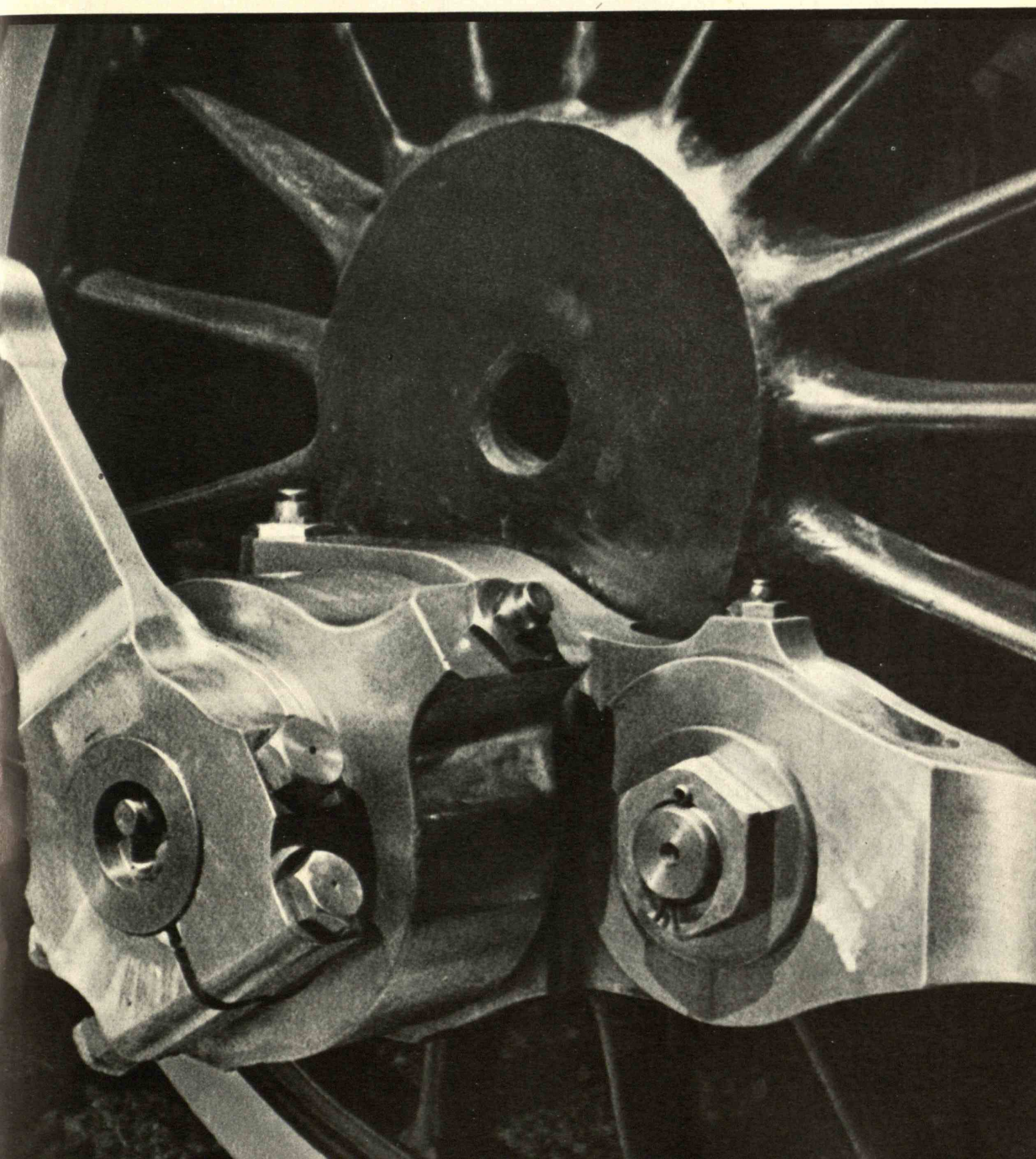
November 1935

TECHNOLOGY REVIEW



From 1900 up to 1934 the leaf tobacco used for cigarettes increased from

13,084,037 lbs. to
326,093,357 lbs.;

an increase of 2392%

. . .

There is no substitute for mild, ripe tobacco.

United States Treasury Building

During the year ending June 30, 1900, the Government collected from cigarette taxes

$3,969,191

For the year ending June 30, 1934, the same taxes were

$350,299,442

an increase of 8725%

—a lot of money.

. . .

Cigarettes give a lot of pleasure to a lot of people.

More cigarettes are smoked today because more people know about them—they are better advertised.

But the main reason for the increase is that they are made better—made of better tobaccos; then again the tobaccos are blended—a blend of Domestic and Turkish tobaccos.

Chesterfield is made of mild, ripe tobaccos. Everything that science knows about is used in making it a milder and better-tasting cigarette.

We believe you will enjoy them.

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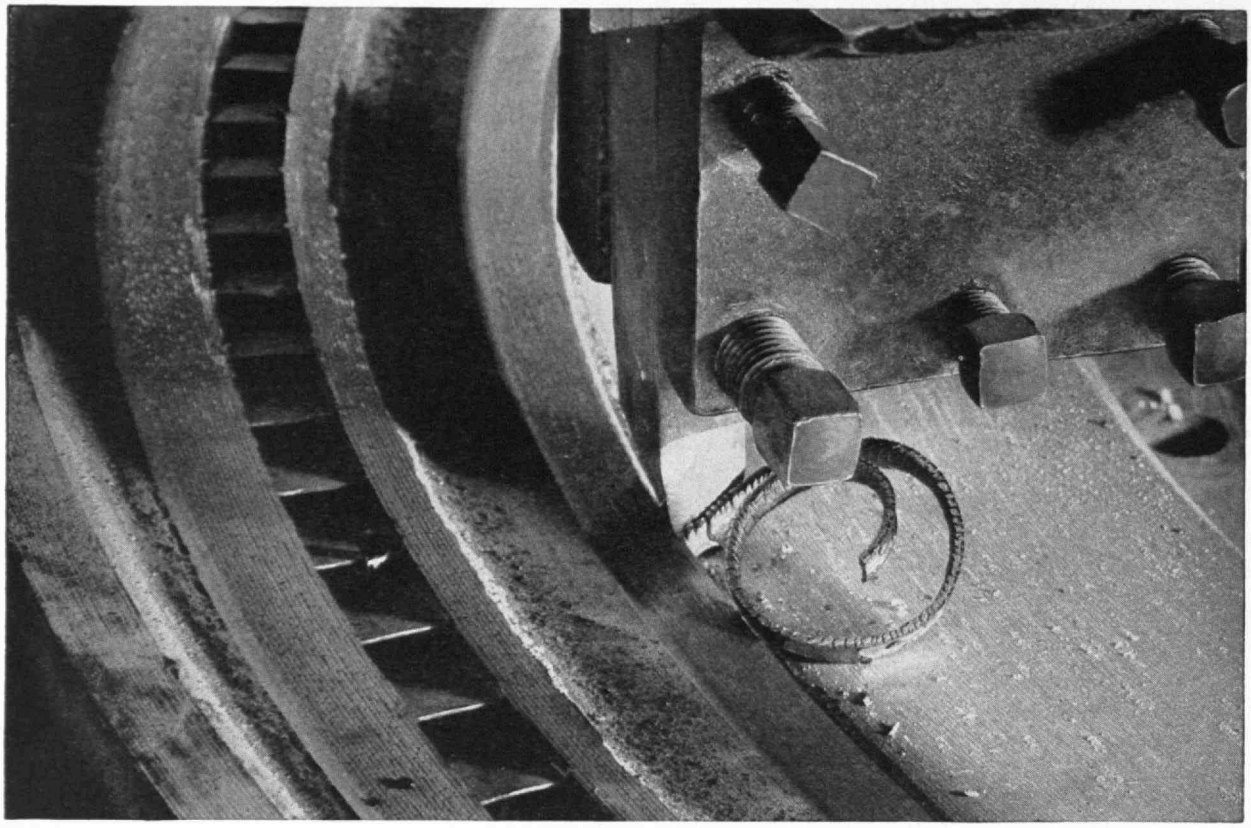
THE TABULAR VIEW

PROFESSOR D. C. JACKSON, a former President of the American Institute of Electrical Engineers and for many years Head of the Department of Electrical Engineering at the Institute, is now in Japan, for the purpose of delivering a series of lectures under the auspices of the Iwadare Foundation by invitation of the Institute of Electrical Engineers of that country. He continues as a special lecturer and Professor Emeritus at Technology.

A YACHTSMAN and navigator by avocation only, R. D. FAY, '17, is Associate Professor of Electrical Communications here at the M.I.T. When Professor Fay received a hurried call this past summer to sail at once for England to take over the duties of navigator on the *Yankee*, he was confronted with a sartorial dilemma. Having always felt that he could sail a boat as well in dungarees as in gold braid, he realized, nevertheless, that to abide by the best tradition of the Cowes regatta, he should obtain a uniform. The Nahant Dory Club, of which he is a member, was, therefore, called upon in great haste to select and authorize an outfit that would be appropriate. This incident recalls another of Professor Fay's encounters with Dame Fashion, on the occasion of the last America's Cup trial races. Professor Fay threw Newport's nose violently out of joint when he appeared in "nautical trousers," about the color, as a Boston newspaper put it, "of the State House brick, and made of duck." "I bought these on the Mediterranean," explained Professor Fay, ensconced in said pants. "They are a Breton fisherman's outfit. I was looking for a blue pair, and this is what happened. Last summer I wore them in a race up at North Haven, Maine; and the boat, which had never won a race, came in first. I decided right then and there that these were racing pants." ¶ The Science Advisory Board, of which President KARL T. COMPTON is Chairman, is issuing this fall its second report on the relations of science to the activities of the Federal Government. Dr. Compton's article on page 57 is drawn from his annual report to the Technology Corporation.

THE book review on page 50 was contributed by FREDERICK G. FASSETT, JR., Assistant Professor of English at the Institute. Professor Fassett teaches an option of freshman English which offers men on the staffs of undergraduate publications at M.I.T. an opportunity to study the technique of newspaper and magazine journalism. As a result of this course, the quality of undergraduate publications has notably improved. ¶ The Review acknowledges the helpful assistance of Professor JOSEPH H. KEENAN, '22, of the Department of Mechanical Engineering in the preparation of the article (page 43) on the competition between steam and Diesel power. ¶ Beginning with this issue, The Review, as a result of a donation covering the cost, goes to some 500 teachers of science throughout the country. The Editors would appreciate any suggestions these teachers may have for making The Review more useful to them.



FROM STONE TO STEEL

THOUSANDS of years ago, a skin-clad workman pounded away with a cobblestone on a slab of hard rock. In a few years, that slab might be passably square and smooth.

Today, busy machines, supervised by trained workmen, pare off crisp, curling ribbons from whirling blocks of steel, as one would unwind ribbon from a spool, shaping the metal to a thousand purposes — to an accuracy within a few ten-thousandths of an inch.

CARBOLOY — a modern tool material developed by General Electric research — has made possible this speed, this precision. It cuts materials hitherto unworkable — cuts faster and holds its edge longer than steel tools — can be run at red heat without losing its temper.

CARBOLOY is only one of the contributions made to improved industrial processes by G-E research—research that has saved the public from ten to one hundred dollars for every dollar earned for General Electric.

96-188DH

GENERAL ELECTRIC

DEPARTMENT STORE IMPROVES HEATING BY MODERNIZATION

Daytons, Minneapolis, Uses Webster Moderator System To Control Temperatures

HEATING PROBLEM SOLVED

Modernization Equally As Effective in Scores of Similar Buildings

REMOVES OLD COMPLAINTS

Minneapolis, Minn.—The Dayton Department Store—one of the largest retail stores in the entire northwest is securing remarkably improved heating service as the result of a Webster Heating Modernization Program carried out in the fall of 1931.

For four years, through some of the coldest winters in Minnesota history, the Webster Moderator System has given the Dayton Store complete "Control-by-the-Weather."

Modernization of the Dayton Company buildings, which consisted in changing the mixed vacuum and gravity system to full vacuum operation, was completed without interrupting store operations.

The buildings vary from three to ten stories in height and have a total floor space of 500,000 square feet. Installation of the Webster Moderator System was made by the Belden-Porter Company, Minneapolis heating contractors.

Frequently, under the old system, certain portions of the store were underheated while others were too hot.

Since the application of modern central heating control to the Dayton Company buildings, temperature readings taken from a central location four times daily indicate that all store zones are perfectly heated even during the severest weather. Following is the record of a typical day, indicating how various departments are kept at the temperatures desired:

Temperature Record, Nov. 6, 1933

Floor	Dept.	10 a.m.	11 a.m.	12 M.	1 p.m.
Base.	Suits	68	69	70	70
Base.	Hardware	74	74	75	75
Main	Gloves	67	68	69	69
Main	Dress Goods	75	75	76	76
2nd	Infants	66	68	69	70
2nd	China	72	73	74	74
3rd	Dresses	68	69	70	70
4th	Victrolas	67	67	68	68
5th	Rugs	66	67	67	68
6th	Furniture	63	65	65	66
7th	Buyers' Office	75	76	76	76
	Outside	34	35	35	33

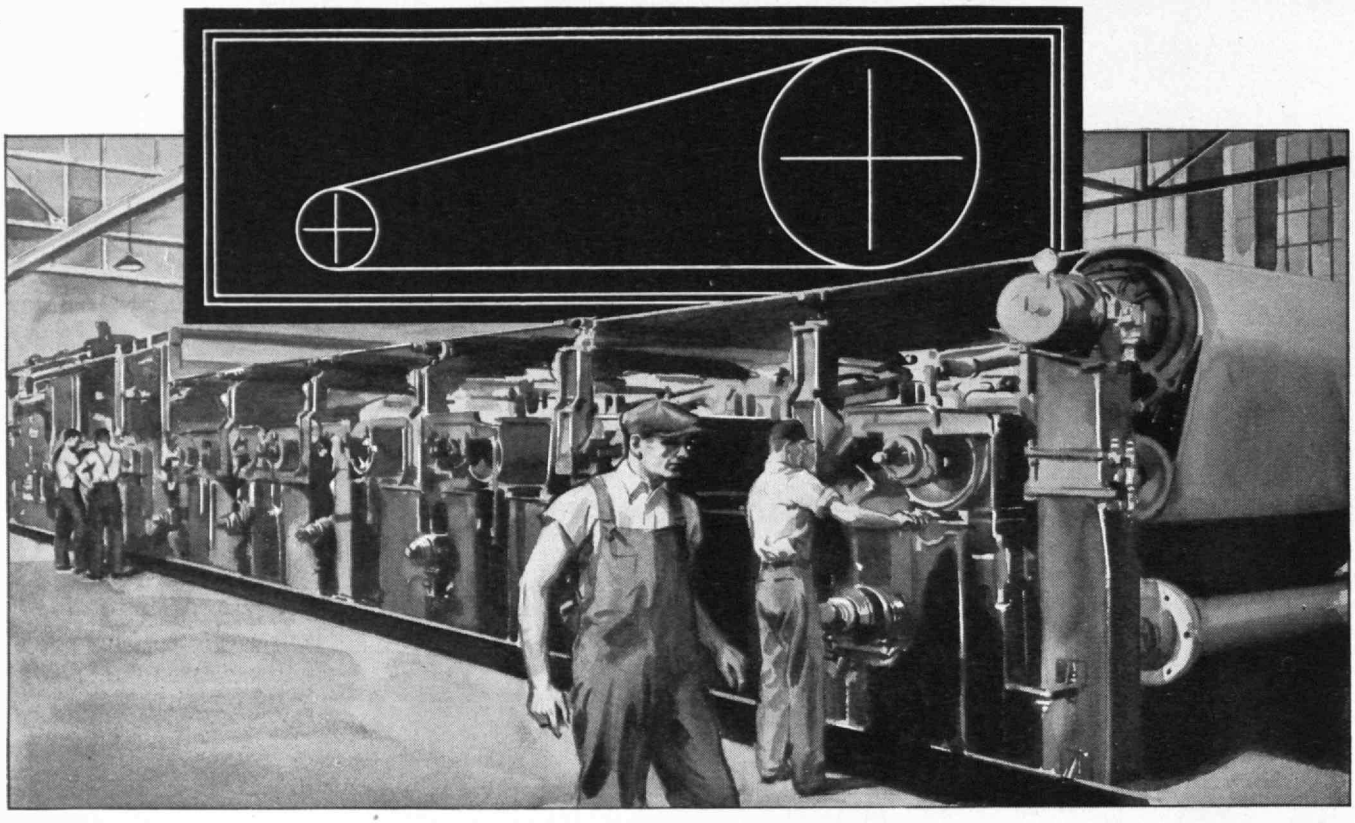
In a department store, well-balanced heating keeps merchandise in first-class condition and is a source of satisfaction to employees and customers.

Webster Heating Modernization has been equally effective in scores of other department store installations, among them the Donaldson Store, also in Minneapolis, with the Hineline Company acting as modernization heating contractors; the Golden Rule Store, in St. Paul, where the Frank Eha Heating Company made the installation; and the L. S. Ayres Department Store, in Indianapolis, with Hayes Brothers making the installation.

If you are interested in (1) improved heating service and (2) lower heating cost in your building, address

WARREN WEBSTER & CO., Camden, N. J.
Pioneers of the Vacuum System of Steam Heating
Branches in 60 principal U. S. Cities—Estab. 1888

NEVER OFF PULLEYS IN THREE YEARS



Goodyear COMPASS (Cord) Endless Belt eliminates costly breaks on paper machine

PAPER making is one business where nobody wants to get the "breaks." A break in the sheet going through the paper machine means a costly delay and wasted paper.

In 1932 that was the difficulty in a large eastern mill. Belt trouble was causing frequent breaks on No. 3 paper machine, despite the expenditure of considerable money to keep this particular belt in repair.

Then the G. T. M. — Goodyear Technical Man — arrived on the scene. He analyzed the set-up with his practical knowledge of belting requirements and specified a 24" Goodyear COMPASS "40" Endless Belt for this 200-horsepower drive.

The COMPASS cost only one-third as much as the belt it replaced — in fact, its price was just about what had been spent in repairing the other.

Has not stretched an inch

Installed in March 1932, this belt has never been off the pulleys. It has not even been necessary to touch the take-ups since the original adjustment for tension — and the belt shows no signs of wear!

But most important of all, COMPASS' smooth, speed-holding performance has greatly reduced the number of breaks in the sheet — *saving more than the belt's entire cost!*

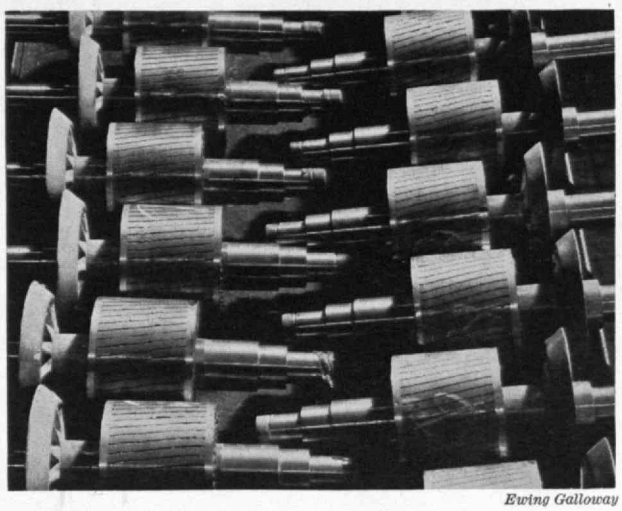
Money-saving performance like this is typical of all Goodyear Mechanical Rubber Goods because they are correctly designed for their job and correctly specified to it by the G.T.M. Let this qualified expert help you. A line to Goodyear, Akron, Ohio, or Los Angeles, California, or the nearest Goodyear Mechanical Rubber Goods Distributor, will bring him.

BELTS
MOLDED GOODS
HOSE
PACKING

MADE BY THE MAKERS OF GOODYEAR TIRES

THE GREATEST NAME IN RUBBER

GOODYEAR



Small induction motor rotors

Ewing Galloway

THE TECHNOLOGY REVIEW

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THE COVER

From a photograph by Alex. J. Krupy, '24

PUBLISHED MONTHLY FROM OCTOBER TO MAY INCLUSIVE AND IN JULY ON THE TWENTY-SEVENTH OF THE MONTH PRECEDING THE DATE OF ISSUE AT 50 CENTS A COPY. ANNUAL SUBSCRIPTION $3.50; CANADIAN AND FOREIGN SUBSCRIPTION $4.00. PUBLISHED FOR THE ALUMNI ASSOCIATION OF THE M. I. T. EDWARD L. MORELAND, PRESIDENT; MARSHALL B. DALTON, C. A. SAWYER, JR., VICE-PRESIDENTS; CHARLES E. LOCKE, SECRETARY; J. RHYNE KILLIAN, JR., TREASURER.

PUBLISHED AT THE RUMFORD PRESS, 10 FERRY STREET, CONCORD, N. H. EDITORIAL OFFICE, ROOM 11-203, MASSACHUSETTS INSTITUTE OF TECHNOLOGY, CAMBRIDGE A, MASS. ENTERED AS SECOND-CLASS MAIL MATTER AT THE POST OFFICE AT CONCORD, N. H. THREE WEEKS MUST BE ALLOWED TO EFFECT CHANGES OF ADDRESS. BOTH OLD AND NEW ADDRESSES SHOULD BE GIVEN.

From a photograph by John P. Mudd for The Midvale Company

Milling Grooves

"Tools of Tomorrow"

MACHINE tools create other machines and are the only machines that reproduce themselves. Their importance is, therefore, fundamental to our machine economy, and their improvement and rate of production offers an index to industrial prosperity. Last July, machine-tool production returned to the 1926 level, indicating increased manufacture of other types of machines, and last September the Machine-Tool Show in Cleveland revealed striking progress in machine-tool design.

In the past two years the broaching machine has become a mass-production unit of primary importance, completely revolutionizing many machining operations. One manufacturer has presented a group of eight basic units fundamental to all machine tools and shown how these units can be assembled in different combinations to form a series of machines. This achievement in flexibility is symptomatic of a wide trend away from highly specialized single-purpose tools.

"Mult-au-matic" machines capable of performing desired operations on many parts simultaneously are reducing manual feed and individual attention. "It is safe to say," wrote R. E. W. Harrison, chief of the Machinery Division of the Department of Commerce in the September issue of *Machine Design*, "that the mass production scheme of the future envisages the uses of a conveyor which will be nothing less than a series of jigs coupled together and indexed from machine element to machine element, the operations on the machine being automatically timed."

Mr. Harrison also foresees the use of the photoelectric cell in machining work, thus giving eyes to tools hitherto blind. Already, electrical and hydraulic controls have added to their dexterity, and new cutting alloys, such as the cemented carbides, to their speed. "Looking ahead," says Mr. Harrison, "we may expect to see heavier and more powerful tools with air-blast and coolant facilities so provided that limitations imposed by heat and friction will be removed . . . and last, but not least, the provision of automatic chip disposal facilities which will remove once and for all this hitherto serious limitation."

Truly, "we have only begun," as J. N. Leonard wrote in his beguiling "Tools of Tomorrow," "to explore the possibilities of machines. They have not yet approached their limits of efficiency or usefulness. . . . Fully automatic machines are the next step upward. They do not need to be fed, or started, or stopped."

THE
TECHNOLOGY
REVIEW

Vol. 38, No. 2 November, 1935

The Trend of Affairs

Steam vs. Diesel—With Notes on a New Steam Generator

AT the jubilee meeting of the British Association for the Advancement of Science in 1881, Sir Frederick Bramwell, then the *Pontifex Maximus* of the engineering world, delivered himself of this now famous forecast:

> I believe the way in which we shall utilize our fuel hereafter will be . . . not by way of the steam-engine. . . . I doubt whether those who meet here 50 years hence will then speak of that motor except in the character of a curiosity to be found in a museum.

Three years later, before the same Association, Lord Rayleigh joined the steam-engine Cassandra chorus with equal prescience:

> The efficiency of the steam-engine is found to be so high that there is no great margin remaining for improvement. The higher initial temperature possible in the gas-engine opens out much wider possibilities, and many good judges look forward to a time when the steam-engine will have to give way to its younger rival.

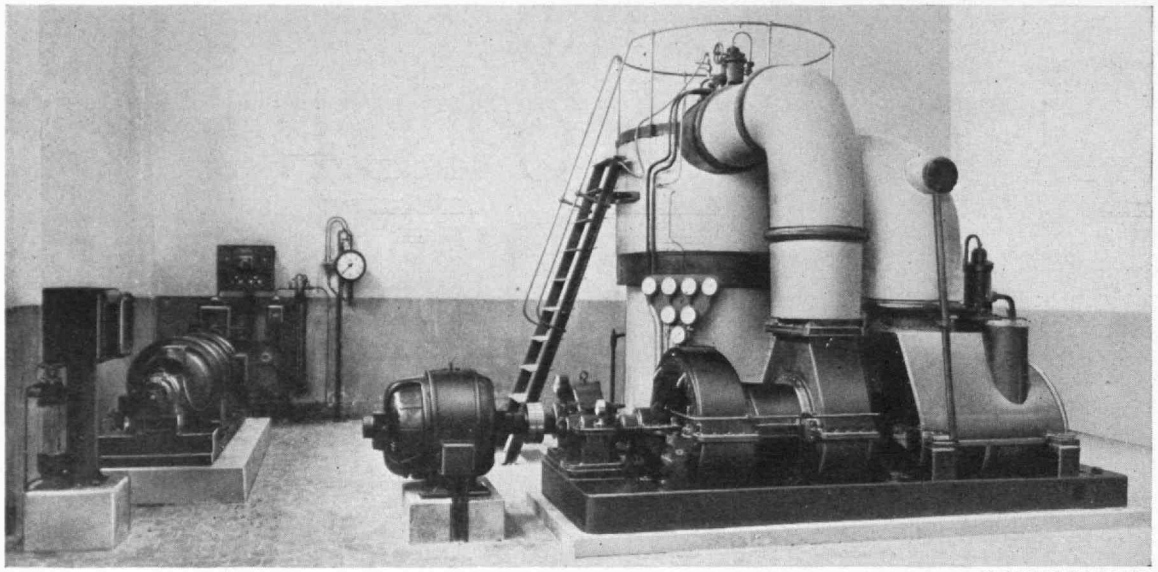
Shrewd as these men were in foreseeing the rapid development of the internal-combustion engine, they could hardly have chosen a more inauspicious time to inter the steam engine. While their prophecies were being recorded, Sir Williams Parsons was inventing the turbine, which, coupled with pressure and temperature increases and feed water heating by extraction, was to give steam such preëminence in large-scale power generation that when Bramwell's 50 years were up in 1931 only one and one-half per cent of the generating stations in his own country were powered by the internal-combustion engine that was to have relegated steam power to the museum.

WE rehearse this episode in prophetic fallibility, because the Diesel engine is prompting similar forecasts today. Steam is stalemated, repeat the oracles of internal combustion, and they probably are as mistaken today as Bramwell and Rayleigh were.

Spurred on by the progress of the Diesel and the increasing advantages of steam, the designers of steam-operated prime movers and generating apparatus are boldly and successfully exploring new possibilities of increasing steam's efficiency. They know that since 1919 coal consumption has been lowered in steam plants from 3.2 pounds per kilowatt hour to less than 1.65 pounds at present. They know that three distinct avenues of development promise higher efficiencies over a wider range of capacities: (1) the employment of higher pressures and temperatures now that metallurgists are supplying metals able to withstand the higher temperatures; (2) the use of binary systems such as the mercury-vapor plants at Schenectady, Hartford, and Kearny; (3) the study of a new type of boiler, with reduced space and weight requirements, in which fuel is burned under pressure and flue gases are given high velocities with a consequent increase in heat-transfer efficiency.

THE last of these, the velocity or "Velox" boiler, is the most immediately beguiling because of its novelty. Originated in Switzerland by Brown, Boveri and Company, it has caused a stir throughout the world of mechanical engineering and given a new direction to research in steam generation.

Ironically, this new boiler was inspired by the Diesel engine itself, and its apparent advantages make it a direct competitor with the Diesel. In speaking of its use in ships, its able inventor, Adolphe Meyer, recently said in the Calvin Rice ['90] Memorial Lecture as reported in *Mechanical Engineering:*



Mechanical Engineering

Velox power plant with self-contained super-heater. Note how the entire plant is combined into one unit, its compactness, and small size. The Velox offers possibilities for use on rail cars and it can be adapted to existing locomotives

The most important field of application for the Velox boiler is doubtlessly the ship. The small space requirements of this boiler and its low weight and high efficiency are of most value here, and the fact that it is essentially an oil-burning boiler is no drawback in most cases. In comparison with the Diesel engine, the Velox steam generator has the advantage that every kind of oil can be used, and there is no restriction as to the use of the more expensive gas and Diesel oils. The fuel consumption of the Diesel engine is, of course, lower than that of a Velox steam-turbine installation. The difference in price between Diesel oil and bunker oil is, in many countries, greater than the difference in fuel consumption, so that the fuel costs for a Velox are generally lower than those for Diesel engines. The Velox steam-turbine plant is also more favorable in regard to weight, except for long voyages where the excess fuel oil equalizes the weights in about 40 days steaming. The weight of a Velox steam generator is on an average one-fifth that of the ordinary oil-fired, water-tube boiler, and its space requirements, even compared with the most modern marine boilers, are less than half. Of great importance are its small height and the smaller dimensions of the flues and funnels. . . .

A fundamental difference between the Velox boiler and navy boilers [for warships] is that full load can be maintained continuously for any length of time with the same high efficiency as on part load. This efficiency amounts to between 88 and 90%, compared with 75% or less obtained with a forced ordinary boiler. The Velox boiler operates entirely automatically; the exhaust gas is completely invisible even at maximum output and has a low temperature. When steam is available from one boiler only, supplementary boilers can be brought from cold up to full load in less than five minutes.

By taking full advantage of the technical means offered by the Velox boiler, war vessels of hitherto unforeseen striking power may be built.

More than 20 Velox units have been built in Europe, in sizes ranging from four to 75 tons of steam per hour, for pressures up to 600 pounds per square inch and temperatures up to 850° F. The fundamental plan of all these units is as follows: Combustion air is compressed by a blower (this blower being driven by a gas turbine operated by the boiler's own flue gas) into a combustion chamber at a pressure of 28 to 30 pounds per square inch absolute and burned at this pressure. The subsequent pressure drop of the flue gases imparts to them a velocity which yields a high rate of heat transfer.

Because of its high combustion-chamber output, the Velox, it is claimed, requires only one tenth or even less of the space required for the combustion chamber of an ordinary boiler. No refractories are used; the combustion chamber is entirely lined with water tubes. Water level, fuel supply, and combustion are all automatically regulated. These features recommend its use not only for ships, but for locomotives and for power stations and industrial services where gaseous or liquid fuel can be obtained cheaply.

Other advantages and features reported by Dr. Meyer include: *Higher Efficiency.* With oil firing and for stationary and merchant-marine boilers, the boiler efficiency, that is, the degree of heat utilization, amounts to 94 to 96%. The plant efficiency, including all auxiliary machinery except the boiler feed pumps, is 90 to 93%. For gases of poor quality or for naval and locomotive boilers, which on account of further reduction in weight have smaller preheaters, the efficiency is 2 to 3% lower. The efficiencies remain practically constant from one fourth to full load. All efficiency figures are based on the lower calorific value of the fuel.

Automatic Control. The load can be increased from one-fourth to full load in from 12 to 40 seconds without any appreciable pressure drop, and unloading can occur over the same range without blowing the safety valve.

Rapid Starting. As a result of the small masses involved, the absence of refractory brickwork, and the positive supply of fuel and combustion air, the Velox boiler can be brought from a cold condition up to full load in four to eight minutes, depending upon the size and loading capacity of the auxiliary motor.

Small Space Requirements. The necessary floor space, including adequate room for operating and erecting purposes, required, for example, for a boiler rating of