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CORRESPONDENCE *Nov. 1958*

N. WIENER MC 22

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1175 PARK AVENUE  
NEW YORK 28, N. Y.

November 4, 1958

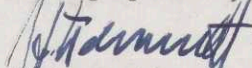
Dr. Norbert Wiener  
Massachusetts Institute of Technology  
Cambridge, Mass.

Dear Dr. Wiener:

Thank you so much for your kind letter of October 24th and the revised manuscript which I received yesterday. We are delighted indeed that you have changed the text in such a way that it has remained clear and stimulating irrespective of any illustrations or drawings. May I repeat that we sincerely appreciate your kindness and all your efforts.

With best wishes from all of us,

Truly yours,



H. Behrendt, M. D.

(for the Publication  
Committee)

# THE UPJOHN COMPANY

FINE PHARMACEUTICALS SINCE 1886

KALAMAZOO, MICHIGAN

November 4, 1958

Dr. Norbert Wiener  
Professor of Mathematics  
Department of Mathematics  
Massachusetts Institute of Technology  
Cambridge 39, Massachusetts

Dear Dr. Wiener:

The Medical and Research people of The Upjohn Company have a program of inviting academic people to Kalamazoo for lectures on recent advances in the physical and biological sciences. The objective of this program is such that we prefer speakers who present a talk on a subject that cuts across a number of scientific disciplines. I have now been asked to explore the possibility of a talk on Cybernetics. In keeping with this objective I would like to invite you to Kalamazoo for a talk on this subject. I am certain that this particular topic would be of great interest to our people in the physico-chemical, mathematical and physiological sciences. Since you have cooperated in the past with scientists in fields other than mathematics your presentation of a talk on cybernetics would certainly be understandable to a scientifically heterogeneous audience.

As a possible time for your trip to Kalamazoo I would like to suggest March 1959. Usually we have these seminar talks on Thursday evening, but any other date you might suggest will be acceptable to us. In addition to travel expenses we pay a small honorarium of \$100.00. Kalamazoo can be easily reached by airplane via Detroit or Chicago. We would be delighted to assist you in your travel arrangements.

Sincerely yours,

THE UPJOHN COMPANY



P. D. Meister  
Product Research and Development

PDM/js

[ans 11/6/58]

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## Memo from PRISMON

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Dr. Norbert Wiener  
Massachusetts Institute of Technology

November 4, 1958

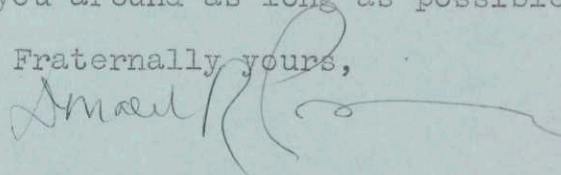
Dear Dr. Wiener:

Let me add my word of praise for your forthright expression of the 'moral problems of a scientist'. You have said (in I am a mathematician) what many of us have thought and would say if we had sufficient prestige.

The time has come for the intellectuals of the world to unite but how rare is the truenintellectual- a person at once highly competent in the world of ideas and fully sensitive to the meaning of humanity.

Don't overwork. We want you around as long as possible.

Fraternally yours,



Social Science Dept.

# American Gas Association

430 Lexington Avenue • New York 17, N. Y.

Member Since 1910

NOV 5 1958

November 4, 1958

Mr. Frank P. Scully, President  
Scully Signal Company  
172 Green Street  
Melrose 76, Massachusetts

Dear Mr. Scully:

I am sorry that I missed you at Atlantic City, even though I was at your exhibit several times during the Convention. I wanted to tell you that the application of your ingenious safety control system had aroused lots of interest. The low water cutoff and the application of the system to the Minneapolis Honeywell safety circuits deserved commendation.

I do not need to remind you that the exhibit at the A.G.A. Convention this year was different from any previous exhibit which had been held in conjunction with our Convention. In the past, any manufacturer who wished to display his wares was at liberty to do so upon renting a booth. This year the exhibit was quite different. Only manufacturers who were invited to exhibit could do so. The invitations were issued on the basis that the potential exhibitor had something that was new within two years, that the development was significant to the industry and that it was already commercially available.

The impact that such an exhibit had on gas company delegates was indeed striking. This was made evident by the amount of time that they spent in the booths and the repeated incidents where men returned bringing additional members of their staff to see a specific exhibit. Yours was among those which was frequently singled out because of the potential contribution to public safety made possible through the application of your circuits. It is a pleasure indeed to send you our congratulations on a job well done.

Cordially yours,

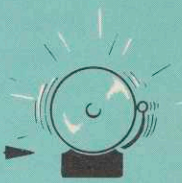
*C. George Segeler*  
C. George Segeler  
Director, Utilization Bureau

CGS:ems

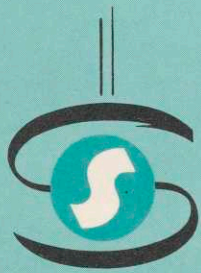
This report describes a remarkably basic invention which can greatly enhance the safety of people and property in a machine-dependent world. The single concept set forth now makes physical equipment capable of . . .

## Ultimate Reliability

## Through Dynamic FAYLSAFE<sup>®</sup> Design



**Physical Systems**, utilizing the principles of dynamic FAYLSAFE design, can now be built which cannot possibly fail in an unsafe manner. As man's dependence upon machine systems continues to increase, and as the hazards of machine failure increase, the development of truly "fail-safe" systems becomes imperative. This technique for monitoring the output of any operating system also proves the integrity of the monitoring system itself; failure in the performance of either operating or monitoring system will cause appropriate warning or corrective action to be taken. Duplication and triplication of critical components is no longer required. The FAYLSAFE technique is basic and can be applied to all operating physical systems; viz., electrical, electronic, mechanical, hydraulic, optical, thermal, and nuclear.



# Widespread Reporting of Scully **FAYLSAFE** Design

(TM Reg.)

## PARTIAL LIST OF PUBLICATIONS

American Artisan (5/56)  
Automatic Control (2, 3/56)  
Automotive Industries (3/15/56)  
Boston Traveler (3/1/56)  
Canadian Power Engineering (5, 6/56)  
Chemical Engineering (4/56)  
Christian Science Monitor (3/1/56)  
Control Engineering (3/56)  
Design News (3/15/56)  
Domestic Engineering (4/56)  
Electrical Equipment (4/56)  
Electrified Industry (4/56)  
Electronic Design (3/1/56)  
Electronic Equipment (4/56)  
Electronics (6/56)  
Food Engineering (4/56)  
Food Processing (5/56)  
Fuel Oil and Oil Heat (4/56)  
Fuel Oil News (6/56)  
Heating & Plumbing Engineer (6/56)  
Hoosier Independent (3/56)  
Industry (3/56)  
Instrument & Apparatus News (5, 6/56)  
Instruments and Automation (3, 4/56)  
ISA Journal (4/56)  
Jour. Plumb., Heat., Air Condit. (4/56)  
Master Plumb. & Heat. Contractor (3/56)  
Mechanical Engineering (5/56)  
National Petroleum News (5/56)  
National Safety News (7/56)  
New England Equip. Dealer (6/56)  
New Englander (3, 4/56)  
Nucleonics (3/56)  
Plumb., Heat., Air Cond. Wholesaler (4/56)  
Popular Electronics (5/56)  
Product Design & Development (4/56)  
Product Engineering (4/56)  
Quincy Patriot Ledger (3/1/56)  
Radio Electronics (4/56)  
S. A. E. Journal (6/56)  
Safety Maintenance & Production (5/56)  
Technical Survey (4/7/56)  
Time (2/27/56)



Leading technical and news publications which have reported on the Scully-Rowell technique of dynamic FAYLSAFE design.

# Background Information — quoted comments and excerpts on Scully Dynamic **FAYLSAFE** Design

FACTORY MUTUAL LABORATORIES, December 2, 1953 (In Laboratory Report No. 12551 on Scully FAYLSAFE Pilot Flame Monitor, Model D):

"Its unusual feature is that there is no electronic component whose failure would cause an 'unsafe' condition (false flame indication)... It incorporates in its design a circuit checking feature that eliminates the unsafe failure possibilities due to electronic component failures generally inherent in combustion safeguard circuits." (In subsequent letter, March 8, 1954)  
"So far as we know, this circuit is the only one which has no unsafe failure possibility within the limits of our normal test procedure."

## INDUSTRIAL TEST INSTALLATION

Since November 17, 1954, an experimental self-checking FAYLSAFE Flame Monitor has been in continuous trouble-free operation, controlling a critical process boiler in the industrial plant of a prominent Cambridge (Mass.) manufacturer. This same installation, just prior to the use of FAYLSAFE self-checking monitoring, had suffered two major and destructive blow-backs. The Scully system has tested and proven its own operability over 96 million times (once every second during the operating cycle) since installation.

## MUTUAL BOILER AND MACHINERY INSURANCE COMPANY

Excerpt from letter from Vice President, Engineering, December 30, 1955:  
"This new technique, in my opinion, has great possibilities in our expanding automation technology. I am particularly impressed with the potential applications to safety controls for we have found from our insurance experience that safety con-

trols sometimes fail just when they are needed. Monitoring of such control circuits should be of great assistance in the prevention of accidents caused by inoperative safety devices and failure of control components.... We will watch with a great deal of interest its future development and application in industry and will do all that we can to encourage the incorporation of this method of obtaining real 'fail-safe' devices."

TIME Magazine, Science Section, February 27, 1956

## "Watching the Watchman"

"As machines get more complicated, quick-acting and violent, they are more prone to self-destruction if something goes wrong. Some nuclear reactors, for instance, can turn into radioactive junk in a fraction of a second. To avoid such misadventures, most modern mechanical and electronic systems are equipped with built-in monitors that watch their operation and shut them down promptly at the first sign of trouble. But if a vacuum tube or relay in the monitor fails, the main machine is like a building whose night watchman has dropped dead. Trouble can start and get out of hand with no one to correct it or give the alarm.

"In Control Engineering, W. G. Rowell of Scully Signal Co. and A. B. Van Rennes of M. I. T. describe a method that they have invented for 'watching the watchman.' The monitor as usual watches all operations of the machine, but when everything is going well, it does not merely sit back and give a 'safe' signal. Instead it gives a rapid alternation of safe and unsafe signals. Unless this alternation continues, proving that the monitor is alert and on the job, the machine will shut itself off. If any part of the machine fails (including

its readiness to shut itself off if the monitor fails), the wide-awake monitor steps in and stops everything."

ELECTRONIC DESIGN, March 1, 1956

"Completely fail-safe, the simple monitoring circuit described here periodically challenges an operating system to prove it is functioning properly.... This is a real departure from the many so-called 'fail-safe' circuits that can actually fail in an unsafe manner.... Increased use of unattended mechanisms in this 'age of automation' has created a greater need for reliable monitoring systems to take a corrective action or give warning in case something goes wrong. Mr. W. G. Rowell, the author, developed a technique described here that virtually eliminates any possibility of an operation failing without warning. The method is being made available for licensing for those who can use it to advantage."

CONTROL ENGINEERING, March 1956

"A BASIC ADVANCE IN SYSTEM SAFETY: Here is a new and startlingly simple approach to 'fail-safe' system operation that goes back to the conceptual stage of system design. It applies to control systems of any type and complexity.... Best of all, for all its invaluable protection, the new fail-safe concept calls for very few extra components in most systems."

AUTOMATIC CONTROL, March 1956

"Duplication and triplication of critical components no longer necessary to insure absolute fail-safe operation. New technique is self checking.... promises to provide process instrumentation and industrial controls with a new and higher level of protection against hazardous failures."

TELE-TECH, March 1956

"The new technique is so basic in principle that it can be applied to practically any type of automatic system."

ELECTRICAL EQUIPMENT, April 1956

"Few additional components are required to change a conventional system from an unsafe, static form to a dynamic self-checking design."

POPULAR ELECTRONICS, May 1956

"Electronic Check and Double-Check"

". . . how do we know that safety devices are always alert? After all, even electronic watchdogs go to sleep sometimes."

"Scully Signal Company answers this problem with a new electronic 'Fail-Safe' monitor system that periodically prods itself to make sure it's awake. The circuit generates 'make-believe' emergency signals at preset intervals. In effect, it gives itself a scare to see how it responds. If it finds itself asleep or loafing on the job, it sounds the alarm."

SAFETY MAINTENANCE, May 1956

"If the self-checking system responds properly to the simulated danger, it is certain to perform when the real calamity strikes."

HEATING AND PLUMBING ENGINEER, June, 1956

"An Electronic Triumph -- An Electronic Watchdog That Never Sleeps"

". . . In the past, the term 'fail-safe' has been applied to systems which are safe from the effects of power failure. It has also been associated with 'safe-start' systems which. . . are agreed to have many possibilities of unsafe failure, yet have

been approved by official testing laboratories on the basis that unsafe failure conditions are inherent in electronic circuits and physical systems. This newly developed and approved method completely removes the possibility of unsafe failure from any defined circuit or physical system."

BOARD OF STANDARDS AND APPEALS, City of New York

Amendment of September 14, 1956 recognizes and gives preference to equipment of dynamic self-checking (i.e., **FAYLSAFE**) design:

"15.2.1 The provisions of Rule 15.2 shall not apply to heating systems.... when such systems are equipped with approved, fully automatic, self-checking electrical safety controls which will shut down the system or systems within five (5) seconds following oil plane failure."

PROMINENT A. E. C. LABORATORY, June 1957

Statements from an A.E.C. report on use of **FAYLSAFE** technique for critical monitoring of glovebox exhaust system:

"A breakdown of the exhaust system can, and has, resulted in a highly dangerous degree of contamination of the enclosure and surrounding area. To forestall such breakdown, it has been customary to provide a dual standby exhaust system and sensing means for detecting a breakdown of the primary system and for activating the standby system. The design of a suitable sensing system has in itself been a considerable problem, since there must be no set of conditions under which it fails to detect the primary system breakdown. Heretofore no such absolutely fail safe sensing means has been available....

"The apparatus to be herein described uses a new sensing technique which is inherently fail safe. . . . This system is essentially one wherein not only the condition of the primary exhaust system is monitored, but the monitoring system itself is continually tested to insure it is operating. The system is thus inherently failure proof, since failure of the sensing means itself, apart from failure of the primary exhaust system, will serve to actuate the standby system."

DEPARTMENT OF PUBLIC SAFETY, Commonwealth of Massachusetts

A letter of January 20, 1959, from Mr. Anthony B. Mastronardi, Fire Prevention Engineer, indicates the need for reliable, truly "fail-safe" controls and shows the desire to continually upgrade requirement. Commenting on regulations requiring that automatic oil burners must have "a type of combustion safety control which shall shut off the oil supply to the burner within four (4) seconds after plane failure once combustion has been established," Mr. Mastronardi wrote, "We have not been able to enforce said rules up to the present time, but if there are combustion controls which will accord with these regulations, we shall, in the interest of safety to life and property, be obliged to take the necessary steps to assure compliance."

AIEE SYMPOSIUM ON SAFETY, February 1959

Quotations from a talk by Mr. F. Deziel of Minneapolis-Honeywell Regulator Company.

". . . As a result, an automatic interlock circuit was designed. . . . For many applications, this system provides a high degree of safety by checking the amplifier for unsafe failures during each call for



heat by the thermostat. It has also been general practice, due to lack of safer systems, to use these simple interlock circuits on burners that run continuously for weeks and even months at a time. Obviously, the degree of safety is greatly reduced in these applications.

"Considerable design and development effort was expended to find a method of providing greater safety for these long running applications, with negative results until the Scully Signal Company of Boston, Massachusetts developed an interest in the general problem. Their efforts resulted in a simple circuit principle that provides the highest degree of safety ever obtained in a control system.

"...The merits of this system were so attractive to Honeywell that Honeywell obtained a license from the Scully Signal Company for a substantial sum of money to use this principle in a combustion safeguard system. . . . In summary, straightforward design techniques were employed in the development of a product design -- based on the principles developed by the Scully Signal Company -- that we believe sets a new standard of safety for combustion control systems."

A. G. A. CONFERENCE, Philadelphia, Penn., April 1959

Quotations from a talk by Mr. R. W. West, Industrial Manager, Minneapolis-Honeywell Regulator Company.

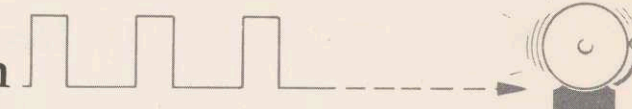
"...Another new and important product to provide greater safety for industrial gas burning installations is a new continuous component checking relay. Many devices designed to provide safe conditions provide

what might be termed "relative safety" or a "high degree of safety", without providing absolute safety. . . .

"Every flame safeguard relay other than the new continuous checking relay is subject to a number of component failures which simulate flame. Thus upon actual flame failure, the shut-off valve would remain open and volumes of gas would continue to flow. To minimize the possibility of this happening, where possible, components of the relays have been lightly loaded and in recent years the relays have been provided with a 'start-up' check. The 'start-up' check performs each time and only at such times as an attempt is made to light a burner. All components on the flame safeguard system must be in perfect order or the burner cannot be ignited. This provides reasonable protection for burners that are operated on an 'on-off' basis and that are cycled frequently. It is obviously inadequate for industrial burners that are operated continuously for days or weeks at a time, or where standing pilots are employed.

"To overcome this hazardous condition, the 'continuous checking' flame safeguard relay checks the components approximately once a second. The check is provided by a continuously pulsing relay. This pulsing relay pulls in approximately once a second making and breaking the flame circuit. If all components are intact and in good working order it continues to pulse. If a failure of any kind occurs the pulsing stops and a shut-down occurs. As a consequence, any failure must be a safe one. This is an inexpensive addition to the flame safeguard system that provides maximum safety. As a result, it is being widely installed by users of gas who want complete protection against explosions due to flame failure."

## The New Concept of **FAYLSAFE** System Design



### Introduction

With the trend toward mechanization and automation, man is becoming increasingly dependent upon the safe operation of physical systems. Critical military and industrial control systems must often be monitored to determine failure in performance, and to provide immediate alarm or corrective action.

Design engineers have long been haunted by the fact that either the operating system being checked or the monitoring system itself may fail in such a way as to indicate falsely that equipment is operating properly. Parallel duplication and triplication of control devices has been resorted to, resulting in increased bulk, complexity, and expense.

By definition, the truly "fail-safe" system is one in which absolutely no equipment malfunction can occur within the system without an appropriate monitoring signal being given. This signal may be in the form of a warning, it may shut down the equipment, or it may switch in a standby system. Operation of the standby correction system can itself be made fail-safe by the principle described.

In the past, the term "fail-safe" has been applied to systems which are safe from the effects of power failure. It has also been associated with "safe-start" systems which cannot be started if certain system conditions are not met. These systems are agreed to have many possibilities of unsafe failure, yet have been approved by official testing laboratories on the basis that unsafe failure conditions are inherent in electronic circuits and physical systems. This article shows a newly developed and approved method for completely removing the possibility of unsafe failure from any defined physical system.

### Unique FAYLSAFE Principle

In one form of FAYLSAFE system, a signal representing the normal (or "safe") condition of the operating system is introduced to the monitoring system. The monitoring system periodically alters this safe operating signal to produce a simulated "unsafe" condition. The resulting output of the monitoring system is a continuous... safe-unsafe-safe-unsafe... oscillation. An alarm, or protective device, is employed which is normally "on", and which is held "off" only when an "alarm suppression circuit" receives the required dynamic oscillating safe-unsafe signal. If the normal operating signal fails (i. e., becomes unsafe), a continual non-oscillating "unsafe" signal will result and allow the alarm to sound. If the monitoring system fails, the "unsafe" perturbation will cease and the resulting continual "safe" signal will actuate the alarm.

The Scully-Rowell FAYLSAFE technique is essentially that of continually and dynamically "exercising" the monitoring system to prove its operability. The method is applicable to all types of monitoring systems, including systems which may stand by inoperative for extended periods before the crucial need to perform arises.

It is important to note that a truly "fail-safe" system must be dynamic (or oscillating) in nature. For example, if the "safe" condition of a system is statically represented by a vacuum tube being "off", this condition can be falsely indicated by an "open" plate or cathode circuit; a statically-closed "safe" relay can be falsely indicated by a relay with shorted contacts. But an "open" tube or a "shorted" relay cannot oscillate dynamically to follow a safe-unsafe input perturbation.

To illustrate further, a man can fall asleep sitting in a chair or laying on a bed. But if he is able to continuously move from the chair, to the bed, to the chair, etc., it is doubtful if he is getting much sleep! In like manner, the dynamic FAYLSAFE system is prevented from ever going to sleep.

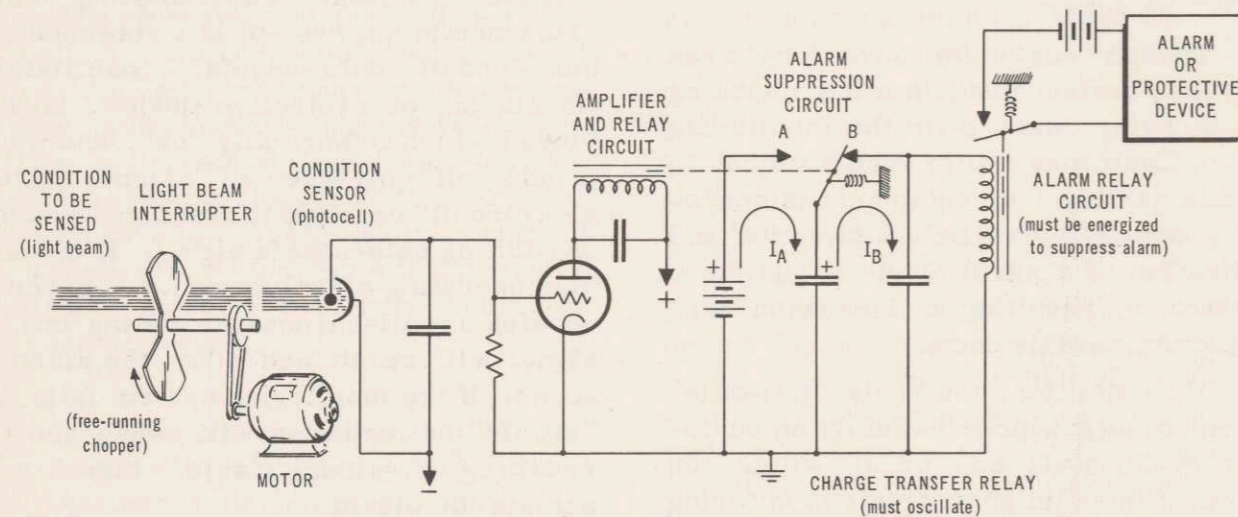


FIG. 1. SCULLY-ROWELL FAYLSAFE LIGHT MONITORING SYSTEM WITHOUT FEEDBACK  
External modulation of condition to be sensed

#### "Unsafe" Condition Simulation

Several methods are possible for modulating the "safe" operating signal to produce the required oscillation condition, and for injecting this perturbation into the monitoring system. A basic form of Scully-Rowell FAYLSAFE system is shown in the schematic of Fig. 1. Here the condition, or signal, to be sensed is a light beam. An alarm or protective action is desired if the light beam should fall.

Failure of the light beam is simulated by a motor-driven chopper. This periodically prevents the beam from reaching the condition sensor or photocell, and produces a checking signal modification of the beam. The resulting pulses from the photocell appear at the grid of an amplifier stage, and periodically energize a relay in the

plate circuit. This relay actuates the relay armature in the alarm suppression circuit, causing the armature contact to alternate successively between positions A and B. In position A, current  $I_A$  charges the capacitor joined to the relay arm. In position B, current  $I_B$  transfers charge from the alarm suppression circuit to the

alarm relay circuit. By making the time constant of the alarm relay circuit slightly longer than the period of oscillation of the light beam interrupter, the alarm or protective device is held "off".

It is an important fact that the relay arm in the alarm suppression circuit must oscillate to prevent the alarm from sounding. If the relay contact (which is the non-bridging type) stops in either position A or position B, one or both of the capacitors will discharge and allow the alarm relay to close. Thus the oscillating safe-unsafe condition must exist to suppress the alarm.

It is also significant that the monitoring circuit of Fig. 1 is an open-loop system, in that the oscillation is caused

by a free-running externally-driven chopper. Later examples show how feedback can be used to generate the required oscillation within the monitoring system. The described FAYLSAFE principle can thus be operated open loop or with feedback.

and both free-running and feedback modulation of the light is possible.

When the event to be detected has an inherent and characteristic perturbation, such oscillation can be used as the basis

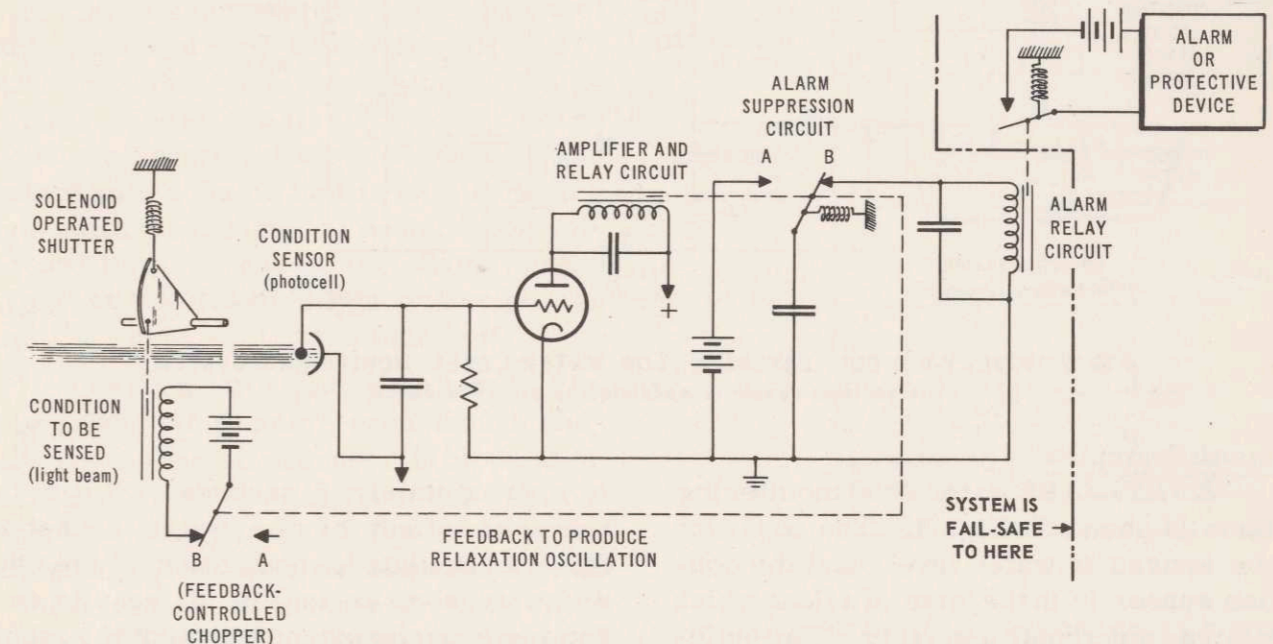


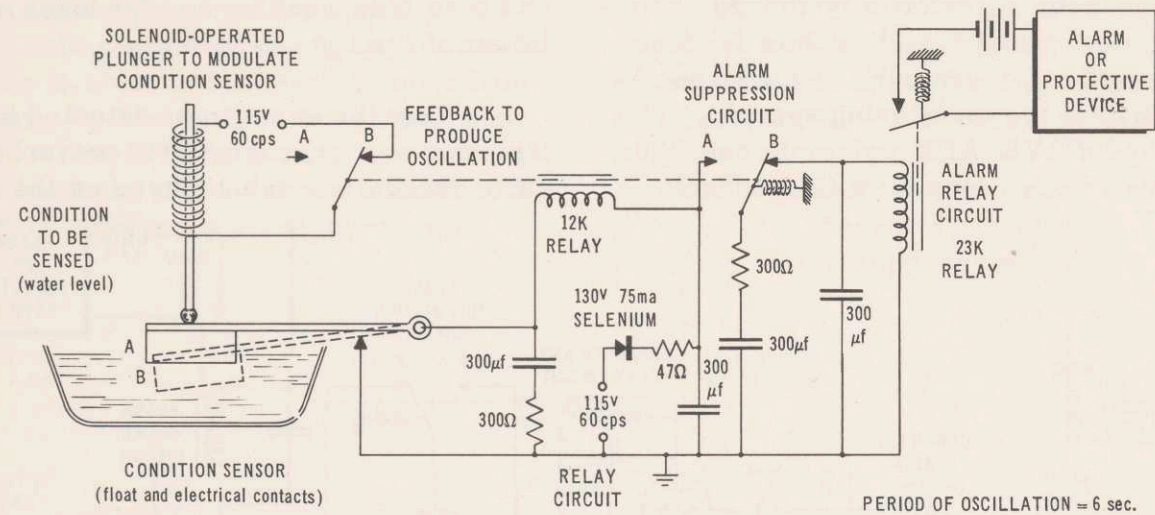
FIG. 2. SCULLY-ROWELL FAYLSAFE LIGHT MONITORING SYSTEM WITH FEEDBACK  
Condition to be sensed is modulated by internally-generated oscillation

In Fig. 2, a light monitoring system with feedback is shown. Again the condition, or signal, to be sensed (a beam of light) is modified or modulated, but in this instance by a form of relaxation oscillator which drives a solenoid-operated shutter. The modulated photocell signal oscillates the relay arm in the alarm suppression circuit and causes the alarm to be held "off". A failure of the light, the shutter, or any portion of the closed-loop monitoring system would cause the required oscillation to cease and result in actuation of the alarm.

One of the simplest forms of light monitoring system employs oscillation of the light source itself, where this is feasible. The complexity and slow response of mechanical light interruption is avoided,

for self-checking monitoring. An example is the FAYLSAFE system utilizing the natural flicker in a combustion flame (U. S. Patent 2,807,008). This system can perform self-checking at the frequencies of the fluctuating light, heat, or sound, which range from 5 to 100 cps. Making use of this inherent, failure-simulating perturbation, a fast-response FAYLSAFE system can be constructed with fewer components than would otherwise be required.

In Fig. 2 and accompanying figures, FAYLSAFE operation is provided up to the alarm relay contacts. If desired, the technique can be applied to the alarm circuit and to the alarm or protective device. A special relay "contact checking" circuit has been developed for this purpose.

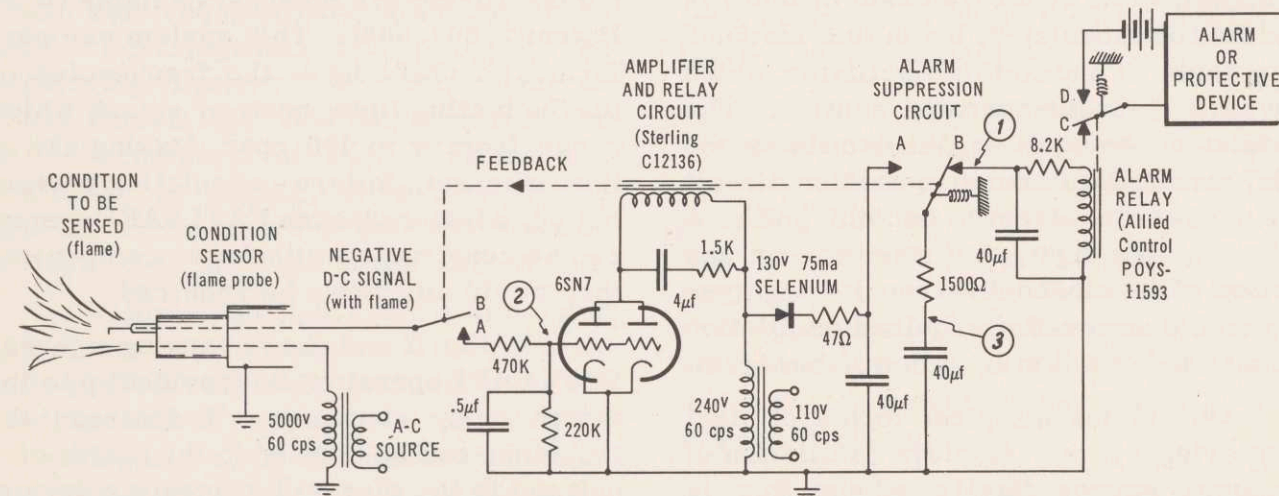


**FIG. 3. SCULLY-ROWELL FAYLSAFE LOW WATER-LEVEL MONITORING SYSTEM**  
Condition sensor is modulated by use of feedback

**System Examples**

A FAYLSAFE water-level monitoring system is shown in Fig. 3. The condition to be sensed is water level, and the condition sensor is in the form of a float which operates electrical contacts. The safe-unsafe oscillation is caused by the use of feedback, resulting in the periodic depression of the float by means of a solenoid-operated plunger. With the circuit parameters indicated, the period of oscillation

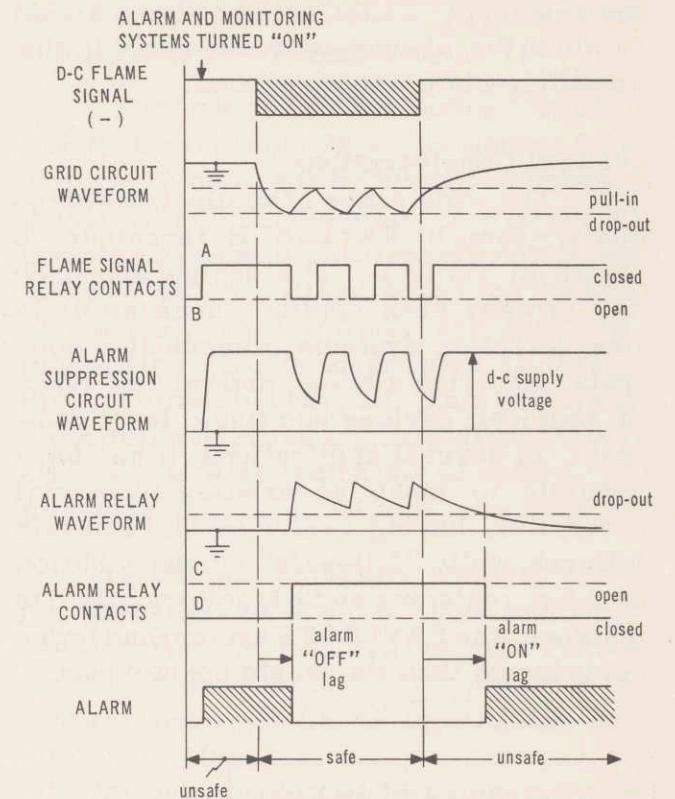
is approximately 6 seconds. Since the buoyance effect of the water cannot be falsely simulated, modulation of the condition sensor, as in Fig. 3, results in a complete performance check of the monitoring system. Two other FAYLSAFE liquid-level monitors are shown later in this report: one uses a 2-arm thermister bridge and the other a pump and flow detector. Both have been operationally proven.



**FIG. 4. SCULLY-ROWELL FAYLSAFE FLAME MONITORING SYSTEM**  
Condition sensor output is modulated by use of feedback

A FAYLSAFE flame monitoring system which has been tested extensively is shown in Fig. 4. Here feedback is employed to modulate the output of the condition sensor, a form of rectifying flame probe. The resulting waveforms are shown in Fig. 5, and these represent the basic nature of performance of many Scully-Rowell FAYLSAFE systems. The rectifying action of a flame causes the flame probe shown to produce a negative d-c signal when it is in contact with a flame that is excited with a high-voltage a-c signal. Feedback controlled oscillation causes the flame probe signal to be periodically connected to the amplifier grid to bias the tube "off".

The flame monitoring system of Fig. 4 is totally "fail-safe" even though the output of the condition sensor is modulated. Full protection results from the fact that there is no way in which the flame probe can falsely generate a negative d-c signal. A short circuit to ground could not bias the amplifier "off". Short circuiting of



**FIG. 5. TYPICAL WAVEFORMS OF SCULLY-ROWELL FLAME MONITORING SYSTEM OF FIG. 4.**

**TABLE 1. WIDE RANGE OF BASIC MONITORING APPLICATIONS FOR SCULLY-ROWELL FAYLSAFE TECHNIQUE**

MONITORED CONDITION	CONDITION SENSOR	TYPICAL METHODS OF MODULATION
Light	Photocell	Interrupting light beam, switching photocell output, modulating light source
Opacity	Light and photocell	Interrupting light beam, switching photocell output, modulating light source
Heat	Bimetal switch or thermocouple	Heating coil, radiation source, insulating shutter
Sound	Microphone	Sound source, sound-proof shutter
Flame	Photocell or flame probe	Light shutter, cell or probe output switching, heat source
Radioactivity	Ionization chamber, scintillation counter	Radiation shield, switching output of fail-safe radiation detector
Force or Pressure	Diaphragm-type strainage transducer, piezo electric crystal	Modulated pressure piston, diaphragm or crystal modulation by mechanical or electromechanical means
Current or Voltage	D'Arsonval movement, electronic measuring circuit	Input switching or modulation
Circuit continuity	Relay, current-triggered circuit	Periodic short or open, resistance modulation
Fluid level	Float and electrical contacts	Water-level modulation, periodic float depression
Etc.		

the a-c supply could not produce a signal to which the shaded-pole d-c relay in the amplifier plate would respond.

#### General Considerations

The wide range of applications of the Scully-Rowell FAYLSAFE technique is shown in Table 1. The design approach has already been applied successfully to fire-detection systems, thermostat controls, intrusion alarms, and various types of photocell devices and liquid level controls. In several applications, it has been possible to make an existing industrial controller, having twelve or more unsafe failures, fully "fail-safe" by the addition of a few resistors and capacitors. In one instance, the FAYLSAFE system had fewer components than its unsafe counterpart.

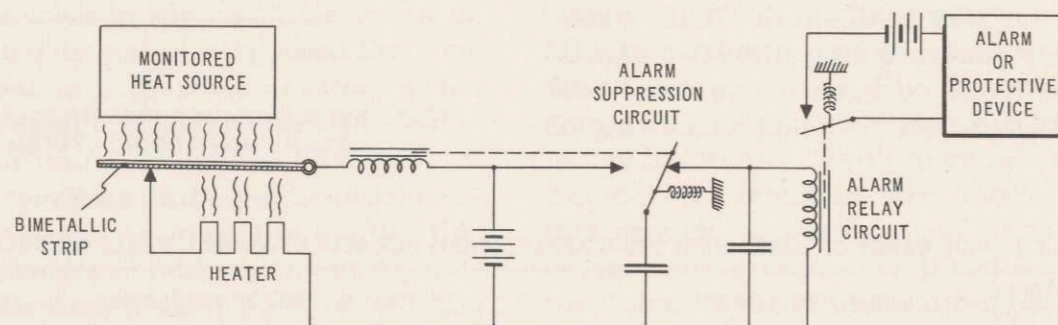


FIG. 6. SCULLY-ROWELL FAYLSAFE TEMPERATURE MONITORING SYSTEM

The frequency of oscillation of FAYLSAFE monitoring system is governed by the speed with which alarm must be given following failure of the condition to be sensed. The safe-unsafe oscillation period must be slightly shorter than the maximum allowable alarm lag which, in turn, defines the discharge time-constant of the capacitor in the alarm relay circuit. The monitoring of security systems and slow-acting processes may require only one oscillation every several minutes. In the

surveillance of combustion control systems and in the control of nuclear reactors, an extremely high monitoring frequency may be necessary. The principle, however, is flexible enough to encompass all such situations.

The illustrative FAYLSAFE systems have been built up with such well-known components as relays and vacuum tubes. Equivalent components such as diodes, gas tubes, magnetic amplifiers, and transistors can also be employed to reduce equipment size, increase frequency of oscillation, extend system operating life, etc. Figure 6, for example, shows a simple form of FAYLSAFE temperature monitoring system requiring no vacuum tubes. An accessory heater modulates the bimetallic

sensing element to prove its operability, causing the alarm suppression circuit to restrain the alarm in the usual manner.

The method for generating or simulating the "unsafe" condition and the point where this condition is injected into the monitoring system can be seen to depend upon the particular application. In general, the unsafe perturbation must be introduced early enough in the monitoring system to affect all components that could possibly

fail in an unsafe manner. The monitoring system is simplified, however, if the input transducer is inherently "fail-safe", as in Fig. 4, making it unnecessary to generate physically the unsafe condition to be sensed.

Fail-safe system monitoring can be used to maintain quantitative control, as well as to check a simple "on" or "off" condition. Circuits can be used that are sensitive to signals of specific magnitude. While Figs. 1, 2, and 4 deal with on-off situations, Fig. 3 shows a quantitative control of water-level, with the control limit being determined by contact position. Both high-water and low-water control could be provided by using two monitored float systems.

#### Conversion from Unsafe to FAYLSAFE

Application of the dynamic FAYLSAFE technique to a conventional industrial monitoring circuit is illustrated in Figs. 7 and 8. Figure 7 shows the monitoring circuit of a widely-used flame-failure safeguard which is today entrusted with the protection of billions of dollars worth of commercial and industrial property.

A photo-voltaic cell is used to detect the luminous flame and produce a negative grid bias signal. The presence of flame produces a static "safe" condition, with the first-stage amplifier biased "off", and the second-stage amplifier held "on". Plate current in the second-stage amplifier holds the alarm relay "open" to suppress the alarm signal.

Certain conventional and so-called "fail-safe" design practices have been used in this circuit: failure of the photocell to generate current would result in the alarm sounding; and an open-circuit in the relay solenoid would allow the alarm relay to

close. But these turn out to be elementary and inadequate precautions.

The industrial monitoring circuit in Fig 7, having only 12 components (4 resistors, 3 capacitors, 2 vacuum tubes, 1 transformer, 1 photocell, and 1 relay), contains at least nine (9) unsafe component failures which will not sound the warning alarm and, even worse, will make the monitoring circuit insensitive to loss of the monitored light signal. This will create a condition of runaway, unmonitored operation and a false indication of safety. The following unsafe conditions are present:

- (1) open transformer winding
- (2) leakage of a few thousand ohms (or short circuit) across series input resistor
- (3) open circuit in input shunt resistor
- (4) open circuit in first-stage cathode
- (5) open circuit in first-stage plate
- (6) loss of cathode emission in first-stage amplifier
- (7) short circuit across second-stage input resistor
- (8) grid-to-cathode short circuit in second-stage amplifier
- (9) plate-to-cathode short circuit in second-stage amplifier

Any one of these failure conditions will lock the monitoring circuit of Fig. 7 in a static and false "safe" condition, making the monitor insensitive to the unsafe input signal it has been entrusted to detect.

The conversion from unsafe to FAYLSAFE monitoring involves only the slight circuit alteration shown in Fig. 8. This modification converts the circuit to a dynamic, pulsating, self-checking design, and eliminates all unsafe failure possibilities within the monitoring circuit itself. The added components include 1 rectifier,

1 relay (double pole), 1 resistor, and 1 capacitor.

The modified **FAYLSAFE** circuit of Fig. 8 can be built within the same housing as the unsafe circuit in Fig. 7. The cost of the few added components is small in terms of the added safety provided, and is certainly much less costly than the duplication and triplication of monitoring systems. Other forms of non-electronic safety controls are also found to require only minor modification in the switch to ultimate-reliability **FAYLSAFE** design.

Failure Discrimination

The **FAYLSAFE** control systems described thus far will, without fail, provide an output indication if either the safe monitored signal fails or the monitoring system itself loses its capability to respond to an unsafe input signal. The "alarm" signal produced can then be used to shut down the monitored system in a safe manner.

In the control of large and costly industrial processes, for example, it is

desired to shut down the process only when the process itself becomes unsafe, and not when the monitoring system ceases to function properly. With a slight modification of the **FAYLSAFE** systems described above, nuisance shutdowns can be completely avoided.

An additional test cycle is merely added to the normal oscillating test program. Should the checking oscillation cease momentarily, a simulated safe signal is introduced at the input to the monitor. If the monitoring system does not respond to this input, it is clear that the monitoring system itself has failed, the process can be allowed to continue, and an "alert" signal sounded or a standby monitor switched in.

If the monitoring system responds properly to the simulated safe input signal, it is clear that the normal, safe input condition has disappeared and the process should be immediately shut down. Where high-speed monitoring control is required, this supplementary failure discrimination can be performed in approximately a single period of the normal checking oscillation.

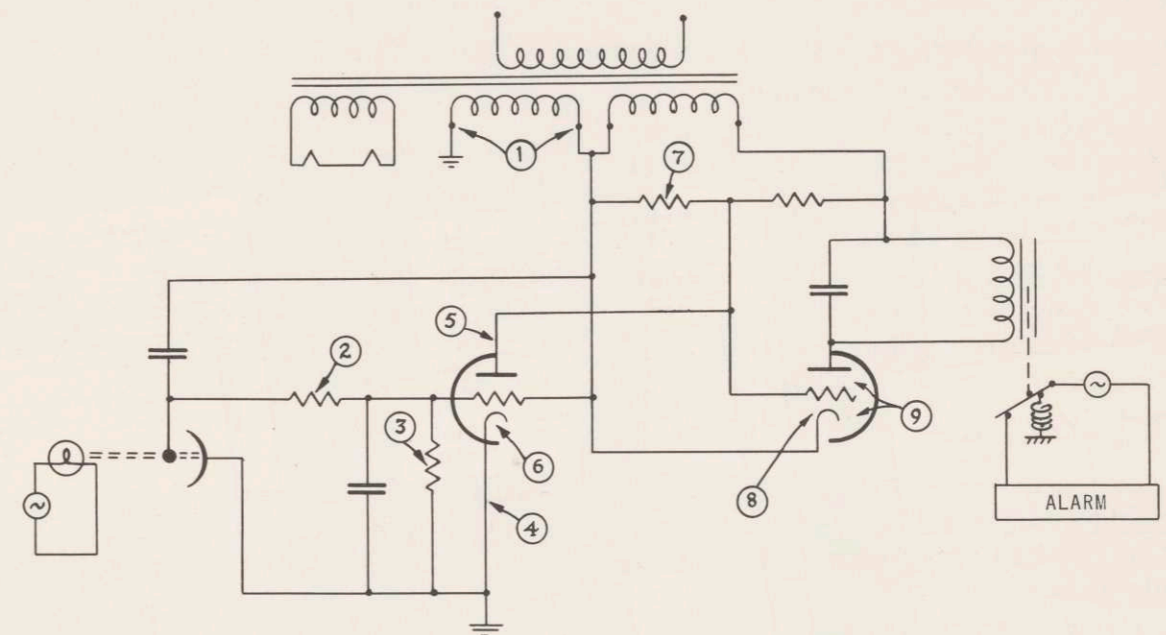
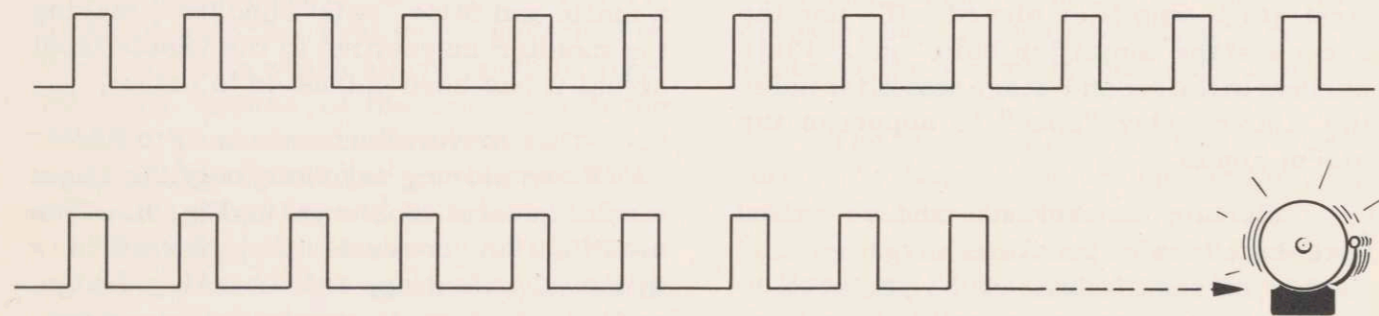


FIG. 7. WIDELY-USED FLAME FAILURE SAFEGUARD  
Nine (9) unsafe failures indicated

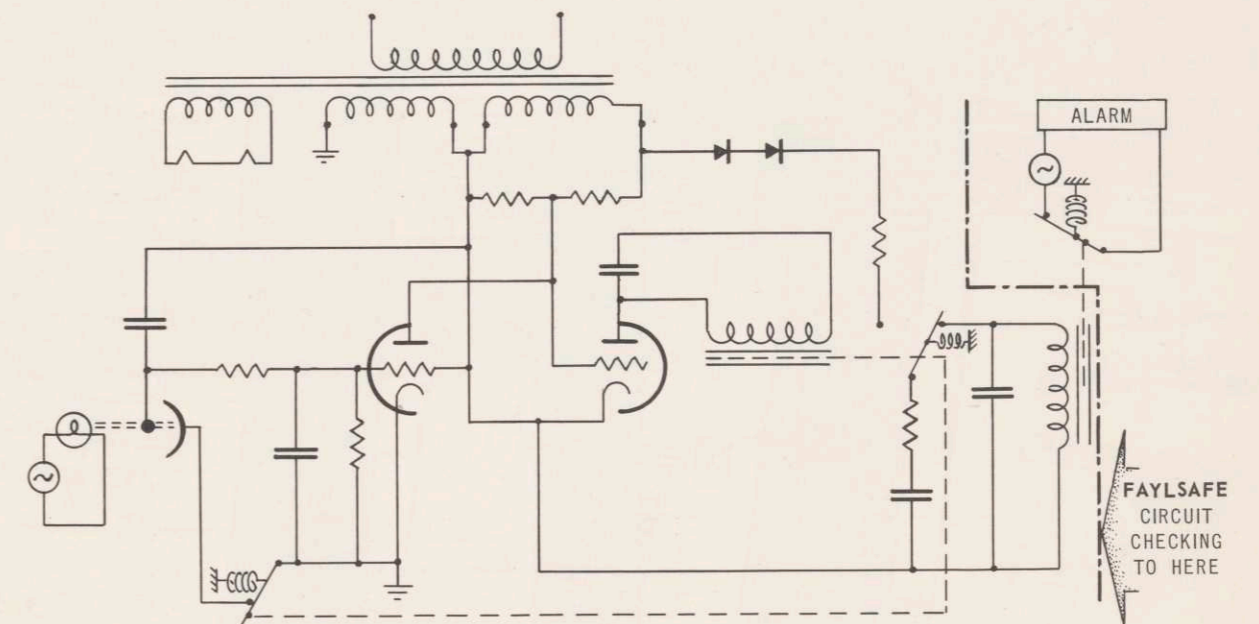
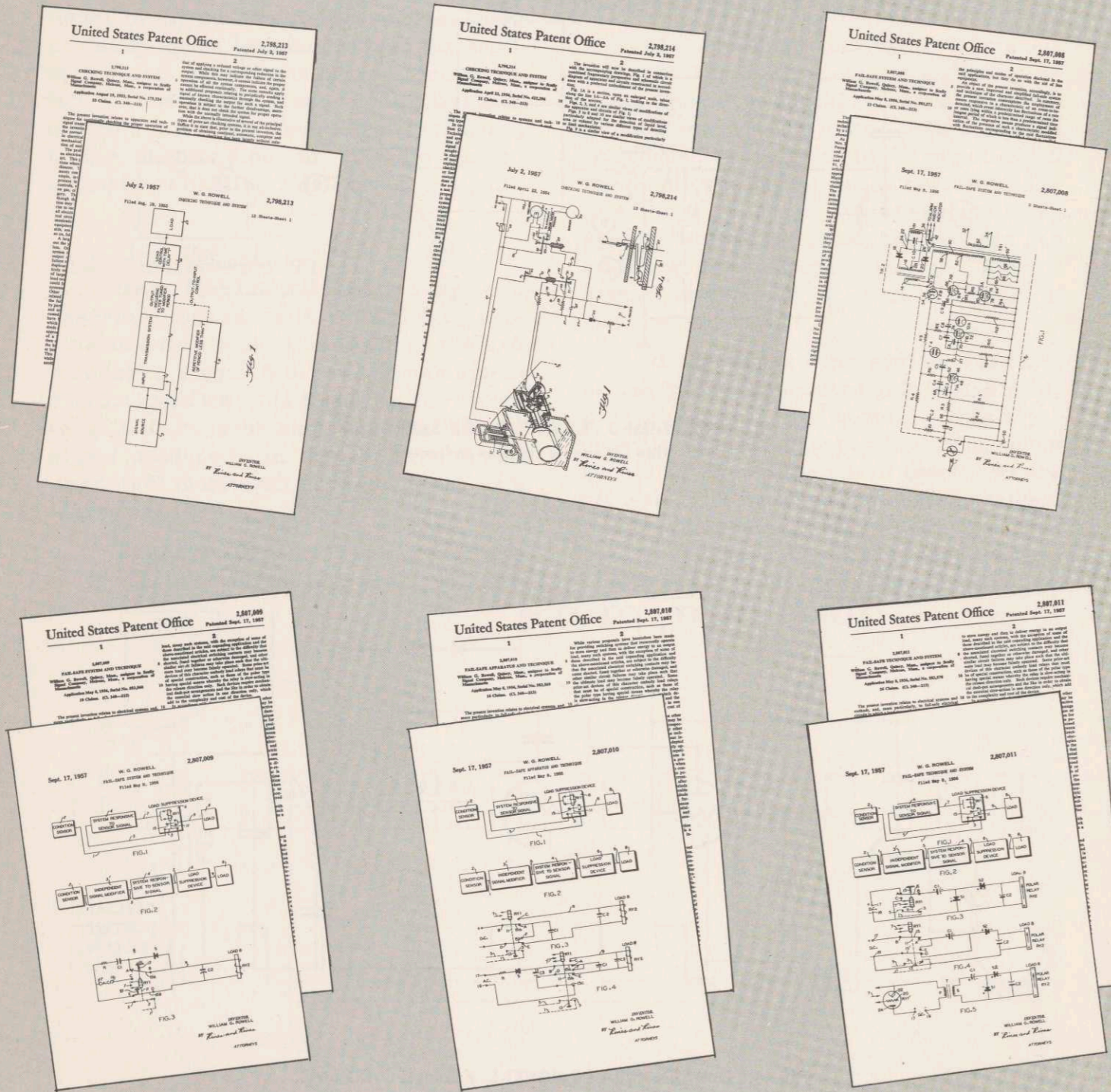


FIG. 8. DYNAMIC SCULLY-ROWELL FAYLSAFE CIRCUIT  
All unsafe failures eliminated

# U.S. Patents Issued on **FAYLSAFE** Technique

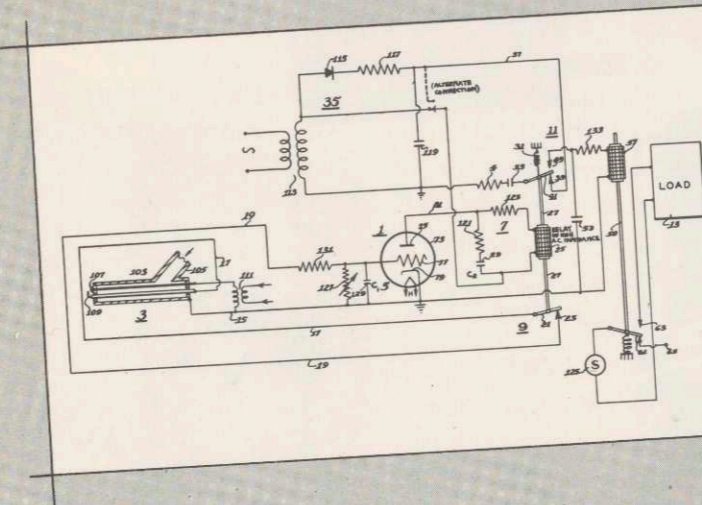
Additional foreign patents have issued, and both U.S. and foreign patents are pending.

Breadth of coverage: There are 139 allowed claims in the 6 issued U.S. Patents below.

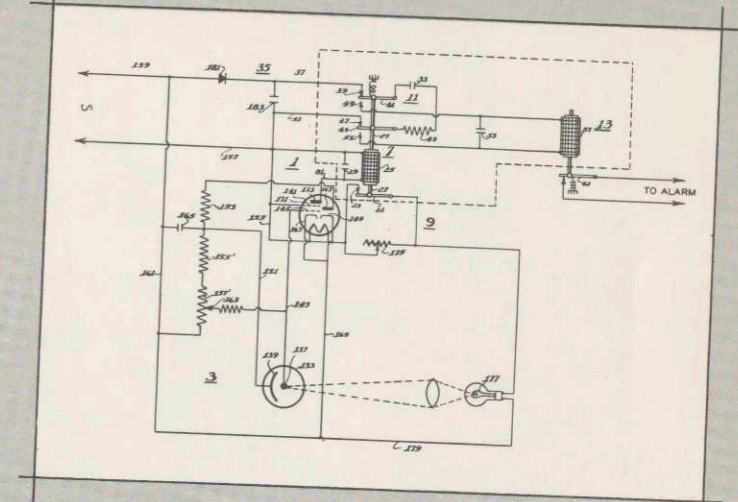


# A Few of the **FAYLSAFE** Product Applications Shown in Issued U.S. Patents

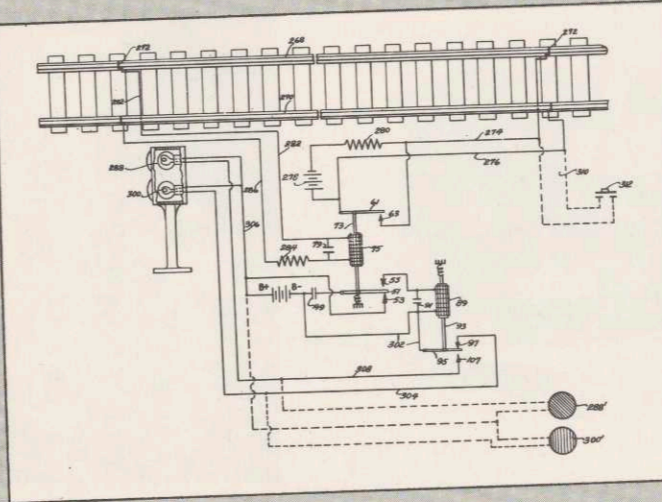
COMBUSTION FLAME MONITORING



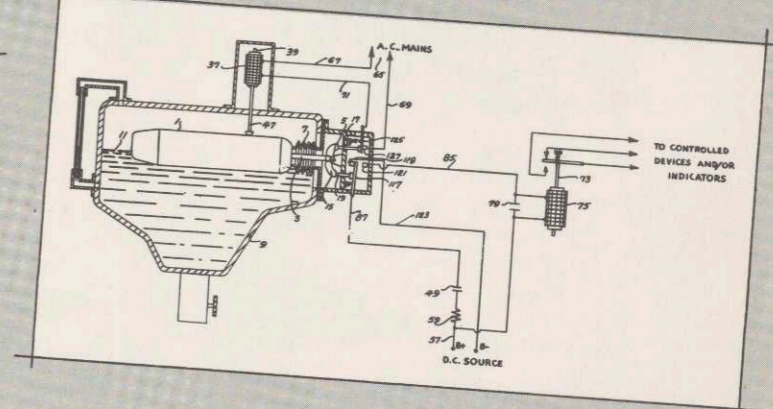
LIGHT OR INTRUSION MONITORING



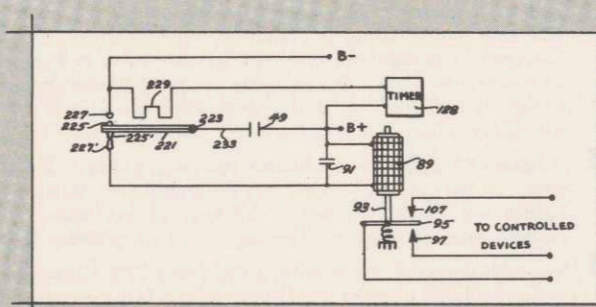
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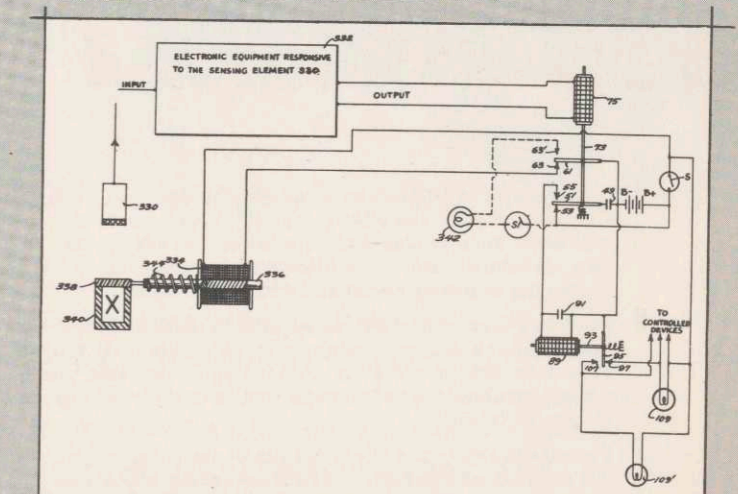
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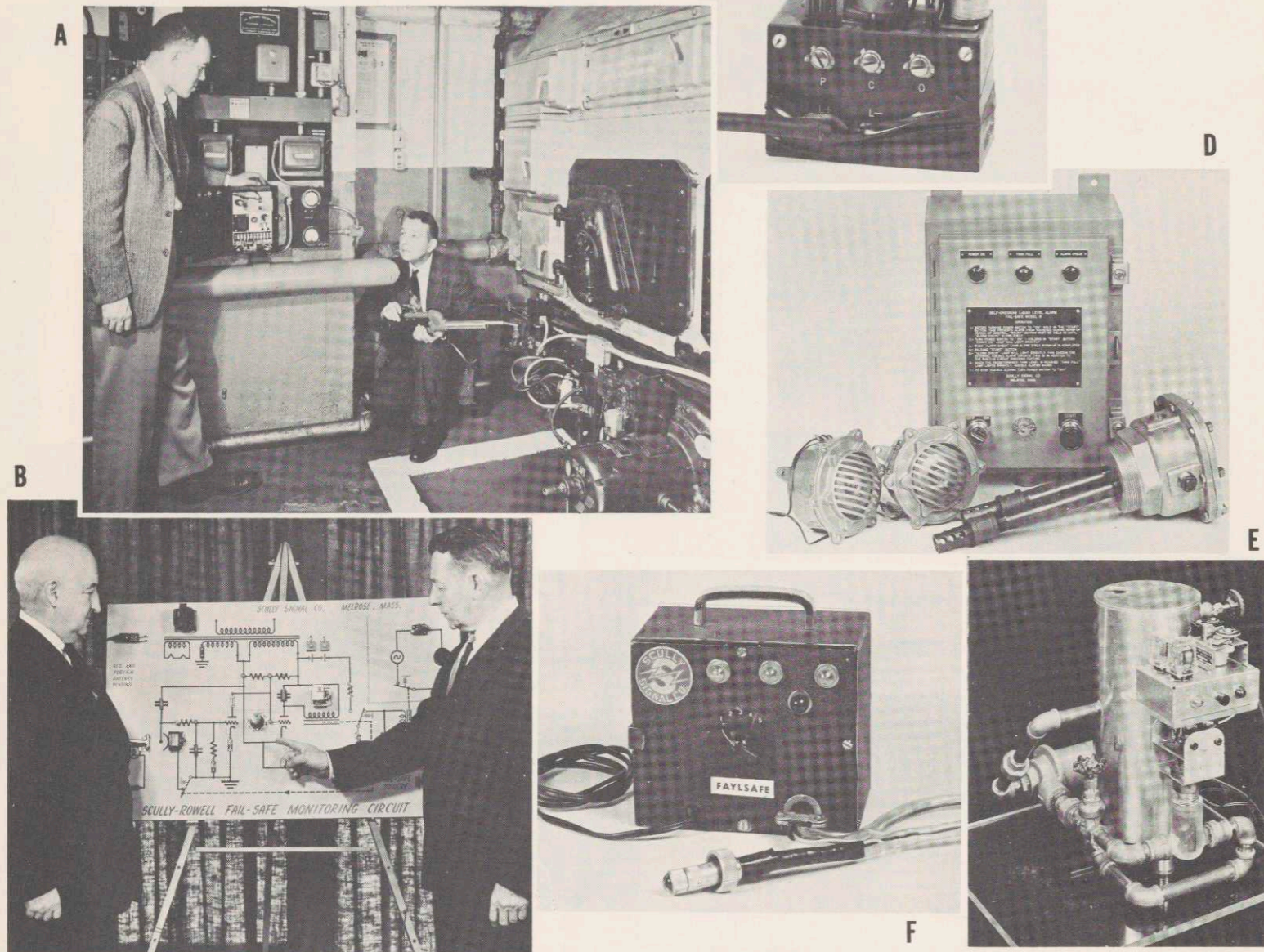
HEAT AND TEMPERATURE CONTROL



RADIOACTIVITY DETECTION



## FAYLSAFE Equipment In Action



**A** An early FAYLSAFE test installation in operation at Polaroid Corporation plant since November 17, 1954. Scully system corrected serious blow-back condition, and has checked its own operability over 96 million times (once every second during the operating cycle) since its installation.

**B** Operating demonstration model of FAYLSAFE monitoring circuit allows failure conditions to be created; all failure conditions are immediately detected and a warning alarm given. Sponsor Frank P. Scully (left) and inventor William G. Rowell (right).

**C** To test reliability and operating life of checking relays, two d-c relays (one hinged armature and one spring-bias armature, both without protective case) have been actuating one another at continuous 4-cps rate since May 1953; i.e., over 70 billion cycles, equivalent to 25 years of continuous once-a-second circuit-checking.

**D** FAYLSAFE high fluid-level detector (tank fill control) prevents over-filling of liquid storage tanks. Two-arm thermister bridge detects "full" level when one arm is immersed in fluid. Periodically actuated heater in lower bridge arm simulates full-level condition and proves operability of monitor.

**E** FAYLSAFE fluid-level detector (low water cutoff) employs pump to periodically inject fluid sample into flow switch (glass enclosed). Periodic checking signal immediately detects loss of fluid or interruption of monitoring action.

**F** Transistorized flame monitor, requiring only 3 transistors and associated circuitry, utilizes natural failure-simulating perturbation of flame for FAYLSAFE circuit checking. Low circuit impedance allows unshielded noise-free cabling; small size and low potential cost open way for fast-acting and reliable monitoring of domestic heating installations.

## Ultimate Reliability FAYLSAFE Design Now Available to Progressive Manufacturers of Control Systems and Components

### FAYLSAFE Licensing

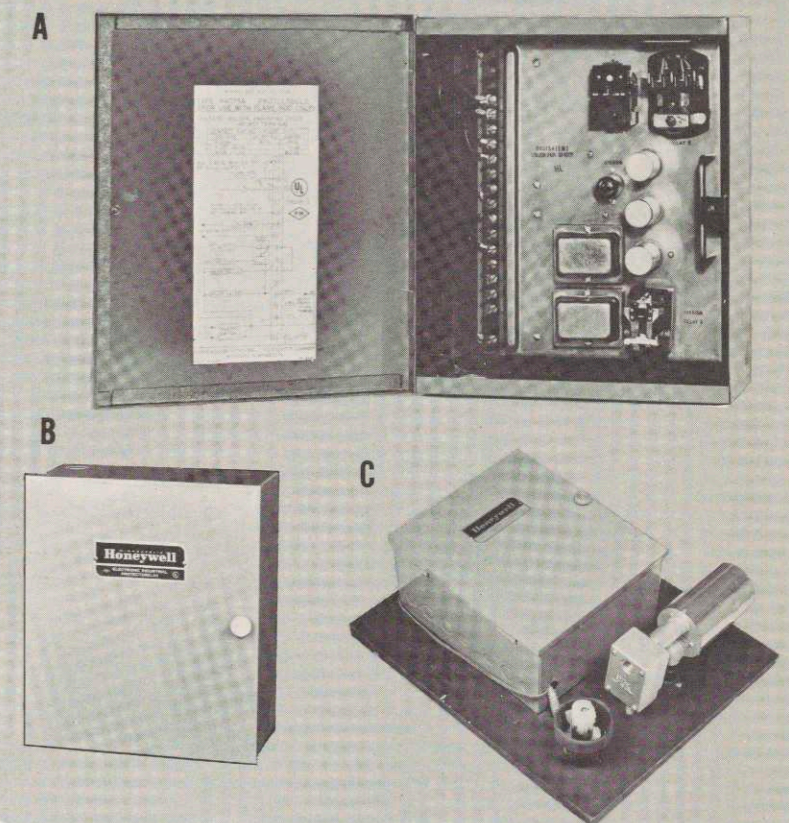
The principles of FAYLSAFE design are so basic and so widely applicable that essentially all physical systems can be made more reliable by the use of such design. Certainly all physical systems which are entrusted to protect human life or to guard physical property should be re-examined in the light of new "maximum-safety" FAYLSAFE design.

Since the adoption of FAYLSAFE design is so much in the public interest and since no single manufacturer can begin to apply the technique in all possible fields, a policy of non-exclusive patent licensing has been established by Scully Signal Company. Royalties are adjusted to the size of the markets which are licensed, and are sufficiently modest to encourage entry into the now untapped markets for truly fail-safe controls.

As FAYLSAFE equipment is made available, safety standards and codes are being re-examined and upgraded to hasten the adoption of ultimate-reliability physical equipment. In areas of critical use, it can be expected that Scully FAYLSAFE equipment (or its equivalent, if available) will be made mandatory, or subject to preferential rating by insurance underwriters.

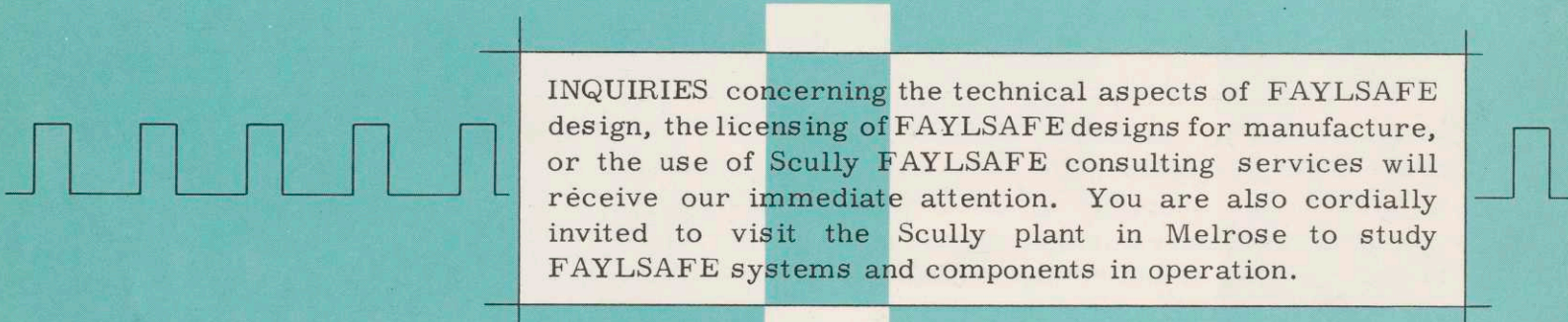
Prominent manufacturing firms have already begun to utilize the techniques of FAYLSAFE equipment design. Adjacent photos show the use of FAYLSAFE design by Minneapolis-Honeywell Regulator Company. A prominent AEC laboratory has taken a license to use the FAYLSAFE technique to safeguard its personnel from contamination by dangerous radioactive materials.

HONEYWELL FAYLSAFE EQUIPMENT -- the FAYLSAFE technique used in commercially available equipment by Minneapolis-Honeywell Regulator Company. (A) Interior of Honeywell R4075A control showing "maximum safety" self-checking FAYLSAFE circuit. (B) Exterior of R4075A Protectoglo Primary Control for electronic flame safeguard. (C) Ultra-violet flame detector with mechanical shutter to convert Honeywell R4075A to FAYLSAFE U-V operation.



### FAYLSAFE Consulting

To hasten the enlightened adoption of FAYLSAFE technology, the Scully Signal Company is prepared to undertake engineering programs to define the hazards of present control systems and to determine how FAYLSAFE techniques can best be used to achieve maximum safety conditions.



INQUIRIES concerning the technical aspects of FAYLSAFE design, the licensing of FAYLSAFE designs for manufacture, or the use of Scully FAYLSAFE consulting services will receive our immediate attention. You are also cordially invited to visit the Scully plant in Melrose to study FAYLSAFE systems and components in operation.



*Electronics Division*

**SCULLY SIGNAL COMPANY**

174 Green Street

Melrose 76, Massachusetts, U. S. A.

NOrmandy 5-3900



BROOKHAVEN NATIONAL LABORATORY  
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REFER:

11/4/58

Dr. Norbert Wiener  
MIT  
Cambridge, Mass.

Dear Dr. Wiener,

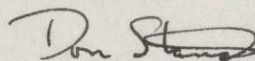
I am, at present, a senior at Antioch College, majoring in physics. Two years ago I became interested in cybernetics through your books and since then I have decided to major in this area in graduate school. I am writing to you because I could use some help in this matter; Antioch is a small school and none of the professors there are able to help me much in choosing a graduate school for this particular area.

With Dr. Shannon and yourself at MIT I once thought that there was no uncertainty about my choice of graduate schools; however, inspection of the catalog has shown that, although courses in the various branches of cybernetics are taught, there seems to be no attempt to integrate them into a cybernetics curriculum. I would like to know, then, if there is anyplace where an attempt is being made to produce such a curriculum. I'm afraid the answer to that will be no, and assuming it is, I have another question. What universities have outstanding departments in the areas of interest to cybernetics, and what men in these departments are of prime interest to me? In short, perhaps I should simply say that I'm trying to choose a school, and I would appreciate any suggestions or help you could give me.

I would also like to know of any suggestions you might have of books in the field. You see, I have yet to meet anyone really interested in the field, and as a result I've lacked any real guidance. Before my appointment to Brookhaven I had never seen more than three or four books on the subject.

Thanking you in advance, I am

Yours,



Don Stanat

Bldg. 703  
BNL

{ans 11/10/58}

November 4, 1958

Mr. Ashley T. Cole  
Counselor at Law  
30 East 42nd Street  
New York 17, New York

Dear Mr. Cole:

Professor Wiener regrets that he has found it necessary to refuse all requests for autographs and samples of his handwriting.

Thank you for your interest.

Sincerely,

Margaret Kruger (Mrs.)  
Secretary to  
Professor Wiener

November 4, 1958

Mr. William Stanton Foulks, Jr.  
Electronic Machine Company  
502 Market Street  
East Liverpool, Ohio

Dear Mr. Foulks:

I really am not in a position to judge the suggestions you have made me in your letter of October 3rd. It is an ingenious idea but I am not in a position to pronounce upon its merits. I suggest that you try to get in touch with people like Canon Lemaitre of Louvain University in Belgium. I regret that I can be of no more use to you in this matter.

Sincerely yours,

Norbert Wiener

NW: mmk



Harvard  
Medical School

Nov. 5, 1958

Dear Professor Wiener:

I was privileged to have dinner with you this evening and to attend the discussion section you led in the Common Room at Vanderbilt Hall. I wanted to write at once to thank you for a most enjoyable and instructive evening.

It is a pity that the discussions on scientific method as it applies to medicine which you and Dr. Rosenblueth led in the pre-war era have terminated. I believe that, above your massive contribution of the notion of "feedback", you personally have a great contribution to make to people as myself, who are attempting to develop a Philosophy of Medical Science. Any institution which brought you periodically to Vanderbilt Hall and thus contributed to the possibility of personal contact with the students is too potentially precious to have allowed to die.

There is an institution at Harvard Medical School, the Boylston Club, before which several fourth-year students each year present papers on topics of medical research which interest them. I have been working on the effects of Epinephrine on behavior, and I expect to work during this next year on the effects of Epinephrine on Learning. If my research goes well, and I believe it looks promising to date, I shall probably present some of it before the Boylston Club next year. Perhaps if I am able to do so, you would consider doing me the honor of attending that meeting, and perhaps commenting on any aspects of the work which might interest you?

Once again, please accept my sincere thanks for a wonderful evening.

Sincerely yours,

*Richard Jay Wurtman*

Richard Jay Wurtman  
Vanderbilt Hall 344  
107 Ave. Louis Pasteur  
Boston 15, Mass.

[Ans 11/20/58]



# The HALL Syndicate, Inc.

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VICTOR RIESEL

November 6, 1958

Professor Norbert Wiener  
Department of Mathematics  
Massachusetts Institute of Technology  
Cambridge 39, Massachusetts

Dear Professor Wiener:

Some day, somebody will do a definitive study on all that's wierd in modern politics. Then we'll discover what happens to newspaper men who try to cover campaigns.

You were gracious enough to tell me over long distance phone that I could visit with you, and then a series of stories broke between here and the west coast, and I was 1,000 miles away. Forgive me for not telephoning or writing sooner. In a very laymanish, unprofessional and unscientific way, let me add -- what is going to become of us all?

Sincerely,

Victor Riesel

VR:dp

November 6, 1958

Mr. P. D. Meister  
Product Research and Development  
The Upjohn Company  
Kalamazoo, Michigan

Dear Mr. Meister:

I am honored by your invitation to present a seminar before The Upjohn Company in March, 1959. However, I must regretfully decline your invitation since I am finding it necessary to conserve my strength for my own creative work.

Thank you very much.

Sincerely yours,

Norbert Wiener

:mmk

# PERSPECTIVES IN BIOLOGY AND MEDICINE

\*

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November 7, 1958

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Dr. Norbert Wiener  
Department of Mathematics  
Massachusetts Institute of Technology  
Cambridge 39, Massachusetts

Dear Dr. Wiener:

PERSPECTIVES would be very pleased if you would be willing to write a review of the book recently published by the Pergamon Press Symposium on Information Theory in Biology. It was edited by Hubert P. Yockey, Robert L. Platzman, and Henry Quastler.

We will hold the copy of the book until we hear from you.

Sincerely yours,

*Elizabeth Munger*  
Elizabeth Munger

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[ms 12/10/58]

3375 Mona Avenue

Muskegon Heights, Mich.

Nov. 10, 1958

Dear Sir:

May I have your autograph?

I am collecting signatures of only the great educators of the world and would very much like to add your name to my collection.

I am enclosing a self-addressed, stamped envelope, and a card.

Would you please write your name on the card and send it to me?

Thank you.

Sincerely yours,

Orville Japke

[ans 11/18/58]



Aleja I Armii 16 m. 7  
Warsaw Poland

Warsaw Nov. 10, 1958

Professor Norbert Wiener  
Massachusetts Institute of Technology  
Cambridge, Mass.

Dear Professor Wiener:

This is to introduce to you my son  
Christopher Lange who is a student  
at MIT. His chief interest is science.  
Christopher will appreciate the opportunity  
of meeting you. I shall be very grateful  
to any advice you will give him which  
may help him to crystallize his interests  
and further course of studies.

I remember with great pleasure  
our common sojourn at the Indian  
Statistical Institute. Please remember  
me to Mrs. Wiener.

With best regards,

yours sincerely,

Oskar Lange

Christopher S. Lange - course III  
2018 Commonwealth  
Brighton, Massachusetts

AL 4-9309

Appt. with Prof. Wiener  
October 14, 1958

November 10, 1958

S. S. Chern  
Department of Mathematics  
The University of Chicago  
Chicago 37, Illinois

Dear Chern:

I have taken the enclosed paper to several of my colleagues and they all agree with me. There isn't much to be said about either the physics or the engineering or the mathematics of impedances that has not been known for a quarter of a century. The paper may be alright for expository purposes but there its merit ceases. Of course, I am not the man to say yes or no as to what is done with the paper, but you will not be far wrong in supposing that if I were asked about it, I would say no.

Sincerely yours,

Norbert Wiener

NW:mnk  
Enclosure

November 10, 1958

Mr. Don Stanat  
Building 703  
Brookhaven National Laboratory  
Upton, L.I., New York

Dear Mr. Stanat:

While it is quite true that we have not organized a specific course on cybernetics as such, we are very actively carrying on investigations of a cybernetic nature here both in engineering and in physiology. I gave last term to some graduate students in electrical engineering with the assistance of Dr.'s Lee and Bose, a course on random functions and nonlinear problems. This will appear as a book within something like four weeks. I am planning to continue work in this field and will take on some graduate students. I will give a similar course next term with the emphasis on statistical mechanics of gases and plasmas. If you come here I should be glad to give you my attention and to refer you to my colleagues for other work of a cybernetic character in related fields. I suggest that you contact Professor Karl L. Wildes in the Department of Electrical Engineering here at M.I.T. for further advice.

From my own point of view it is much more important to have a field as a going concern at a place rather than to adapt the courses to a formal program, which may soon be left behind in a developing field.

Sincerely yours,

Norbert Wiener

NW:mmk

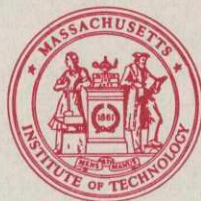
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November 13, 1958

Professor Norbert Wiener  
2-276

Dear Professor Wiener:

Your presentation last night was both clear and forceful; the audience was given much to evaluate. I am very thankful that you have fulfilled so well the function of the Skeptics' Seminar.

Sincerely,

*Hayward R. Alker, Jr.*  
Hayward R. Alker, Jr.

HRAjr:ct

# The Technology Press



MASSACHUSETTS INSTITUTE OF TECHNOLOGY  
CAMBRIDGE 39, MASSACHUSETTS

November 14, 1958

Professor Norbert Wiener  
M. I. T. 2-276

Dear Professor Wiener:

The enclosed check for \$5.00 is your share of the fee we charged the General Electric Company for mimeographing 100 copies of chapter eight of Cybernetics.

Very truly yours,

*Lynwood Bryant*

Lynwood Bryant  
Director

LB: cw  
Enc.

THE UNIVERSITY OF CHICAGO  
CHICAGO 37 • ILLINOIS  
DEPARTMENT OF MATHEMATICS

Nov. 15, 1958

Dear Professor Wiener:

Many thanks for your letter on  
Dr. Wu's paper. Best regards.

Sincerely yours,

S. S. Chern

MICHIGAN STATE UNIVERSITY EAST LANSING

DEPARTMENT OF SOCIOLOGY AND ANTHROPOLOGY

November 15, 1958

Dear Former Grantee:

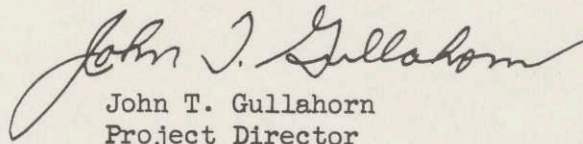
We are writing to ask your help in a study of American Fulbright and Smith-Mundt award holders. This survey has been undertaken by Michigan State University at the request of the United States Department of State and is designed to provide information concerning professional and personal consequences of the awards. The items included in the enclosed questionnaire are based primarily on interviews which were held last year with 200 former grantees in nine states.

In addition to the questionnaire, you will find enclosed a sheet asking for a list of publications, theses, works of art, lectures, concerts, and other accomplishments growing out of your overseas experience. This information will be compiled and issued as a separate report. Because the inventory of grantees' achievements is considered one of the most important aspects of the survey, we will appreciate your giving as complete information as possible on the enclosed data sheet.

Your answers on the questionnaire will be confidential. No individual will be identified (except in the report of the Bibliography and List of Accomplishments). Please do, however, put your name on the return envelope so that we will know you have responded. This will prevent your being bothered if there should be a follow-up mailing.

We want to thank you for your cooperation. Every effort will be made to ensure that the results of the study will contribute positively to the program of international educational exchange.

Sincerely yours,

  
John T. Gullahorn  
Project Director

Enclosures

JTG:pj

[ans 12/16/58]

Hobart, 16. 11. 1958

Professor Norbert Wiener

Massachusetts Institute  
of Technology

Cambridge 39, Massachusetts

Lehr geehrter Herr Professor Wiener!

Kürzlich las ich das von Ihnen verfaßte Buch  
"I am a Mathematician" und entnahm  
daraus zwischen Ihnen und mir bestehen  
viele Parallelgedanken.

Durch finanzielle Notlage war ich  
verhindert Hochschulen in Deutschland  
zu besuchen. Mathematische Kenntnisse  
habe ich mir mit Hilfe mathematischer  
Bücher erworben. Außerdem besitze ich  
von Natur aus ein gutes dreidimensionales  
Vorstellungsvermögen. Meine Kenntnisse in  
Mathematik verglichen mit den Kenntnissen  
eines Professors der Mathematik sind nur ein



2)

Bescheidenen Bruchteil. Ich möchte Ihnen nur kurz andeuten, daß ich im Alter von 7 Jahren einfache Körper in drei Dimensionen zeichnete, während Kinder gleichen Alters allgemein, die Körper nur zweidimensional zeichneten. Ohne trigonometrisches Lehrbuch errechnete ich die Höhe der Sonne für einen  $x =$  beliebigen Ort der Erde; mein Rechnungsgang war etwas umsständlicher als der übliche kürzeste vorhandene mathematische Weg. Dieses bewies mir Herr Professor Kochmann, Leiter der Hamburger Sternwarte in Hamburg Bergedorf, welcher zuvor Direktor an der Göttinger Universitätsternwarte war; ich war zu dieser Zeit 24 Jahre alt. ~~Zeit~~

Jetzt bin ich 43 Jahre alt und von Beruf technischer Zeichner.

Da ich eine Familie mit zwei Töchtern habe und man für den Lebensunterhalt arbeiten muß, ist die Freizeit kaum bemessen sich völlig der Mathematik zu widmen.

3)

Meine Frau ist meistens verärgert wenn sie ein Mathematikbuch sieht und sagt, „hast du die Mathematikbücher oder hast du mich geheiratet.“; beim Professor für Mathematik hat es einen Sinn er verdient Geld damit und er nährt seine Familie, während ich nur das Familienleben störe und kein Geld damit verdiene.

Weil ich in Deutschland nicht das Reifzeugnis einer Oberstufe hatte und nicht die Universität besuchen konnte; entschloß ich mich auszuwandern, um auf diese Weise schneller und besser English zu lernen. Denn im Commonwealth und U S A ist man nicht ganz so streng wie in Deutschland, und es ist eher möglich eine reinen Fähigkeiten entsprechende Stellung zu bekleiden. Es ist bekannt, daß es sehr viele verschiedene Kartenprojektionen gibt. Ich habe eine neue Kartenprojektion

4)

von praktischem Werte im Geiste  
 fertig vor mir liegen; kann aber nicht  
 mit Sicherheit sagen ob diese Art von  
 Kartenprojektion von einem Wissenschaftler  
 bereits gefunden ist, denn bei etwa  
 2500 000 000 Endbewohnern gibt es Menschen  
 genug die etwas mehr von Mathematik  
 verstehen. Herr Professor, falls es Ihre  
 Zeit erlauben sollte, bitte ich Sie um  
 Auskunft, ob für mich in meinem  
 Alter eine Möglichkeit besteht, eine  
 Anstellung <sup>als mathem. Praktikant</sup> an einer technischen  
 Amerikanischen Lehranstalt, z. B.  
 Technical College or School of Technology  
 zu bekommen. Falls eine Möglichkeit  
 bestehen sollte könnte ich diese  
 Stelle frühestens im Juli nächsten  
 Jahres antreten, weil ich bis dahin  
 meine zweijährige Arbeitszeit in Australien  
 vollenden muß. Australien liegt von  
 Europa dreimal so weit entfernt  
 als die Atlantikküste der Vereinigten  
 Staaten Nordamerikas, und es besteht  
 daher für meine Familie eher die  
 Möglichkeit Europa wiederholt zu besuchen.

5) Mein Vorschlag ist, einen zwei-  
jährigen Kontrakt mit einer Technischen  
Lehranstalt abzuschließen. Während  
dieser Zeit können dann Experten  
der Mathematik ~~ent~~ sicher ent-  
scheiden, ob ich eine geeignete mathem.  
Kraft <sup>für eine Dauerstellung</sup> an einer Amerikan. Techn. Lehr-  
anstalt bin. Ich würde zunächst für  
die ersten zwei Jahre allein nach  
USA auswandern, um mich mit  
der Mathematik intensiver befassen  
zu können; denn meine Frau ist  
völlig disinteressiert in Mathematik  
und hemmt mich nur in der  
schwierigsten Anfangszeit.

Ich würde mich freuen erfreuliche  
Nachrichten von Ihnen zu hören  
und mir die wichtigsten mathem.  
Bücher zu empfehlen die für eine  
Techn. Lehranstalt benötigt werden;  
um die zwischenliegende Freizeit  
von jetzt bis zur zweiten Hälfte

6)

nächsten Jahres mühselig auszufüllen.  
Ich bin interessiert mathematischen  
Unterricht zu erteilen und  
gleichzeitig schöpferische Arbeiten  
zu leisten. Den schöpferischen  
Arbeiten gebe ich den ~~V~~Vorrang.  
Um auf neue Ideen zu kommen,  
ist nicht die Dauer eines Schul-  
besuches abhängig, sondern diese  
können manchmal plötzlich  
erscheinen.

Ich schließe den Brief mit  
freundlichen Grüßen

Ihr

Lothar Zache

Meine Adresse ist:

Mr. L. ZACHE 20, Glebe St., Hobart, Tas.: Australia
---

Anlage: 1

B e g l a u b i g t e   A b s c h r i f t !

---

Herr Lothar Z a c h e (Lübeck-Eichholz, Steinlager III/4)  
hat Ostern 1952 an der Volkshochschule seine mittlere Reifeprüfung bestanden. In Mathematik erhielt er das Zeugnis:  
sehr gut.

Ich führte damals den Vorbereitungskursus zu dieser Prüfung in Mathematik durch und kann Herrn Zache bescheinigen, daß sein Wissen in Mathematik weit über den eines Prüflings für mittlere Reife hinausgeht, ja sogar, daß sein mathematisches Können (vor allem sein geometrisches Vorstellungsvermögen) noch weit das eines durchschnittlichen Abiturienten überträgt.

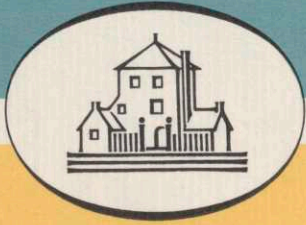
L ü b e c k , den 9.10.1954.

gez. Dr. Erich H o r n ,  
Dozent an der Volkshochschule  
in Lübeck.

Die Übereinstimmung vorstehender Abschrift  
mit der Urschrift wird hiermit beglaubigt.  
Lübeck, den 20. Okt. 1954



*Schulze, August*



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November 18, 1958

Mr. Norbert Weiner  
Massachusetts Institute of Technology  
Cambridge, Massachusetts

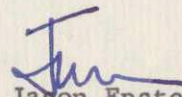
Dear Norbert:

My colleagues agree that we should go ahead with the novel.

I will be in Boston during the first part of the week of December 1st and if you tell me when, we might get together to discuss a contract and revisions, I will make my plans accordingly.

With best wishes.

Yours as ever,

  
Jason Epstein

JE/id

[ms 11/21/58]

November 18, 1958

Professor Dillon  
U.C.L.A.  
Los Angeles,  
California

Dear Professor Dillon:

I have checked up with my wife and my doctor and am delighted to accept your invitation to U.C.L.A. this summer. They tell me that with reasonable care I have nothing to be afraid of. I am prepared for your choice of dates but would prefer my visit to be either very early in the summer or very late, so that I shall have as long an uninterrupted vacation as possible.

Gratefully yours,

Norbert Wiener

NW:mnk

[ms 12/16/58]



November 18, 1958

Mr. Orville W. Jafke  
3375 Mona Avenue  
Muskegon Heights,  
Michigan

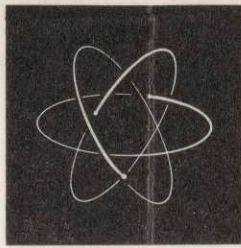
Dear Mr. Jafke:

Professor Wiener regrets that he has found  
it necessary to refuse all requests for autographs.

Thank you for your interest.

Sincerely,

Margaret Kruger (Mrs.)  
Secretary to  
Professor Wiener



Organizing Committee for the

Swiss Educational Tour  
for Automation  
and Operations Research  
to the U. S. A.

Professor Norbert Wiener  
Department of Mathematics  
Massachusetts Institute of Technology  
Cambridge 39, Mass.  
USA

under the auspices of the »Society of Swiss Friends of the U.S.A. (SFUSA)« Zurich and in co-operation with the »Institute for Automation and Operations Research« at the University of Fribourg (Switzerland) □ Mailing address: c/o The American Express Co. Inc., Bahnhofstr. 20, Zurich 1, Tel. (051) 23 57 20.

Basle, November 19, 1958

Dear Professor Wiener:

Thank you for your very kind letter of October 10, 1958 of which we have taken knowledge.

We are pleased to hear that you are willing to receive our group when same is in your city. Our group will be in Boston on April 9 and April 10, 1959 and stay at the Hotel Statler.

We would suggest the morning of Friday, April 10, 1959 for the visit to M.I.T., and we kindly ask you to let us know if this date is suitable to you. Otherwise, please advise us of an alternative. We shall send you a list of the members as soon as the bookings have been completed.

Thanking you again, we remain,

Very truly yours,

*E. Billeter*

ERNST Billeter

eg

[ans 12-3-58]

# ROGER HARRIS

162 GROVE ST., RUTLAND, VERMONT

November 19, 1958

Dr. Norbert Wiener  
Belmont, Massachusetts

My dear Dr. Wiener:

I should like to compile a collection of autographs of prominent persons.

I hope you do not mind my imposing upon you and will permit me to include you in such a collection as I sincerely believe that you, through your inspiring efforts and outstanding contributions, have played an important role in enriching the lives of many people.

If you would be so kind as to autograph the enclosed card, I shall be very grateful. A stamped, return envelope is included for your convenience.

Of course, if you have a photo available that you could autograph, it would please me immensely.

I would be greatly interested in knowing, Dr. Wiener, what you consider your greatest satisfaction during your illustrious career.

With cordial best wishes, Sir, for much happiness and good health,

Respectfully yours,

*Roger Harris*

[ms 11/25/58]

November 19, 1958

Mr. Jerome Rothstein  
21 East Bergen Place  
Red Bank, New Jersey

Dear Mr. Rothstein:

Enclosed is the copy of your thesis on "Communication, Organization, and Science" which you so kindly sent to Professor Wiener. He wishes to return it now with many thanks.

Sincerely,

Margaret Kruger (Mrs.)  
Secretary to  
Professor Wiener

enc:

November 20, 1958

Mr. Richard Jay Wurtman  
Vanderbilt Hall 344  
107 Avenue Louis Pasteur  
Boston 15, Massachusetts

Dear Mr. Wurtman:

I am very much interested in the Boyleston Club of which you speak, but think it best to hold any participation on my part in it in abeyance for the present, until I am more rested than I am at present. Please remind me of the matter in the future.

Sincerely yours,

Norbert Wiener

NW:mnk

DEPARTMENT OF AERONAUTICAL ENGINEERING

MASSACHUSETTS INSTITUTE OF TECHNOLOGY  
CAMBRIDGE 39, MASSACHUSETTS

November 21, 1958

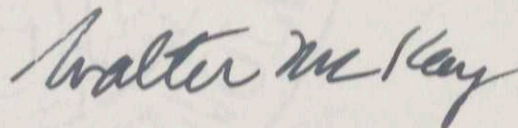
Professor Norbert Wiener  
Room 2-276

Dear Professor Wiener:

On Monday, December 8, Sir Geoffrey Taylor will be here to give a seminar on the formation and disintegration of thin sheets of fluid, a notice of which will be sent you.

In Dr. Hunsaker's behalf, I write to invite you to a luncheon on that date with Sir Geoffrey and some of our colleagues to be held at the Faculty Club, dining room three, at 12.30. We hope you will be able to come.

Yours truly,



Walter McKay  
Associate Professor of  
Aeronautical Engineering

WMcK:bg

[ans 11/24/58]

November 21, 1958

Mr. Jason Epstein  
Random House Inc.  
457 Madison Avenue  
New York 22, New York

Dear Jason:

I am delighted at the acceptance. I could not wish for a higher honor than to have Random House take my book nor for a greater gratification than to have it done through you. I shall be at Tech the week of December 1st. I shall return from a visit with my daughter in Chicago on the 1st and from then on I should be completely at your disposal. I have a class 9:00-10:00 on Monday, Wednesday and Friday, but any other time you wish to fix would be suitable. I promise to put my best work into seeing the manuscript into shape.

Sincerely yours,

Norbert Wiener

NW:mmk

November 21, 1958

Mr. and Mrs. David Riesman  
49 Linnean Street  
Cambridge 38, Massachusetts

Dear Mr. and Mrs. Riesman:

My novel has been taken by Random House and Jason will be up soon to talk over the final spit and polish. I want to express my gratitude for your interest in the material.

Sincerely yours,

Norbert Wiener

NW:mmk



November 21, 1958

Miss Jessie Whitehead  
Harvard University Library  
Cambridge 38, Massachusetts

Dear Jessie:

The novel is taken by Random House. Jason will be up the week of December 1st and will help me get it into final form. Meanwhile I want to express to you my appreciation of the interest you have taken in the book at all stages.

Sincerely yours,

Norbert Wiener

NW:mmk

Mathematics Department  
The Institute of Science  
Bombay 1, India

November 24, 1958

Professor Norbert Wiener  
Department of Mathematics  
M. I. T.  
Cambridge 39, Mass.  
U. S. A.

Dear Professor Wiener :

Herewith a copy of a joint paper on the work we did on  $2 \times 2$  matrix factorization in the case where the determinant vanishes. I have stated the factorizability condition in the most general form and included the necessary lemmas on beschränktartige functions. I hope you will have time to go through the manuscript and offer suggestions. I would especially like you to notice Section 5 wherein I have commented on the (rather clumsy) symbolism for multiple processes, introduced in a recent paper by a Russian, named Rosanov. I have put this section last so that it may be left out if you do not like it.

To save time, however, I am going ahead with the paper. As soon as I can get the summary translated into Russian, I will send it to the Russian Journal of Probability, Moscow as we had decided when I saw you last, unless you would rather that I wait.

I got back about two weeks ago after interesting visits to Cambridge and Paris. I liked both places immensely. I passed through Rome, but unfortunately had only 2 days there. In Paris, I met Professors Kampé de Fériet and Paul Levy. They send you their greetings. All told, I had a most profitable year abroad, especially from the mathematical standpoint.

My sincere thanks to you and to the Mathematics Departments of M. I. T. and Harvard for making all this possible.

After this paper, no joint work from last year's collaboration remains. However I am going to follow up the paper by another one in which I will characterise the generating function of bivariate processes in terms of the optimal factorisation of beschränktartige function. I have already sent to Professor Grenander a third paper in which I have given an example to show that the Wold decomposition in the time domain and the splitting of the spectrum into absolutely continuous and non-absolutely continuous parts need not correspond. This paper also contains the conditions for the removal of this pathology. I am also hoping to take another crack at the  $q \times q$  generate case. As soon as

some of this work is completed I will turn to the non-linear case.

I trust your own work is progressing to your satisfaction and that your book is out. Do please send me a copy if you can spare one. I do hope that there will be more opportunities for collaboration in the future. It is rather difficult to work here single-handed. I am therefore hoping that you were quite serious when you said that you would like to come to India again or that we might meet in Europe. No red tape will come in the way of my joining you between March 15 and June 15 — our vacation period. If it is to be in Europe, I will need some financial help as we are not allowed any foreign exchange; but if it is to be in India, there will be no problem. The idea of working on some Himalayan hill-station seems very attractive. I am awfully sorry that I have neither the position nor the power to extend to you an invitation from this Institute or any other.

Do please let me know your plans.

With very kind regards,

Sincerely yours

*P. Masani*

P. Masani

P.S. On the paper I have put my name before yours only because the departure from the alphabetical order in our previous papers resulted in some confusion. Some quoted it as M. & W. In one paper it appeared correctly as W. & M. but was listed under the letter M.

November 24, 1958

Miss Janet Corliss  
Box 1124  
Winter Park, Florida

Dear Janet:

I have not written you about the novel until now because it has just been accepted by Random House. Jason Epstein is now editor at Random House and has been tied up moving from one place to another. I want to tell you my gratitude to you, not merely for your fine secretarial work but for your participation in my entire effort as a creative job.

Best regards from Margaret and myself.

Sincerely yours,

Norbert Wiener

NW: mmk

November 24, 1958

Professor Walter McKay  
Room 33-217

Dear Professor McKay:

Professor Wiener thanks you for your invitation  
and will be most happy to join you for luncheon on  
Monday, December 8, at the Faculty Club.

Sincerely,

Margaret M. Kruger (Mrs.)  
Secretary to  
Professor Wiener

:mmk

November 24, 1958

Mrs. Irngard Wintner  
Mr. Claude Wintner  
3750 Tudor Arms Avenue  
Baltimore 11, Maryland

Dear Wintners:

The novel is taken by Random House and I am going ahead with the work. Jason Epstein is now with Random House. I want to express my appreciation to both of you for your valuable criticisms and to emphasize the fact that Aurel's encouragement and criticism has been of the greatest possible value to me.

Sincerely yours,

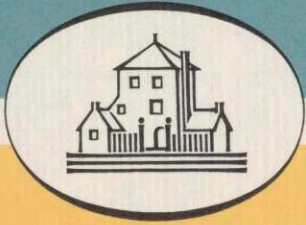
Norbert Wiener

NW:mmk

P.S. Mrs. Wiener and I are actively looking for the manuscripton "Harmonic Analysis and Random Time Function", but have not located it as yet. I am enclosing a reprint which is the only thing we have found on the above subject. We are continuing to search and you will be hearing from Mrs. Wiener as soon as possible.

Sincerely,

Margaret Kruger (Mrs.)  
Secretary to  
Professor Wiener



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November 25, 1958

Prof. Norbert Wiener  
Dept. of Mathematics  
Massachusetts Institute of Technology  
Cambridge 39, Mass.

Dear Norbert:

I wonder if we can meet at M.I.T. on the afternoon of  
Wednesday, December 3rd. I can be there at about  
3 o'clock if it is all right with you. At that time  
we can discuss the contract, etc.

Yours as ever,

Jason Epstein

JE/id

[orig 12/1/58]



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November 25, 1958.

Professor Norbert Wiener  
Department of Mathematics  
Massachusetts Institute of Technology  
Cambridge, Mass.

Dear Professor Wiener:

One of our informal advisors in the field of mathematics has informed us that you are writing a text in non-linear analysis of stocastic processes, and that the manuscript is nearing completion.

I hope it is not too late to express the formal interest of Ginn and Company in this project. I realise that you have been considering other publishers and in particular John Wiley during recent months. In fact, I remember very well meeting you when I worked for Wiley some years ago, and this makes me all the more interested in getting in touch with you again.

We would be only too delighted to examine your manuscript as soon as it is available. We would arrange to have it carefully reviewed and would make such reviews available to you, in the hope that they would be helpful to you.

Let us hear from you at your convenience.

Yours very truly,

Henry B. Stanton, Head  
College Department.

sm



ИЗДАТЕЛЬСТВО  
ИНОСТРАННОЙ ЛИТЕРАТУРЫ

Москва

СССР

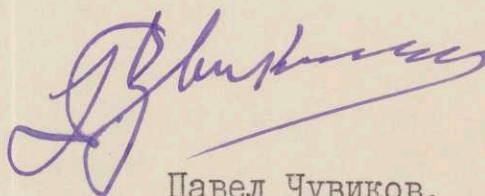
№ 1-53/716

"25" ноября 1958 года.

Глубокоуважаемый господин Норберт Винер,

Профессор Летов сообщил нам о Вашем намерении приехать в Советский Союз в 1960 году. Мы готовы в случае Вашего приезда уплатить гонорар за издание на русском языке Вашей книги "Кибернетика и общество".

С уважением



Павел Чувиков,  
Директор Издательства.

[ано 12-16-58]

Publishing House  
for Foreign Lit

25 NOV 1958

Moscow

USSR

Dear Mr N.W. :

Prof Letov communicated to us  
your intention to visit the USSR in  
1960. In the case of your arrival  
we are ready to pay an honorarium  
for the <sup>Russian</sup> edition of your book (Cybernetics  
and Society)

Respectfully,

Pavel Tschyvetkov  
Director of Publishing House

оказание

МЕЖ...

RUSSCOU 278  
196

Prof. Norbert Wiener  
Massachusetts Institute  
of Technology  
Cambridge 39,  
Massachusetts, USA

Проф. Норберту Винеру  
Массачусетский Технологический  
ститут, Кембридж 39  
Массачузетск, США

МОСКВА

-----  
г. Москва И-278, Ново-Алексеевская 52, Издательство  
иностранной литературы. П. Чувилов.

И-53/1716



November 25, 1958

Wright-Patterson Field  
Dayton, Ohio

Gentlemen:

This is to confirm my interview of November 17. There is new material which is about to appear - my book on Nonlinear Problems in Random Theory will be published December 2 jointly by the Technology Press and John Wiley. I also wish to submit my article in Scientia which I herewith enclose.

As to coming to the meeting I suggest that Assistant Professor Amar Bose of the Electrical Engineering Department take my place. If my being there is absolutely indispensable, then I suggest that Bose and I both go, that I attend the conference briefly and keep in touch with Bose, so as to have my ideas available to all of you. I am at present not in the best of health and at no time have I been able to take a conference lasting many hours without excessive fatigue. I am quite certain that Professor Bose can represent my ideas and even more certain that if Bose and I are there together and we keep in touch, I can assure that my ideas will be made available to you in a better form than I could possibly give to them myself.

Sincerely yours,

Norbert Wiener

NW:mnk  
Enclosure

[ans 12/5/58]

November 25, 1958

Mr. Roger Harris  
162 Grove Street  
Rutland, Vermont

Dear Mr. Harris:

Professor Wiener regrets that he has found it necessary to refuse all requests for autographs and/or photographs. However, he thanks you for your expression of interest.

Sincerely,

Margaret M. Kruger (Mrs.)  
Secretary to  
Professor Wiener

:mmk

Dr. Norbert Wiener  
M.I.T., Cambridge,  
Mass.

27 Nov. 58  
APO 815, S.Fran.  
(Dwofunia B.I.)  
Det. 35, 30<sup>th</sup> Decem

My Dear Sir,

If I have had the inestimable honor of this letter ever having reached your respected attention, I am first & sincerely more than honored.

I have been enthralled by the reading & study of your excellent work, "The Human Use of Human Beings". I have been so impressed by your force, appeal to fact, & humane evaluation of ideals which humans should embrace or eschew that for the first time I am writing, perhaps foolishly, to an honored person to add my feeble voice to the praise of the luminaries of our time who have praised yourself & your numbered peers. Please excuse my rashness; it typifies youth.

I do believe that I perceive the pith of your caveat, moreover, I do believe that I shall retain your message of cogent insight & profound honesty as an integral portion of my attitude which I am attempting to expand & give reason by seeking after your incisive & pertinent message. To me, yourself along with the late Dr Einstein, Dr Oppenheimer, Dr Werner Heisenberg & Sir Bertrand Russell stand as pillars of wisdom combining with the renowned scientific these you have propounded, a quality of altruistic & compassionate human worth which I hope to be able to emulate in attitude, direction, & to perhaps be capable of also living with the satisfaction, fleeting & transitory it seems, that I am honestly endeavouring to be human in the sense of progressing toward the potential which should be expected of humans.

I should like to be able to consider myself a member of the youthful laity with ultimate hope of gaining some insight of depth into the

remarkable mechanics of Physical Science.

With Respect + Admiration,

John W. Ackerman

A/2C U.S.A.F.



Ackerman, John.  
AF-19574284  
Oct 35, 30th Weason  
ALO 815, Sfran



Dr. Norbert Wiener  
Professor of mathematics  
Massachusetts Institute of Technology  
Cambridge,  
Mass.

**VIA AIR MAIL**



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DE L'AERONAUTIQUE  
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Paris, le 28 Novembre 1958

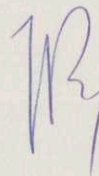
Prof. N. WIENER  
Massachusetts Institute  
of Technology  
CAMBRIDGE (Mass.)

-U S A-

Cher Prof. Wiener,

Je me permets de vous envoyer 3 notes dans  
lesquelles j'ai cité votre nom, en me référant à  
vos travaux de "generalized harmonic analysis".  
La troisième surtout est en rapport direct avec  
vos résultats sur les fonctions d'auto-corrélations  
de fonction prenant les valeurs 1 ou -1.

Je vous prie de croire à mes sentiments  
dévoués.



J. BASS

Professeur à l'Ecole Nationale  
Supérieure de l'Aéronautique

[ms 12/5/58]

TATA INSTITUTE OF FUNDAMENTAL RESEARCH

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29 November 1958

Dear Professor Wiener,

I have pleasure in sending you by separate post a complimentary copy of TAUBERIAN THEOREMS by H. R. Pitt which is the second title in a series of monographs financed, edited and printed by this Institute, and published for the Institute by the Oxford University Press.

Yours truly,

*K. Chandrasekharan*

Professor K. Chandrasekharan

Professor Norbert Wiener  
Massachusetts Institute of Technology  
Cambridge 39, Mass.  
U. S. A.

KC:a  
29.11.58