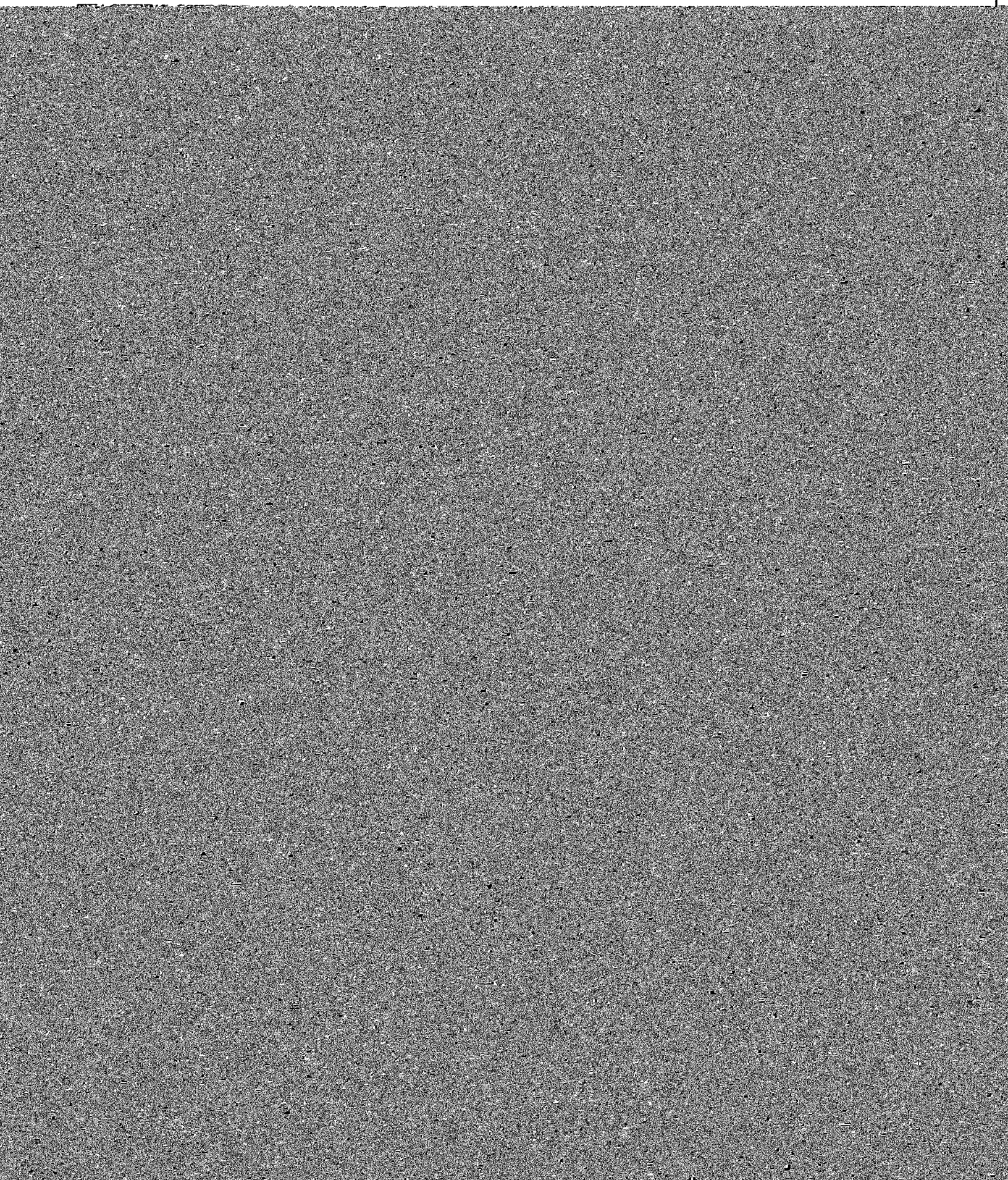
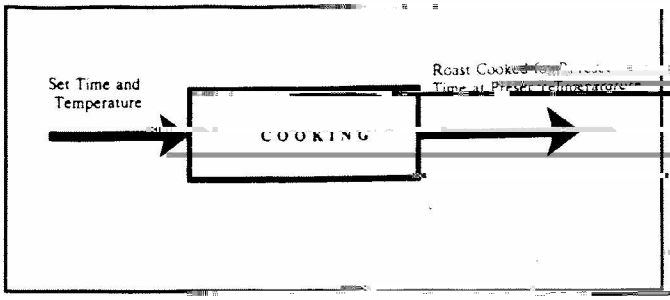


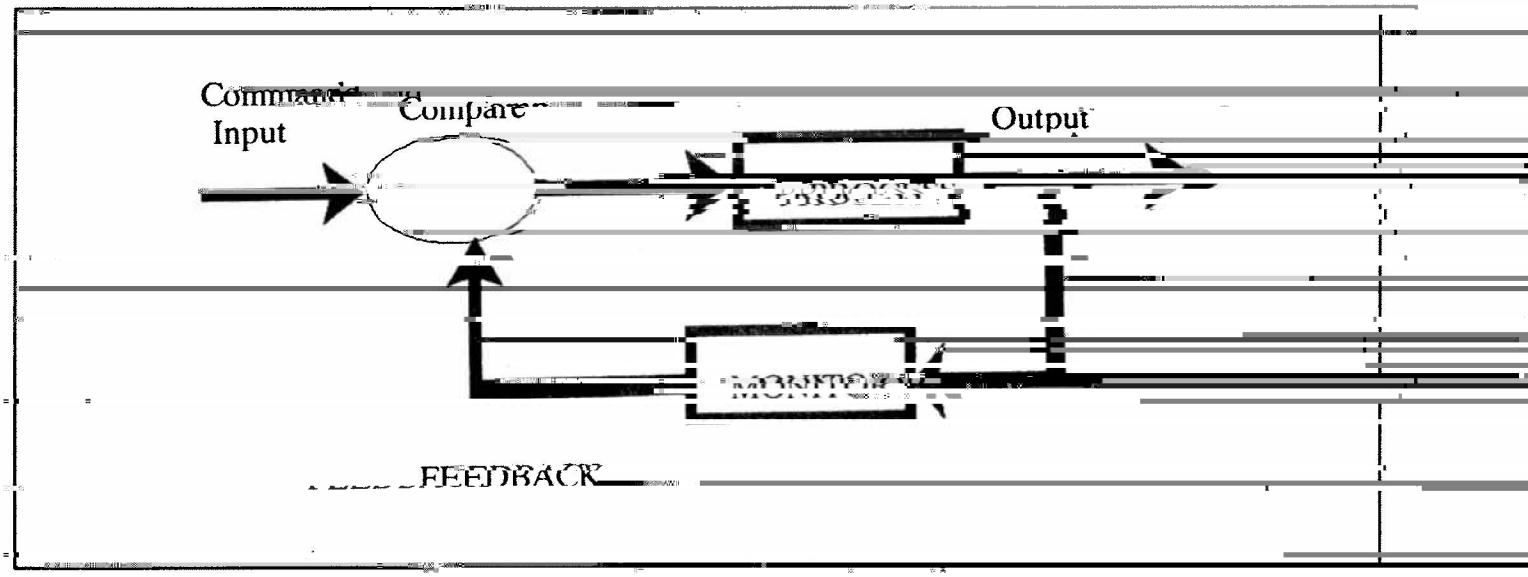


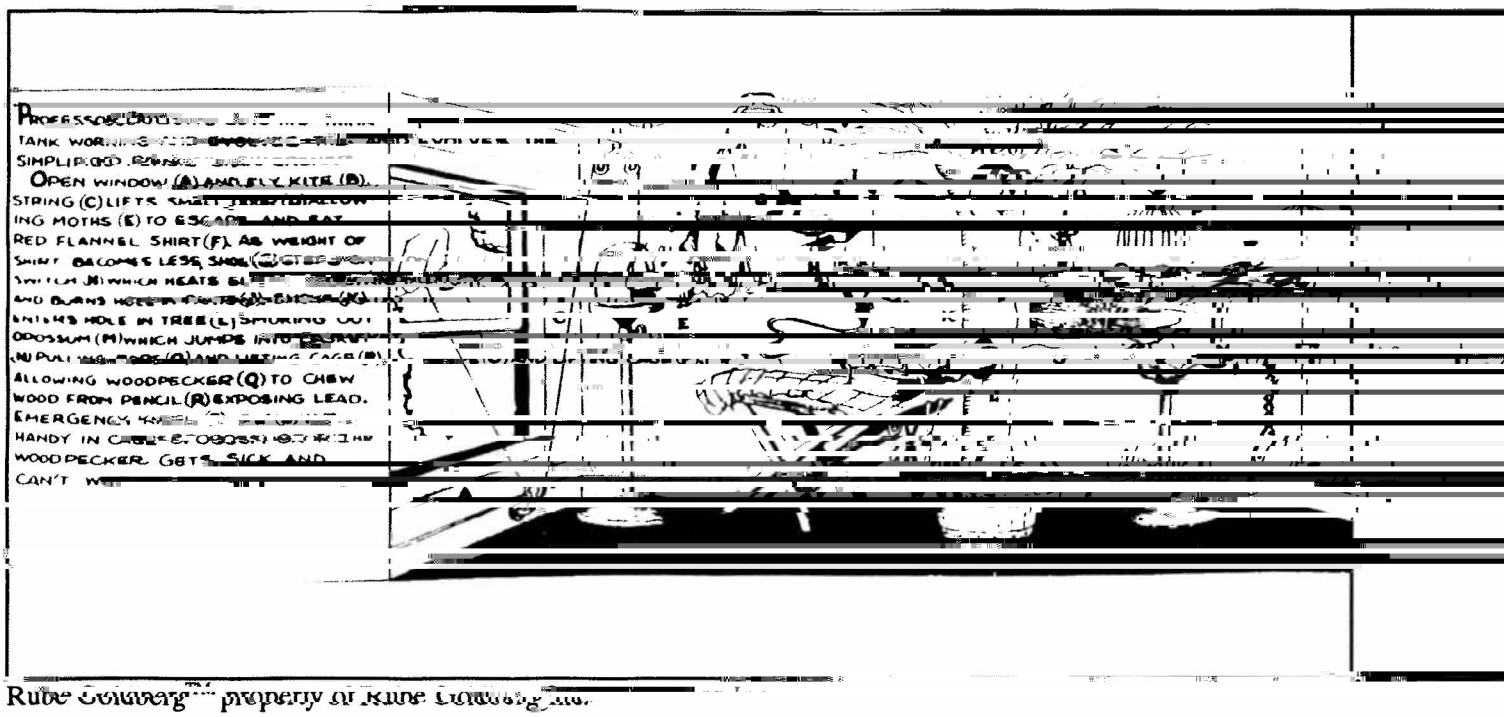
In the earlier example of cooking a roast, we can convert the open-loop system into a closed-loop control system by the introduction of feedback through the use of a meat thermometer (a sensor) placed in the roast. The roast will cook until the meat thermometer indicates the desired roast temperature and upon reaching this temperature the oven would then shut off. The external inputs to the system would be the starting time, the oven temperature and the desired meat temperature. The difference between the desired and actual meat temperature would then be used to control the oven.

An example of an open-loop control system is the cooking of a roast in an oven with a timer. We place the roast in the oven, set the cooking temperature and cook for the desired time. Then remove the roast. The input to the control system is the time setting. The controller is the timer that determines when the oven is to be turned on and off. The output controlling the cooking element is the oven temperature. An example cooking is the process of cooking the roast. The actual cooking time for the roast is the output.

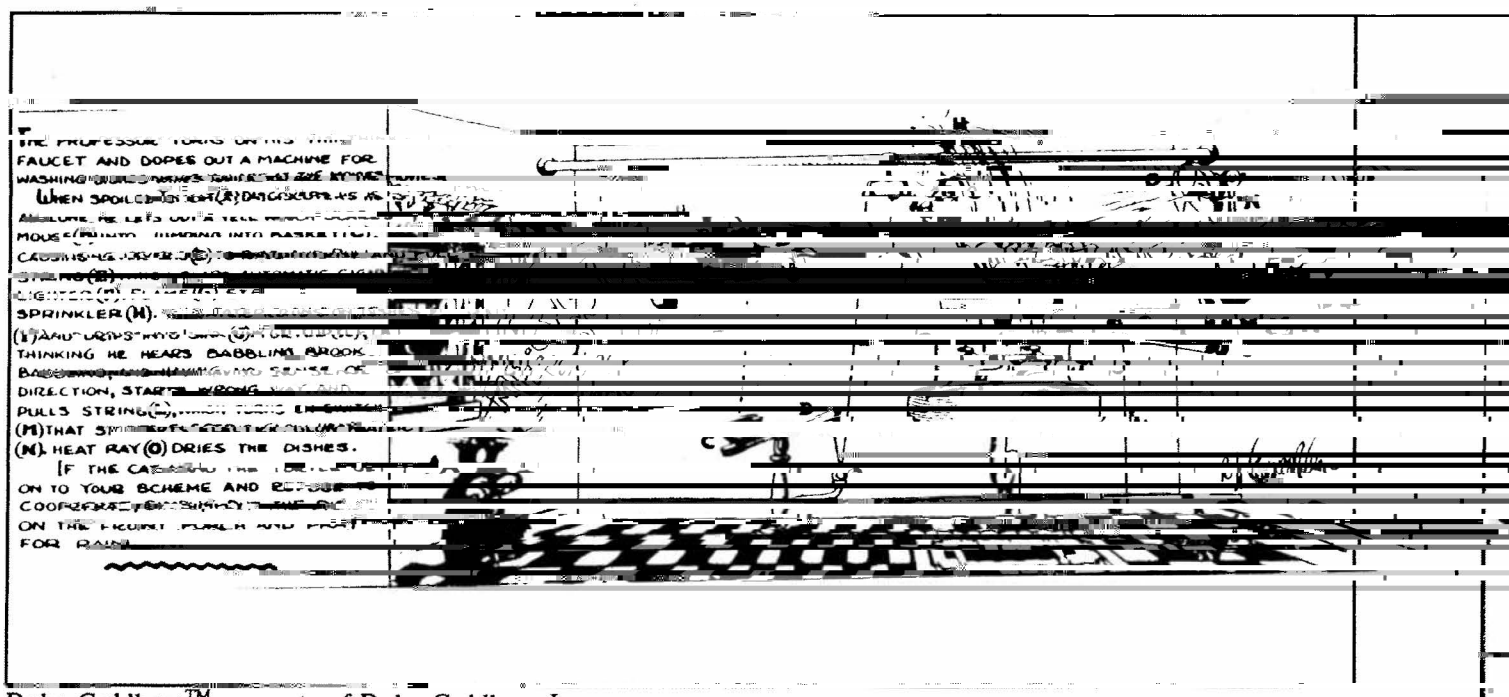
In a technological system the output may be controlled automatically by the use of feedback. Feedback is the action of measuring the difference between the actual result and the desired result. This is accomplished by the sensors. These sensors measure the output of the system which is compared to the desired output. If the two are different, the controller will adjust the system to keep the actual output very close to the desired output. Systems that utilize feedback are called closed-loop control systems.

Review the Rube Goldberg™ type cartoons on the following pages.

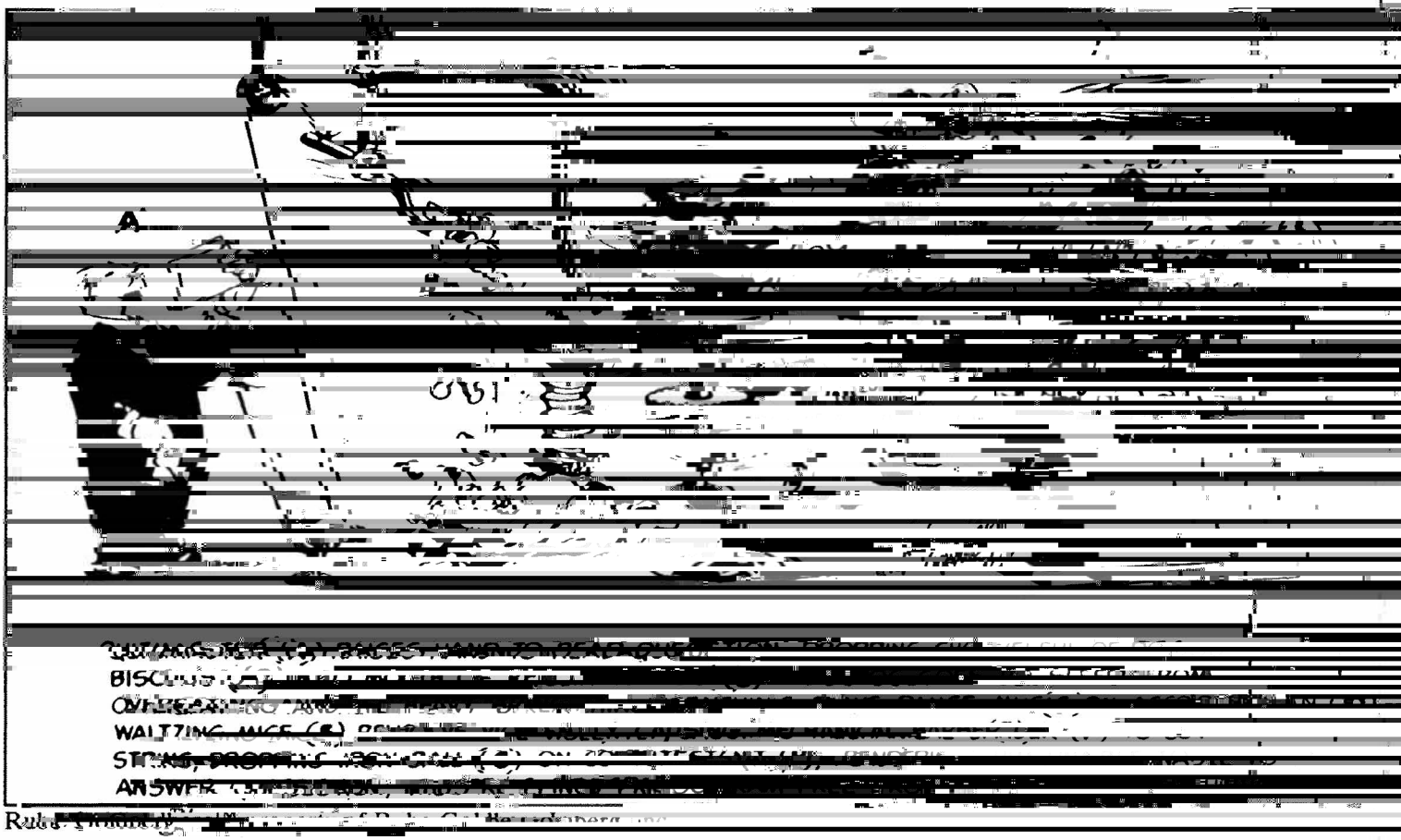




Rube Goldberg™ property of Rube Goldberg Inc.



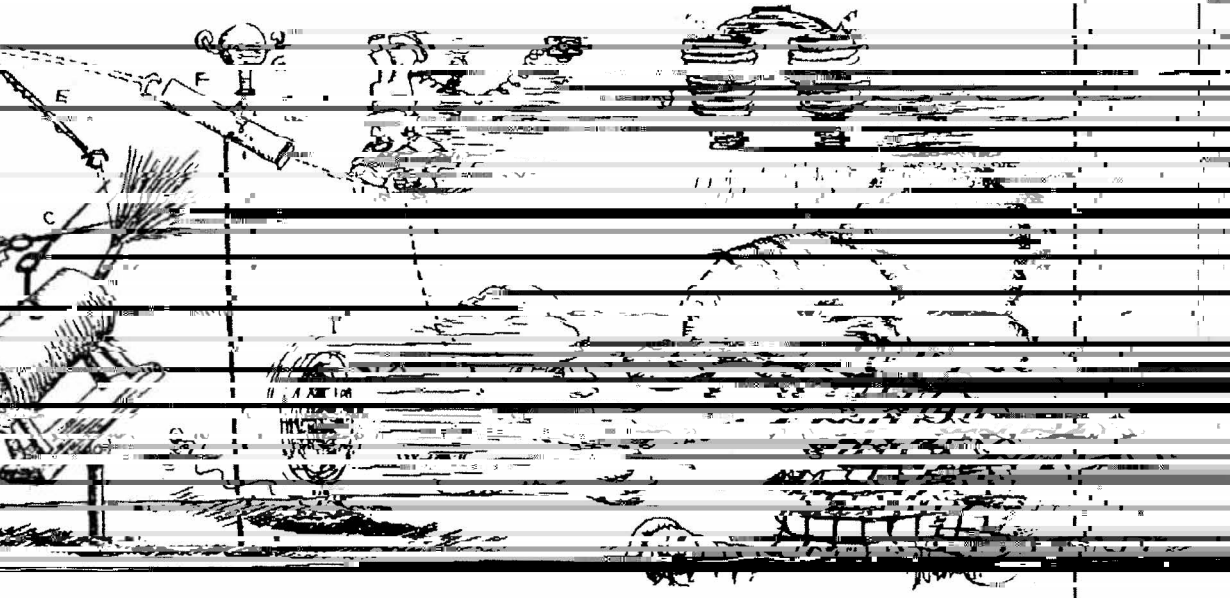
Rube Goldberg™



ACTIVITY ONE: Understanding Complex Systems

Use this worksheet to analyze a Rube Goldberg™ type systems. Identify the subsystems and how they are connected. Using this worksheet as a model, ask students to analyze several other Rube Goldberg™ devices or systems in a similar manner.

The cartoon below was drawn by the famous illustrator, Rube Goldberg™. Can you figure out how the parts of this complicated machine work together to do a job?



Rube Goldberg™ property of Rube Goldberg, Inc.

The above complicated machine system is made up of 10 subsystems. Make an educated guess (hypothesis) about the purpose of the Rube Goldberg™ device.

Test your hypothesis by analyzing how the 10 subsystems work together to achieve the desired result. Try working backwards, starting at the end.

ACTIVITY TWO

Each group needs to solve the following Rube Goldberg™ The problem can start anywhere but it must terminate

Boisjoly, were engineers who worked for Morton-Thiokol, take. The first route is via the manager of the particular

hydraulics, and robotics. Schools, for this vital reason, should be providing students with an introduction to the fundamentals of these evolving technologies in an interesting practical way, through hands-on experiences and problem-solving applications.

How these technologies work and how they can be applied are the thrusts of this case study on machine automation. The emphasis is on gaining an understanding, in a hands-on, practical way, of the physical sciences behind the technologies. Math and high physics come alive to students when what has been abstractions are applied in real-life problem-solving situations.

The main focus of this case study is on conversion of energy, and transmission and control of power. It is not intended to produce "technicians or automation specialists." Instead, the students are being exposed to the foundations on which such technologies depend. This will be accomplished by combination of classroom theory and practical hands-on experience.

SHELTER DESIGN

Human-kind has been engaged in the building and designing of structures since the beginning of recorded history. The conquest of the environment and the ability to exist in many of the inhospitable climates has allowed humans to create the technological wonders which now have become commonplace. The design and construction of structures is a knowledge built on thousands of years of practical trial-and-error study and application. The understanding of structures and the forces that act upon structures will be explored in this case study. A real-world discussion on a structural collapse (e.g., the two suspended walkways within the atrium area of the Hyatt Regency Hotel in 1981) as well as various demonstrations of structural principles should be covered as an introduction to the case study problem. The main focus of this study is on survival and how structures must protect human inhabitants in the most difficult of situations. The instructor will have the ability to diverge into structural forces, thermodynamics, energy loss and gain, material properties, ergonomics, instructional documentation, mass production considerations, and materials processing.

This understanding will be accomplished by a combination of classroom theory, research, sketches and actual designs utilizing CAD. Technical drawing and hands-on experience of building a working model of the structure complete the unit.

DESIGNING STRUCTURES FOR PEOPLE WITH DISABILITIES

This project is supported by a grant from the NEC of America Foundation. For more information contact:

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Overview of Project and Engineering Design Case Studies

- Designing Adaptive Devices
- Adaptive Radio Controlled Car
- School Accessibility for Students with Physical Impairments

PURPOSE

The main purpose of the Designing Technology for People with Disabilities project is the development of curriculum materials to engage students in the design of technological solutions to problems with disabilities. Besides developing knowledge based case studies, the project will also develop a technology course to enhance the education of all students. The two objectives of the project are:

1. Development of curriculum materials to be used with high school students participating in the Principles of Engineering (POE) course sponsored by Project Lead the Way for people with disabilities.

APPENDIX A
USING ENGINEERING CASE STUDIES IN MST

provide opportunities for Engagement, Exploration, collaborating with a group of colleagues in New York