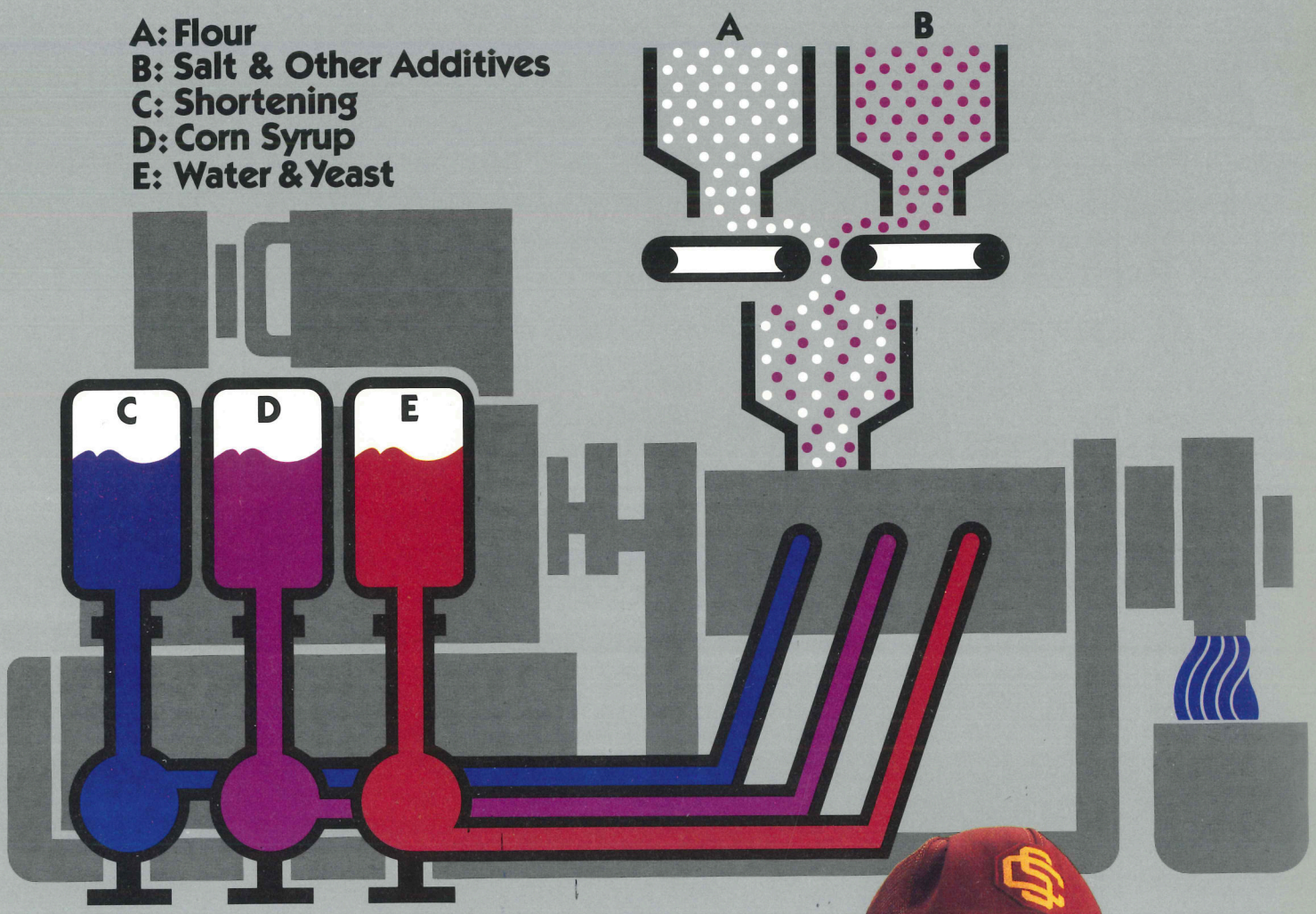
# TeledyneReport

Second Quarter 1982

## Mixing: A Fine Blend of Art and Science

# THE MAKING OF A PRETZEL

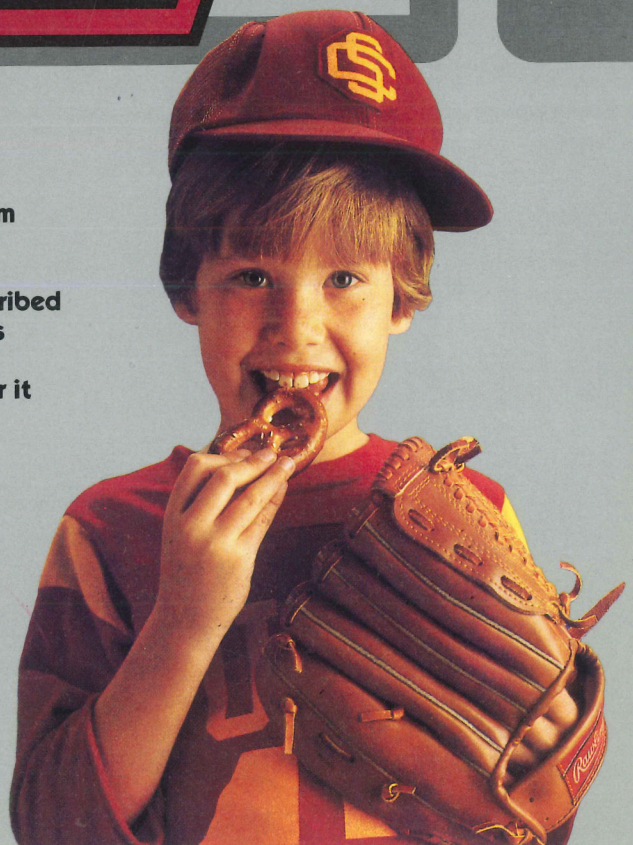
A: Flour
B: Salt & Other Additives
C: Shortening
D: Corn Syrup
E: Water & Yeast




There are more ways than one to bend a pretzel—and the same applies to mixing the dough. Commercial bakers have traditionally used large double arm mixers to blend their ingredients in batches of about 500 pounds or more.

Teledyne Readco's modern continuous processors (described in this article and diagrammed above) have the advantages of uninterrupted production of extremely uniform dough. As long as the basic ingredients are fed into the processor it will provide an endless stream of dough ready for forming and baking.

The end result is a crisp, high quality, uniform product that is the delight of pretzel munchers everywhere.



# The Fine Art of Mixing

The quality and uniformity of hundreds of everyday products from baked goods to plastics and pharmaceuticals depend on thorough mixing processes. Teledyne Readco makes the machinery that does the job.

All it takes to mix up the batter for a respectable cake in your home kitchen is a bowl, a spoon and some old-fashioned elbow grease. A small electric mixer can make it a lot easier, though. Either way, the end result—intimate blending of a number of dry, liquid and paste-like ingredients into a uniform mass—is the same goal sought by manufacturers of food products, plastics, rubber, chemicals, pharmaceuticals, cosmetics and dozens of other products. The difference is that manufacturers may need to mix anywhere from a hundred pounds to a hundred tons of material an hour. The ingredients they use may range from liquids thinner than water to materials more viscous than tar. Others may be solids in the form of powders or granules, or pellets almost as hard as hockey pucks.

Teledyne Readco manufactures a broad line of mixing equipment that fills a wide spectrum of these commercial and industrial needs. Their product line includes one-quart laboratory mixers, high intensity mixers, ribbon mixers and sophisticated 1,000 horsepower continuous processors capable of thoroughly mixing up to 400,000 pounds of material an hour.

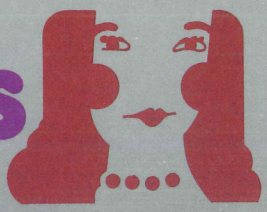
**On the Cover:** Thorough mixing of diverse materials—the subject of this issue—is symbolized by a schematic rendering of a Teledyne Readco continuous processor.

## FROM MAKING DOUGH...

Over the years, many unique ways of mixing materials have evolved, and Teledyne Readco has had a hand in that history. The company was founded in 1906 as a producer of mixers for commercial bakeries. The original vertical dough mixers that they produced are still used for various kinds of small batch bakery mixing. To handle much larger scale production, however, horizontal mixers with U-shaped bowls that tilt to discharge their contents were soon developed. These mixers have single mixing arms of various configurations, each designed for mixing specific types of dough or batter.

Similar mixers with horizontal bowls were then developed with two parallel mixing arms that rotate separately, either interlocking as they rotate or passing each other tangentially. The rapid, thorough mixing possible with these double arm mixers led to the development by Teledyne Readco of a complete line ranging from laboratory mixers up to heavy duty production mixers with 1,500 gallon working capacity, powered by 400 horsepower electric motors.

SEALANTS
COSMETICS
ADHESIVES

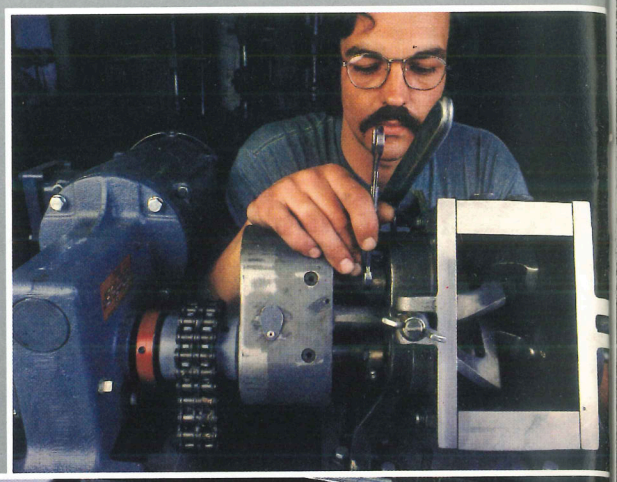


RUBBER

ORES
PUTTY
PREPARED FOODS
BISCUIT DOUGH
WELDING FLUX
TEXTILE FIBERS
GRAIN PRODUCTS
POLYESTER
SILICONE RUBBER
AUTO BODY FILLER
PET FOOD

ASPHALT
CHEESE
DONUT DOUGH
POLYPROPYLENE
MEAT ANALOGS
ALUMINUM PASTE
BREAD DOUGH
CHEWING GUM

One-quart capacity double arm laboratory mixers such as this one are the smallest in the Teledyne Readco line. Though of small capacity, the size of the drive components confirms that it is made for very heavy duty service, indeed.

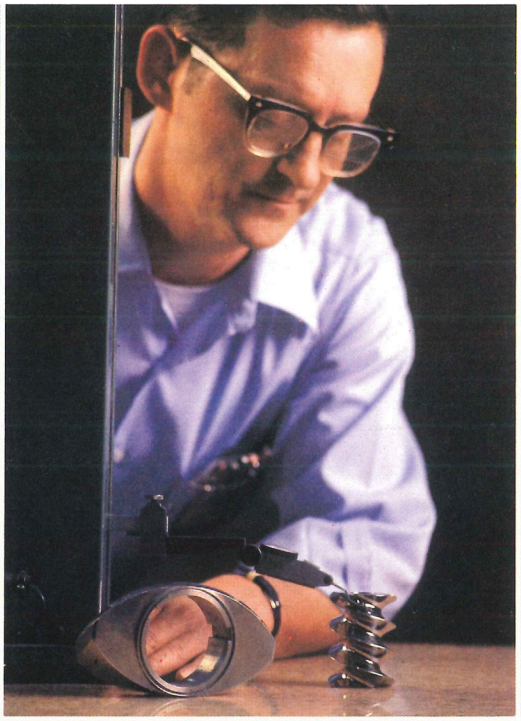


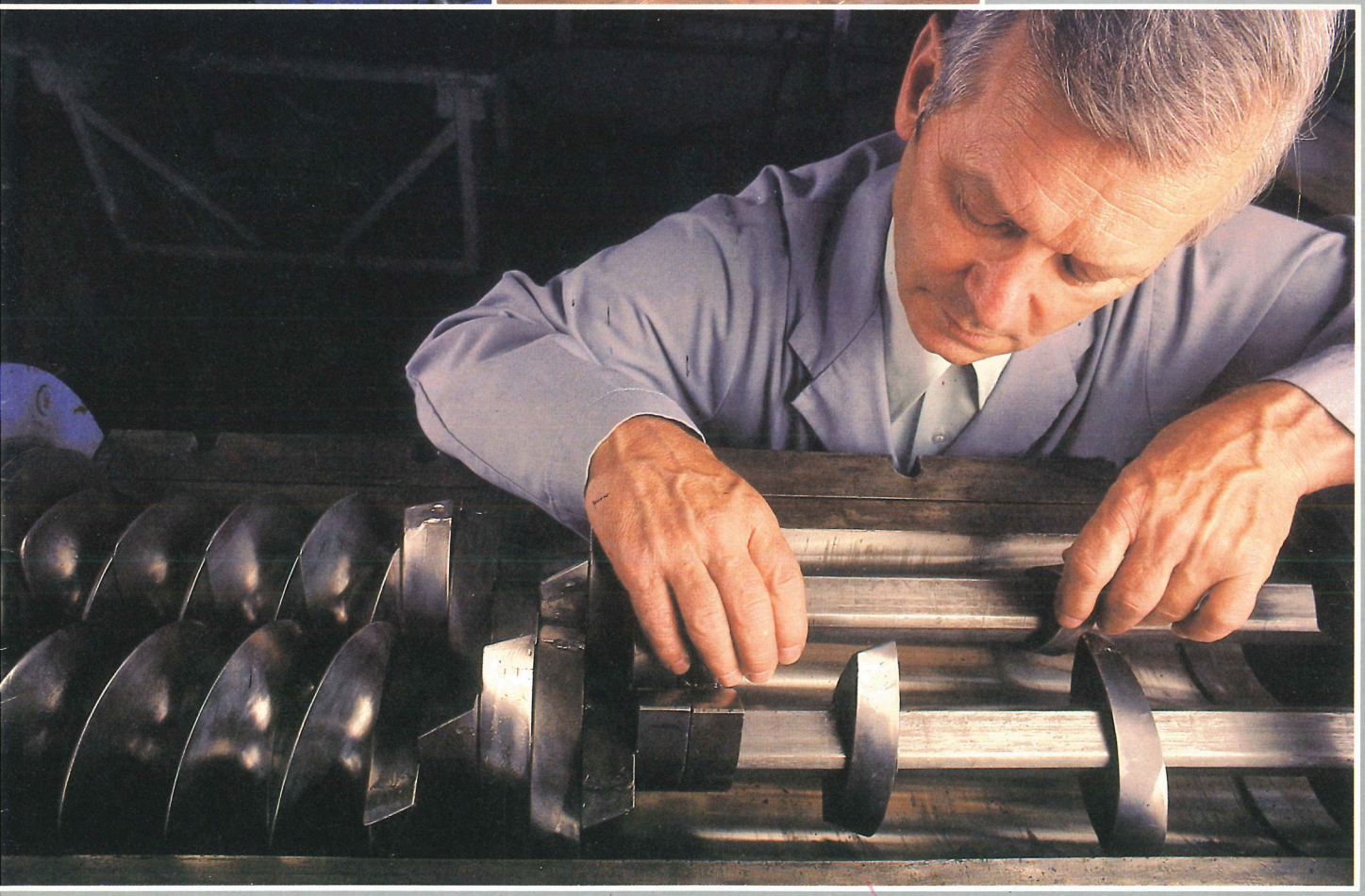
Above Center: This 370 gallon, single arm Teledyne Readco batch mixer is one of a type widely used in the baking industry for making various types of dough.

Above Bottom: The mixing arm for a 200 gallon chemical mixer dwarfs the workman who is grinding it. The arm is fabricated with internal passages for cooling.

High intensity mixers can reduce extremely viscous or even solid materials such as plastics, rubber and asphalts to a completely uniform mix in from 30 seconds to 5 minutes. As this picture shows, they have relatively small mixing chambers combined with exceptionally high power drives.

Dimensional tolerances of a small feed screw for a continuous processor are being checked here. At the left of the screw is a lens-shaped mixing paddle for a larger processor.





Helical and flat-surfaced mixing paddles can be arranged on the continuous processor shafts in various sequences to achieve the desired intensity and duration of mixing that a specific material needs.

**...TO INDUSTRIAL PROCESSES**

Double arm mixers of this type were quickly adopted by industries dealing with chemicals, plastics, rubber, paints and pigments, as well as many types of food products. Double arm mixers are today among the most commonly-used types of mixing equipment.

Teledyne Readco has engineered this type of mixer to a high degree of sophistication. The mixing arms and bowls are machined to tight tolerances to achieve uniformly small clearances between the rotating and fixed parts. This eliminates dead spots in the mixing zone where unmixed material can accumulate, and assures thorough mixing in a short time. The bowls for these mixers may be provided with jackets to permit circulation of fluids to heat or cool the mixer contents. The mixing arms may also be made with internal passages to permit circulation of heating or cooling fluids.

Since mixers of this type are used in the production of many kinds of materials ranging from food products to aggressive chemicals, they are often fabricated to custom specifications from various stainless steels as well as from more exotic corrosion-resistant alloys.

**NEW SLANT ON MIXING**

Teledyne Readco took the double arm mixer a giant step forward with the design of heavy duty dual level models that offer a number of unique advantages. In the conventional double arm mixer, the two shafts on which the mixer arms turn are parallel and on the same horizontal plane. In the Readco dual level design, one shaft is raised to a higher level. Since the bowl conforms quite closely to the swept area of each mixing arm, fluid material in the bottom of the bowl beneath the higher arm can flow by gravity into the lower bowl area. This permits fluid material to be discharged conveniently from a single bottom port if desired. If this is done, tilting of the bowl and drive mechanism can be eliminated, reducing the mechanical complexity of the mixer.

More important advantages of this design include better retention of material within the mixing zone during operation, and a 50 percent greater mixing and jacketed area than conventional designs. These heavy duty mixers, which incorporate double-end drives to equalize the loads on the mixing arms, are available in working capacities up to 1,500 gallons with 400 horsepower motors. They are widely used in the production of food products, plastics, pigments, paints, printing inks and many other materials.

**THE BASICS OF MIXING**

Two of Teledyne Readco's more advanced products are high intensity mixers and continuous processors, but before describing them it may be of interest to understand just what physical processes occur in highly-efficient mixers and how they are used in practical manufacturing situations.

In the simple case of mixing two or more liquids of similar viscosity, such as motor oils, the process is little more than stirring or agitating the material until the molecules of each liquid are evenly interspersed with the molecules of the others. When one liquid is much thicker than another, such as molasses and water, the problem is more difficult and most efficient mixing occurs when the thinner liquid is slowly added to the thicker during the mixing process. This keeps the viscosity of the mass at its maximum until the mixing process is complete. The importance of this factor is explained below.

Another frequently required task for mixing equipment is dispersing of one material, such as a powdered solid, throughout another such as a viscous liquid. An example of this is the mixing of pigment into thick liquid plastic resins. Proper dispersion requires that the particle size of the solid material be reduced as much as possible in the mixer. Since these solid particles tend to clump together, high shearing forces caused in the mass by high input power levels help to rub and tear these clumps apart. This process is called deagglomeration. Shearing forces increase with the viscosity of the mass and the amount of input power applied by the mixer motor. Close clearances between the moving and stationary parts of the mixer also contribute to these effects as local areas of the mass are alternately compressed, expanded and stretched in the mixing process. Many different impeller shapes have been developed to create these effects in various materials of differing viscosities.

Practical experience has shown that higher shearing forces will reduce the size of the particles more, but that simply mixing the mass longer at lower shearing forces will not necessarily do so. This means that the mixer must be properly sized and powered to do the specific job for which it is intended, if efficient processing is to be achieved.

In some industrial processes, a large volume of solid particles must be coated with a smaller volume of liquid material. Known as particle coating, this process is actually a specialized case of dispersion that presents little problem for properly-designed mixers. An example of this type of process is the preparation of powdered soft drink mixes.

Mixers are also frequently used for carrying out other simple physical changes in materials. Dissolving a solid in a liquid is one such common use. Drying or devolatilizing substances is another. This latter process is often carried out under vacuum with the mixer used to constantly expose fresh surfaces of the material to the vacuum for efficient drying.

**THE MIXER AS A REACTOR**

One other very wide use of mixing equipment is in carrying out various types of chemical reactions. Since chemical reactions involve the making or breaking of molecular bonds between the reacting substances, often in the presence of a catalyst, many reactions proceed more rapidly and to greater completion if the materials are stirred and agitated to constantly bring fresh unreacted molecules into close contact. Many of these reactions also require control of temperatures and pressures, and sealed, jacketed mixers are frequently used. Mixers designed for these purposes actually act as chemical reaction vessels and are built to custom specifications.

Polymerization, the reacting together of various organic molecules known as monomers, to form long chain-like molecules called polymers, is the important process by which many plastics are made. Some polymerizaton reactions can be carried to completion in heavy duty mixers so little or no further processing is required to produce the finished material.

**INCREASING THE INTENSITY**

The need to thoroughly mix extremely viscous and even solid materials such as rubber and plastic pellets led Teledyne Readco to the development of its line of high intensity mixers. These machines are characterized by comparatively small mixing volume with exceptionally high power drives. The smallest model which has a mixing capacity of less than a half gallon of material (about the capacity of a large kitchen mixer) is powered by a 25 horsepower electric motor. The largest version which is 35 feet long, 29 feet high and 16 feet wide uses a 1,500 horsepower motor to mix a maximum load of about 160 gallons.

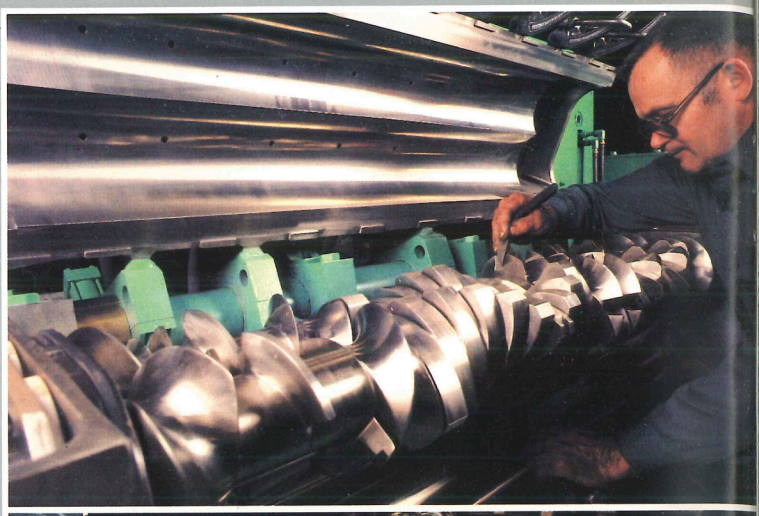
The design of these high intensity mixers is entirely different from that of the mixers described so far. Pairs of precisely-machined lens-shaped agitators rotate on parallel shafts in a chamber shaped like a figure "8" lying on its side. Clearance between the tips of these rotors and the mixing chamber wall is as small as one-fiftieth of an inch. A similar clearance also exists between the tips of each rotor and the side surfaces of its adjacent mate. The geometry is such that the rotor tips wipe the surface of the chamber wall twice during each revolution. Likewise, the faces of each rotor are wiped once each revolution by the tips of the adjacent rotor. This self-cleaning action eliminates dead spots in the mixing chamber and greatly increases the heat transfer between the chamber walls and the material being mixed.

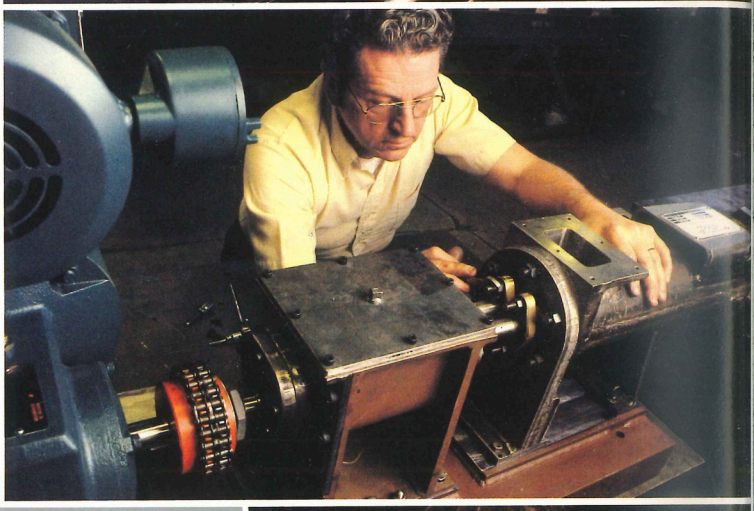
**HIGH SHEAR AND FAST MIXING**

Two pairs of these rotors are mounted side by side on the shafts with their tips oriented at 90° to each other. During the mixing operation the material is alternately compressed and expanded by the changing volumes created around each pair of meshing rotors. This compression of the material, which forces it through the very small clearances in the chamber, results in the very high shear rates needed for thorough and efficient high viscosity mixing. At the same time the helically-ground face of each rotor forces the material back and forth from one end of the chamber to the other to assure complete uniformity of the mix.

STARCH
PIGMENTS
RESINS
PLASTICS
WOOD FILLER
PEANUT BUTTER
SUGAR
DYES
CLAY
COOKIE DOUGH
FERTILIZERS
PAPER COATINGS
RUBBER CEMENT
MODELING CLAY
MALTED MILK BALLS
BATTERY PASTE
NITROCELLULOSE
PENCIL LEADS
PAPER PULP
CERAMIC MATERIALS
CATALYSTS
POLYSTYRENE
CARBON PASTE

This intricate continuous processor is designed specifically for mixing the ingredients of smokeless gunpowder. The close-fitting, finely machined housing that closes down over the rotors can be seen tilted up across the back of the machine.



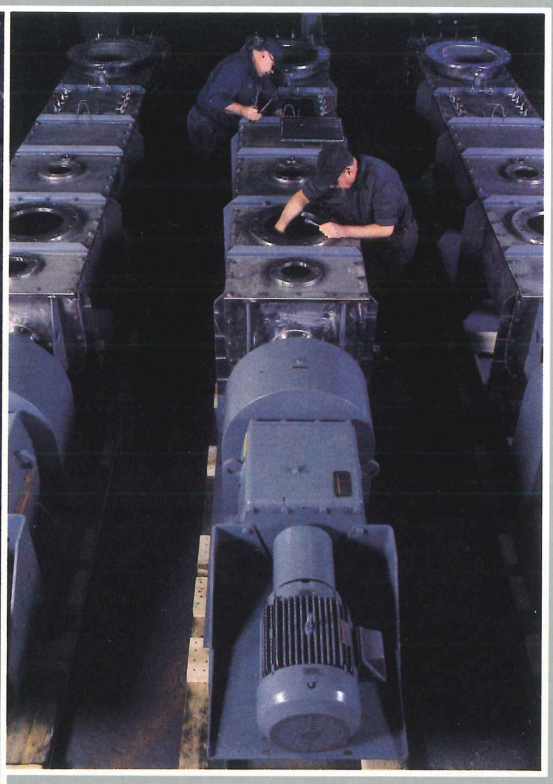


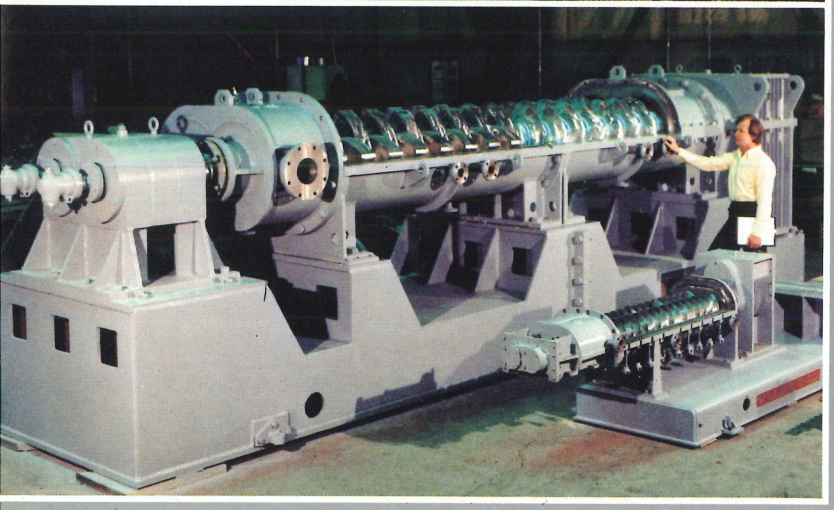
Above Center: Smaller continuous processors such as this one with two-inch rotors are used to thoroughly mix products ranging from foods to plastics.

Above Bottom: The scale of Readco's larger continuous processors can be judged from this screw section and double mixing paddle for a 24-inch machine.

The helical design of the inner and outer impellers of this continuous ribbon mixer creates a counterflow folding action that can thoroughly mix light powders and low viscosity liquids in a short time.

These large continuous mixers, being readied for shipment, will be used in chemical manufacturing processes by a large petrochemical company.





This 24-inch Readco continuous processor and the 8-inch model beside it were made for use in manufacturing synthetic fibers. When installed, the smaller unit is mounted atop the larger unit to premix the raw materials and discharge them directly into the larger processor.

Both high density and low viscosity materials can be mixed efficiently with these units. With some materials, such as pigments, the Readco high intensity mixers have reduced mixing time from 10 hours down to 15 minutes. Interestingly, even tough solid materials such as plastics, rubber and asphalts can be made into a completely uniform mix in as little as 30 seconds.

**MIXING WITH RIBBONS**

At the opposite end of the mixing spectrum from high intensity mixers is Teledyne Readco's line of ribbon mixers. These are typically used to mix large volumes of much lighter, low viscosity materials. Dry, granular or powdered solids can be mixed as can liquids, or combinations of dry and liquid materials. The agitator configuration of these mixers consists of long thin metal bands or ribbons arranged in helical fashion at the ends of spokes on a central rotating shaft. This shaft turns in a "U" shaped trough that forms the mixing bowl. The ribbons may be interrupted into separate sections curved in opposite directions. This causes a counterflow action within the mixer that moves material back and forth on itself with a folding action that results in very thorough blending in a short time.

These mixers, which are made in capacities up to 650 cubic feet, are widely used in mixing powders and liquids for pharmaceutical products, plastics, fertilizers, cosmetics, powder metallurgy, catalysts, tobacco products, soaps, ceramics, paper coatings and food products.

**CONTINUOUS PROCESSING**

The mixers we have described so far are known as batch mixers. A measured quantity of each ingredient is added to the mixer which is then operated until the mass is uniform or the desired reaction has taken place. The mixer is then emptied, cleaned and reloaded for another batch. This is desirable for many applications in which ingredients are changed frequently to make different products. But for others, where the same ingredients are used to make one product for long periods, continuous processing can have advantages. Among these are higher volume production, lower manpower requirements and better utilization of equipment.

Teledyne Readco introduced a unique line of continuous processors in the early 1960s. These were the first Readco products to use the highly-efficient lens-shaped agitator design described on page 5 under the sub-head "Increasing the Intensity." In the continuous processor, however, the parallel shafts on which the agitator blades are mounted and the closefitting figure "8" shaped mixing tube are much longer and can accommodate a long series of specialized blades. In a typical continuous processor, the feed materials are metered into an opening at one end of the long horizontal mixing housing. The first blades they encounter are screw-shaped impellers that force the material down the mixing tube. These may be followed by several sets of flat lens-shaped blades that have very strong mixing and shearing action but no conveying action. Next may come sets of helical-surface lens-shaped blades that give moderate mixing action combined with moderate conveying action. The helical blades may be mounted so that they either propel the mixture through the tube or force it back toward the inlet end. This counterflow arrangement may be used to increase the length of time the material stays in the mixing zone.

**A PROCESSOR FOR ALL REASONS**

The sequence and arrangement of these agitators can easily be changed by the user of the processor to custom tailor the intensity and duration of the mixing to suit the specific material being produced. Once the mixer is started, properly mixed product is continuously discharged from the end of the mixing tube as long as feed materials are provided.

The same advantages attributed to high intensity mixers also apply here: self-cleaning action, strong compression and expansion of the mass, and high shear properties with viscous materials. Powders, granules, pastes and liquids can be continuously metered into the feed hopper, and other liquids can be added through injection ports at various points along the mixer body to achieve specific mixing sequences.

Readco continuous processors are made with agitator diameters ranging from 2 inches to 30 inches, and with drives of 2 to 1,000 horsepower. Typical hourly output for a 5 inch diameter model with a 36 inch mixing tube and a 10 horsepower drive motor would be 900 pounds of very stiff cookie dough, 1,200 pounds of donut batter, 600 pounds of epoxy resin with filler and catalyst, 400 pounds of smokeless powder, or 4,000 pounds of lead/acid storage battery paste.

**CONTINUOUS MIXING**

Teledyne Readco also manufactures continuous mixers using the helical ribbon design described on page 8 under the sub-head "Mixing With Ribbons." These mixers are much longer—up to 18 feet in the 36 inch rotor diameter size—and like continuous processors will accept an uninterrupted stream of materials at one end and discharge a uniformly blended product at the other. They are constructed with a two-section continuous helical inner ribbon and a multiple section broken outer ribbon. The two sections of the inner ribbon convey material from the center of the mixing zone toward the ends, while the outer ribbons convey it toward the center. This counterflow motion results in a folding action that mixes ingredients in a very short time. An adjustable weir at the discharge end of the mixer controls release of the mixed product and affects retention time in the mixer.

Such Readco mixers are widely used in processing foods, chemicals, plastics, ores, fertilizers and other products.

**PROVING GROUND FOR MIXING**

Since so many different types of products are processed in Readco mixers, and since each application is unique, Teledyne Readco maintains and operates a complete testing laboratory for the use of its customers. In this lab, full-scale production-size mixers and continuous processors of all types made by the company are available for running tests using the customer's own ingredients. A staff of experienced application engineers works in cooperation with customer representatives to carry out these tests. The results not only serve to demonstrate the capabilities and advantages of Readco equipment, but also help the customer choose the proper type and size of equipment for his specific needs.

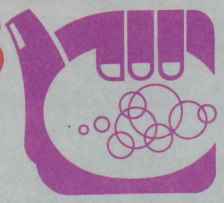
**MIXING FOR THE FUTURE**

Though industrial mixing equipment has been manufactured for a long time, the technology is still developing. Teledyne Readco is actively involved in improving mixer design and furthering the understanding of mixing physics, as well as exploring new uses for mixing equipment. The company has done development work, for example, on a special evaporator design that can efficiently remove water from dilute radioactive waste, greatly reducing its volume. The evaporator then feeds the concentrate into a Readco continuous processor where it is mixed with cement, asphalt or other agents for solidification. The system is designed for continuous operation, simple cleaning and easy decontamination if maintenance is required. These and other advantages over competing methods may make it helpful in solving the worldwide problem of nuclear waste management.

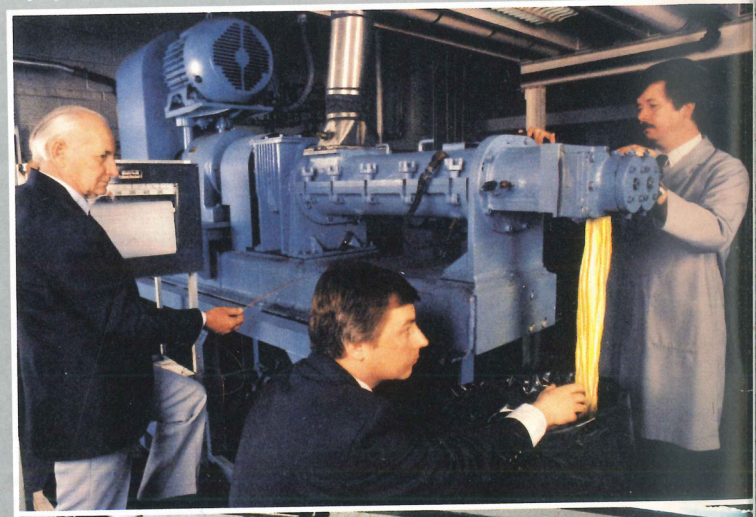
The company's ongoing research interests include adapting its continuous processors to the baking industry. While some continuous processors are used to make specialized doughs and batters, the bulk of baked goods dough production is still done in large batch mixers. Attempts at using continuous processors to make baked goods have in some cases resulted in changes in the finished products. If the reason for these changes can be understood and the results controlled, continuous processors may be able to further increase bakery production and efficiency.

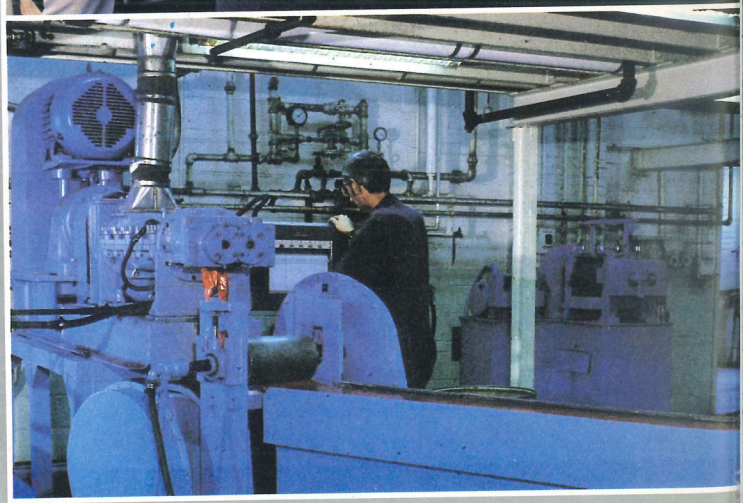
The technology of mixing is an art as well as a science and Teledyne Readco is well versed in both.

GRASS SEED MIXTURES
CELLULOSE ACETATE
MATCH COMPOUNDS
CORN PRODUCTS
CANDY BARS
MEDICINES
CHOCOLATE
GLUTEN PRODUCTS
EPOXY POWDERS
COLOR DISPERSION
METAL POWDERS
SOAPS



Full-scale production-size mixers and processors, as well as experienced application engineers, are available at Teledyne Readco's laboratory for customers to use in running mixing tests with their own ingredients. This service helps customers choose the proper type and size mixing equipment for their specific needs.





Extremely fine powdered pigments and resins are mixed with Readco continuous processors for use in coating metal parts. These dry powders, electrostatically sprayed on parts and then fused with heat to form a durable, attractive finish, eliminate the air pollution associated with the use of solvent-based paints.

## TELEDYNE, INC. AND SUBSIDIARIES

### Consolidated Statements of Income

*(In millions except per share amounts)*

| | Three Months Ended June 30, | | Six Months Ended June 30, | |
|---|---|---|---|---|
| | *1982* | *1981* | *1982* | *1981* |
| **Sales** | **$737.3** | $828.5 | **$1,523.1** | $1,634.5 |
| **Costs and Expenses:** | | | | |
| Cost of sales | **551.6** | 610.4 | **1,136.0** | 1,208.8 |
| Selling and administrative expenses | **102.2** | 94.2 | **206.7** | 191.3 |
| Interest expense | **8.0** | 6.2 | **14.8** | 12.9 |
| Interest and dividend income | **(16.1)** | (10.5) | **(30.2)** | (20.4) |
| Provision for income taxes | **37.5** | 61.2 | **83.7** | 116.0 |
| | **683.2** | 761.5 | **1,411.0** | 1,508.6 |
| **Income of Consolidated Companies** | **54.1** | 67.0 | **112.1** | 125.9 |
| **Equity in Net Income of Unconsolidated Subsidiaries** | **23.6** | 53.6 | **56.8** | 92.1 |
| **Net Income** | **$ 77.7** | $120.6 | **$ 168.9** | $ 218.0 |
| **Net Income Per Share** | **$3.76** | $5.84 | **$8.18** | $10.55 |

### Consolidated Balance Sheet

*(In millions)*

| | *June 30, 1982* |
|---|---|
| **ASSETS** | |
| **Current Assets:** | |
| Cash and marketable securities | **$ 597.0** |
| Receivables | **387.2** |
| Inventories | **150.9** |
| Prepaid expenses | **6.5** |
| Total current assets | **1,141.6** |
| **Investments in Unconsolidated Subsidiaries** | **1,345.7** |
| **Property and Equipment** | **384.6** |
| **Other Assets** | **33.7** |
| | **$2,905.6** |
| **LIABILITIES AND SHAREHOLDERS' EQUITY** | |
| **Current Liabilities:** | |
| Accounts payable | **$ 128.8** |
| Accrued liabilities | **246.6** |
| Current portion of long-term debt | **53.3** |
| Total current liabilities | **428.7** |
| **Long-Term Debt** | **576.0** |
| **Other Long-Term Liabilities** | **194.8** |
| **Shareholders' Equity** | **1,706.1** |
| | **$2,905.6** |

# Review

### QUARTER AND FIRST HALF RESULTS

Net income was $77.7 million or $3.76 per share for the quarter ended June 30, 1982 compared to net income of $120.6 million or $5.84 per share for last year's second quarter. Sales were $737.3 million for the second quarter of 1982 compared to $828.5 million in the 1981 period.

For the six months ended June 30, 1982, net income was $168.9 million or $8.18 per share compared to $218.0 million or $10.55 per share for the same period of 1981. Sales for the six months were $1.52 billion compared to $1.63 billion for the first half of 1981.

The use of equity accounting for certain investments of unconsolidated subsidiaries increased net income by $13.3 million or $0.65 per share for the second quarter of 1982 compared to $29.3 million or $1.42 per share for the same period of 1981. For the six months ended June 30, 1982, equity accounting increased net income by $30.5 million or $1.48 per share compared to $43.6 million or $2.11 per share for the same period of 1981.

Economic conditions adversely affected sales and earnings of many product lines, particularly in specialty metals and in industrial and aircraft engines. Earnings from oil service activities were also lower. The decline in equity in net income of unconsolidated subsidiaries was due primarily to deterioration in underwriting results of the casualty insurance companies, as well as the inclusion in 1981 results of the $15.6 million of equity in Curtiss-Wright Corporation's gain on sale of its Dorr-Oliver subsidiary and its interest in Kennecott Corporation.

There were 20,657,531 average shares of common stock outstanding during all periods presented.

### COMPACT COPIER FOR ENERGY EXPLORATION

Teledyne Rotolite recently introduced a new whiteprinter which greatly enhances dissemination of information vital to companies engaged in the search for new energy sources.

The Logger™ whiteprinter is specially designed for field use. It makes blueline and blackline diazo copies of seismic charts up to 15" wide by any length. With the Logger, oil well log charts may be duplicated on site.

Logger is the only compact fluorescent tube log copier available. This economical printer requires no external ventilation of ammonia, heat or ozone as do other copiers. The compact 12" x 10" x 26" Logger may be wall mounted or used on a table.

### THERMOELECTRICS FOR CATHODIC PROTECTION

Late in 1983, 11 cathodic protection stations along the Algerian national oil company's Tinfouwe-Hassi Mesad gas pipeline in northeastern Algeria will be outfitted with TELAN® thermoelectric generator systems built by Teledyne Energy Systems.

A small amount of the transported gas from the pipeline will be used to generate heat which is converted directly to electricity in the Teledyne solid-state TELAN generator system. The electrical current is then applied to the piping to counteract the natural galvanic action between pipe and earth, thereby minimizing induced corrosion.

The company will supply 528 standard 80-watt TELAN units for the cathodic protection function plus a 60-watt unit for control power at each station.

Teledyne Japan K.K. obtained this power system contract from a major Japanese petrochemical engineering company. Deliveries are scheduled in February and August of 1983.

Teledyne Energy Systems recently completed delivery of TELAN thermoelectric power systems for the Abu Dhabi National Oil Company.

### TELEDYNE MEC RECEIVES AWARD FROM NAVY

Teledyne MEC, a leading manufacturer of traveling wave tubes (TWTs), recently received an Excellence award from the U.S. Navy for its role in the Aegis program.

Aegis is a term from Greek mythology referring to a goatskin shield used to protect Zeus and his wife. Today, Aegis is the name given to another "shield," a complex shipboard defense system which forms a radar net of protection for Navy fleets deployed worldwide.

Teledyne MEC's role in the Aegis program is to produce the electron tubes, known as driver TWTs, for the system which is capable of detecting multiple threats against our ships at sea.

### NEW COMPUTER BY TELEDYNE SYSTEMS

Teledyne Systems has developed a new airborne, militarized computer that is compact, light weight and has lower power consumption.

The product of a two year development program, which culminated recently with verification testing by the U.S. Air Force, the TDY-750 Standard Computer series has been designed to encompass a full range of avionics, ground system and space applications.

Additional developments have focused on fault tolerant and multiprocessor architectures. Current program activities include processors with capabilities of over 100,000,000 operations per second and redundant configurations with seven to ten year operational lives.

### TARGET OPERATION CONTRACT FOR AIR FORCE AND NAVY

Teledyne Ryan Aeronautical has been selected to conduct target operations for the U.S. Air Force and Navy at specified overseas locations.

The contract calls for the operation and maintenance of the Remotely Piloted Vehicle Facility at Wallace Air Station, Republic of the Phillippines in support of Air Force training activities. Similar target operations will also be conducted for the Navy at Wallace, as well as at Diego Garcia, Okinawa and afloat in support of fleet operations.

Under a separate contract, Teledyne Ryan Aeronautical also performs target operations at the U.S. Army's White Sands Missile Range in New Mexico. The company has developed a complete family of aerial targets and has produced over 6,300 of its famed Firebee targets. Firebees have flown more than 30,000 operational missions.

This **Teledyne Report** explores the mixing and processing capabilities of production machinery manufactured by Teledyne Readco.

The company manufacturers a broad line of mixing equipment that fills a wide spectrum of commercial and industrial needs. Literally hundreds of everyday products ranging from foods and pharmaceuticals to plastics and rubber products are mixed with Teledyne Readco machinery. The equipment ranges in capacity from simple lab mixers to giant continuous processors capable of handling 400,000 pounds of material in an hour.

The Teledyne Readco line includes single and double arm mixers, high intensity mixers that turn high viscosity materials such as plastics and rubber into a uniform mix in a few minutes, ribbon mixers and advanced high volume continuous processors. With over 75 years experience in building mixing equipment, Teledyne Readco is a leading force in this industry.

Teledyne Report features subjects of particular interest from Teledyne activities and is issued on a quarterly basis. Previous topics include:

**Aircraft Ground Support:**
Saving the airlines millions.

**Turbine Engines:**
Smaller in size and cost.

**Heating Water:**
For health and home.

**Relays:**
Thriving in an ultraminiature world.

**Truth in Radiation:**
A matter of accurate measurement.

**Remotely Piloted Vehicles:**
Those ingenious flying machines.

**Mining Tungsten:**
From glowing ore to versatile metal.

**Hi-Fi:**
Music reproduction goes hi-tech.

**Columbium:**
Superconductivity to computers.

**Energy:**
Fueling spaceship earth.

**Radar:**
Sensing the unseeable.

**Fluid Power:**
Muscle for machines.

**Pipeline Controls:**
Operating petroleum pipelines.

**The Aerospace Metals:**
Superalloys and titanium.

**Screw Threading:**
Machine tools for industry.

**Urban Waste:**
Recovering energy and materials.

**Aerial Mapping:**
Advanced digital techniques.

**The Water Pik Story:**
Innovative consumer product designs.

**Dental Health:**
Supplies for the dentist.

**Space Navigation:**
Computers that guide space launches.

**Analytical Instruments:**
Chemical detection for industry.

**1776-1976:**
Technology then and now.

**Life Insurance:**
Financial security and investment.

**The Refractory Twins:**
Producing tungsten and molybdenum.

**The Instrument Makers:**
Instruments and optical encoders.

**Industrial Engines:**
Small piston engines.

**Job Corps:**
Teaching young people.

**Friendly Explosives:**
Aircraft emergency escape systems.

**Microelectronic Hybrids:**
The step beyond integrated circuits.

**The Energy Options:**
Nuclear fuel versus coal.

**Workman's Compensation:**
Extending the coverage.

**Drilling for Offshore Oil:**
Getting the oil out.

**The Search for Oil:**
Finding new oil deposits.

**High Speed Steels:**
Premium alloys for machine tools.

**Energy Crisis in the Computer Room:**
Controlling power quality.

**Raydist:**
Super-precise radiolocation system.

**Welding:**
Advanced alloys for joining metals.

**General Aviation Engines:**
Piston power for aircraft.

**Rubber:**
Products for automobiles and industry.

**Loran:**
All-weather navigation system.

**Seismology:**
Instruments for earthquakes.

**Casting:**
Precision production of metal parts.

**AIDS:**
Monitoring commercial aircraft.

**Thermoelectrics:**
Conversion of heat to electricity.

**Thin Metals:**
How they are made and used.

**The Reproduction of Music:**
Speakers for high fidelity sound.

**The Crowded Spectrum:**
Technology of traveling wave tubes.

**Science and Cinematography:**
Motion pictures for scientific analysis.

**Superalloys:**
High temperature metals.

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