newspaper; the workday's use of the telephone, copying machine, computer, Internet, and video conferencing; the evening's digital recreation with family and friends, televised sports events under the lights, and late-night television; and the overnight comfort provided by an air-conditioned home, a cozy bed, and indoor plumbing.

These and like conveniences — many of which were nonexistent just a century ago — are on display in this book's striking photographs, crisp diagrams, and concise descriptions. The notable achievements presented here are, of course, only a representative selection of what engineering has contributed to our well-being, quality of life, and joy of living. A number of patents are featured here, and they are but a small fraction of the approximately nine million that have been issued by the United States alone since 1790, a statistic that emphasizes how indefatigable engineers and other inventors have been at producing a steady output of technological

improvements. There has been no shortage of original ideas, and there is no reason to think that there will be in the future. Indeed, the president of the National Academy of Engineering has written recently that, "The only certainty about the future is that it will depend on engineering, just as it always has."

Engineering effort and achievement — whether historical, contemporary, or future; whether patented or not — are and always will be at the heart of technological success stories of invention, innovation, and entrepreneurship. They drive a thriving nation's economy, fuel its prosperity, and enrich the lives of its citizens. The stories of engineering and technology in this book collectively provide both confirmation of and inspiration for the promise of engineering to set the standard for the entire world.

We must not forget that engineering is done by engineers, however, and this book recognizes a good number of them, from the past and the present. A remarkable one is Kate Gleason, who in 1884 had to leave the mechanical arts program at Cornell University, in which she had been the first woman to enroll, to return to Rochester, New York, to save the family business of manufacturing gear-cutting machines. Like many an engineer, she went on

to accomplish a variety of things, including in her case designing affordable housing made of concrete and becoming president of a bank. In 1918, she became the first woman admitted to full membership in ASME. Today, the College of Engineering at Rochester Institute of Technology, where she had continued her studies, is named for Kate Gleason.

Another engineer, Anupam Pathak, as an engineering graduate student at the University of Michigan worked on a project that sought to stabilize the rifle barrels of soldiers using them in stressful conditions. Afterwards, he employed similar technology to develop tremor-canceling eating utensils for patients with neurological diseases like Parkinson's. Such beating of swords into ploughshares is a common theme in engineering achievement, especially where the research and development involved in the early stages is so novel, expensive, and risky that only the government is willing or able to underwrite it. It has been military- and space-related engineering programs that have paved the way for such technological marvels as the Internet, GPS navigation, and high-resolution imagery.

The content of this book has been adapted from the exhibit on display at ASME world headquarters at Two Park Avenue in New York City. It has been a pleasure for me to participate in this project that gives such

prominent recognition of the value of engineers and engineering to our lives, our society, and our culture.

A handwritten signature in black ink, appearing to read 'Henry Petroski', with a stylized, cursive script.

**Henry Petroski**

*Aleksandar S. Vesic Professor of Civil Engineering and  
Professor of History, Duke University*

## INTRODUCTION

At ASME we are fortunate to pursue a humane and worthy mission: to serve the art and science of engineering and the professionals who devote their careers to its practice.

One way we do this is by sharing the inspiring stories of the men and women whose achievements, insights, and innovation form the bedrock of engineering history. Engineers rightly understand that the history of our field is also the history of our highly advanced technological civilization and its progress. It comprises the stories of all the visionary builders and makers who have dreamt and realized their dreams — bringing about momentous changes in our world as a result.

It's our hope that everyone will learn about the many and great contributions of engineers — for this history — our history — also belongs to every one of us.

There is challenge here. As human beings we grow accustomed to even the most extraordinary facts when they become our everyday. The towering achievements of engineering, once realized, become our new “normal.” We proceed through life without pausing to contemplate the remarkable contributions of our engineers — even as their very contributions are what

make it possible to live life as we do. The ease, health, well-being, and quality of life we may enjoy today are the products of their work. Yet only rarely do we stop to think about their pivotal importance to us all.

A monument in Kitty Hawk, North Carolina, stands tall and solitary on what is still a sandy, windswept, mostly undeveloped strip of coastal beach. One pauses there to see the place where, in 1903, two brothers triumphed and realized the ancient human dream of flight. There is a truly awe-inspiring quality about that place. The Wrights' achievement, once hardly imaginable, brought along the miracle of intercontinental travel and a host of other revolutionary changes. And yet only sixty-six years later men would walk upon the moon.

We hope the volume you hold in your hands — and the permanent exhibition that graces ASME's global headquarters in New York City — will be another such occasion for reflection. *Engineering the Everyday and the Extraordinary* shares the stories of 80 such wonders of engineering, large and small. These 80 highlights provide ample reason of why engineers can take pride in our profession. Likewise, we at ASME are proud to serve as the essential resource for engineers working for the benefit of humankind around the world.



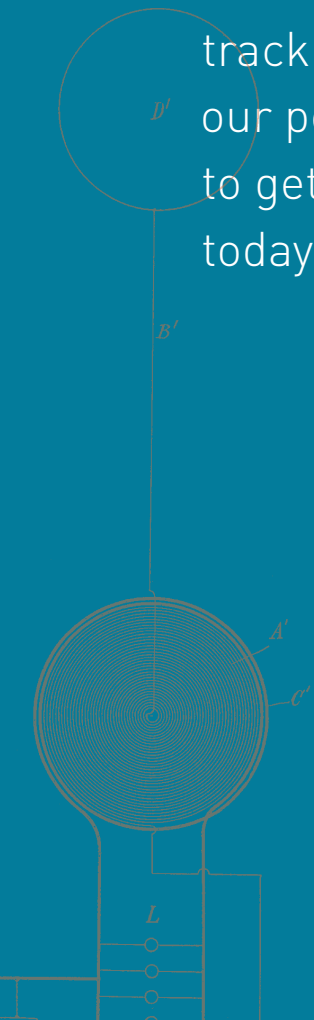
On behalf of ASME's board, volunteers, members, and staff, and to all the devoted engineers we serve: thank you. Special thanks as well to Professor Henry Petroski of Duke University for his thoughtful curation of and contributions to the *Engineering the Everyday and the Extraordinary* exhibit and this volume.

A handwritten signature in black ink, appearing to read 'Tom Loughlin', with a horizontal line extending to the right.

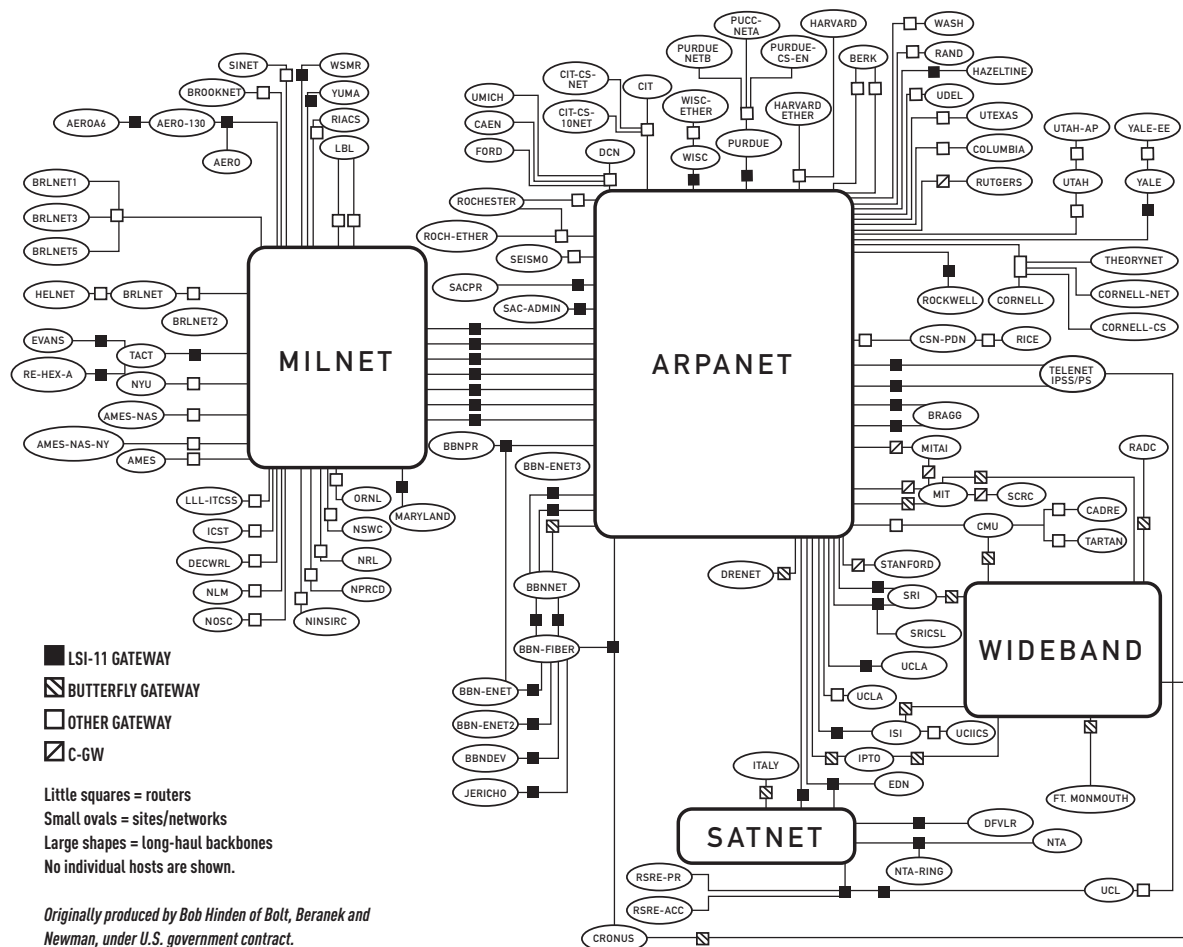
**Thomas G. Loughlin, CAE**  
*ASME Executive Director*

# COMMUNICATION

“Keep in touch” is a phrase that dates back to when communicating across a distance required effort and time. People wrote letters by hand and mailed them, and then days, weeks, or even months went by before receiving a reply. Today, cell phones, computers, and the Internet have made communication practically instantaneous. We keep in touch with each other, keep track of our schedules, our business inventories — even our pets. It took a steady flow of engineering innovation to get from that old handwritten correspondence to today’s lightning-fast forms of communication.



### Contemporary map of the entire Internet, circa late 1985/early 1986



- Technological advances can be accompanied by unintended consequences. Over 75 percent of all email messages in the U.S. are considered spam.
- In 2013 there were an estimated 637 million U.S. websites, 250 million of which were blogs.
- The first email message was sent in 1971 by Ray Tomlinson (1941–), the U.S. programmer from Bolt Beranek and Newman who invented the email system.





*An 82nd Airborne paratrooper deployed in Iraq uses an online video-chat program to talk with his wife and children in Fort Bragg, N.C.*



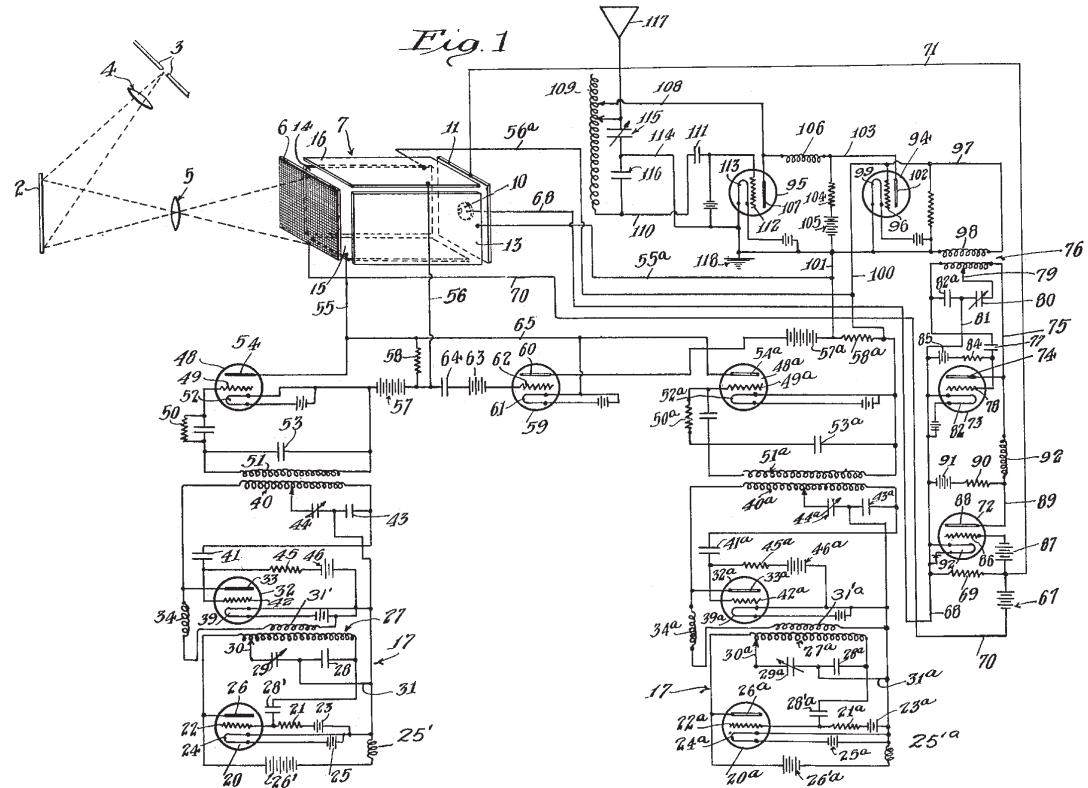


*Watching the flight of Astronaut Alan Shepard on television: Vice President Johnson, Arthur Schlesinger, Admiral Arleigh Burke, President Kennedy, Mrs. Kennedy. White House, Office of the President's Secretary, 1961*

# TELEVISION: A NEW KIND OF TUBE

Television is among the most influential inventions of the 20th century. Television was first successfully demonstrated in San Francisco on September 7, 1927, using a system designed by Philo Taylor Farnsworth (1906–1971), a 21-year-old inventor who had lived in a house without electricity until he was 14. While still in high school, Farnsworth had begun to conceive of a system that could capture moving images in a form that could be coded onto radio waves and then transformed back into a picture on a screen. Though others around the world conducted related research, Farnsworth's invention, which scanned images with a beam of electrons, is the direct ancestor of modern television.

- TV sets in 1930s America cost roughly \$400–\$500; the average annual household income at the time was \$1,300.
- In 1956, Robert Adler (1913–2007) invented the first practical remote control. It was called the Zenith Space Commander.



## Original Patent Drawing

P.T. FARNSWORTH —  
TELEVISION SYSTEM  
U.S. Patent No. 1,773,980  
Patented Aug. 26, 1930

Fig. 1: Diagrammatic view  
of complete television  
transmitter, including  
circuit diagram

2: Object, an image  
of which is to be  
transmitted  
3: Arc light  
4, 5: Lens

6: Light-sensitive plate  
7: Photo-electric cell  
8: Fine mesh screen  
10: Anode  
11: Electric shutter  
13-16, 26, 33, 54, 60, 74,  
88, 102, 107: Plate  
17: Oscillator  
20: Tri-electrode valve  
20<sup>a</sup>: Oscillating tube  
21, 84: Grid leak  
22, 42, 49, 62: Grid  
23: Negative bias battery  
24, 39, 52<sup>a</sup>, 61, 82, 82<sup>a</sup>,  
92, 99, 113: Filament

25, 26', 57-57<sup>a</sup>, 67, 91,  
105: Battery  
25': Choke coil  
27, 34, 51, 76, 109:  
Inductance  
28: Fixed capacity  
28': Capacity  
29: Variable capacity  
31, 65, 68, 75, 97, 100,  
101, 103, 108, 110,  
114: Lead  
31': Secondary coil  
32, 48, 72: Tube  
40: Audion  
41, 43, 44: Capacity

45: Leak  
46: Negative bias battery  
48<sup>a</sup>: Oscillating tube  
50: Grid condenser  
51-52: Secondary  
53, 64, 77, 80: Condenser  
55-56, 55<sup>a</sup>-56<sup>a</sup>: Lead  
58-58<sup>a</sup>: Resistance  
59: Modulating tube  
63: Negative bias battery  
69: Resistance  
70, 81, 89: Line  
73: Oscillating tube  
78, 86, 96, 112: Grid  
79: Variable tap

85: Negative battery  
87: Negative bias battery  
90: Resistance or choke  
94: Double modulating  
tube  
95: Oscillator  
98: Coil  
104: Choke or resistance  
106: Choke  
111, 116: Condenser  
117: Antenna  
118: Ground