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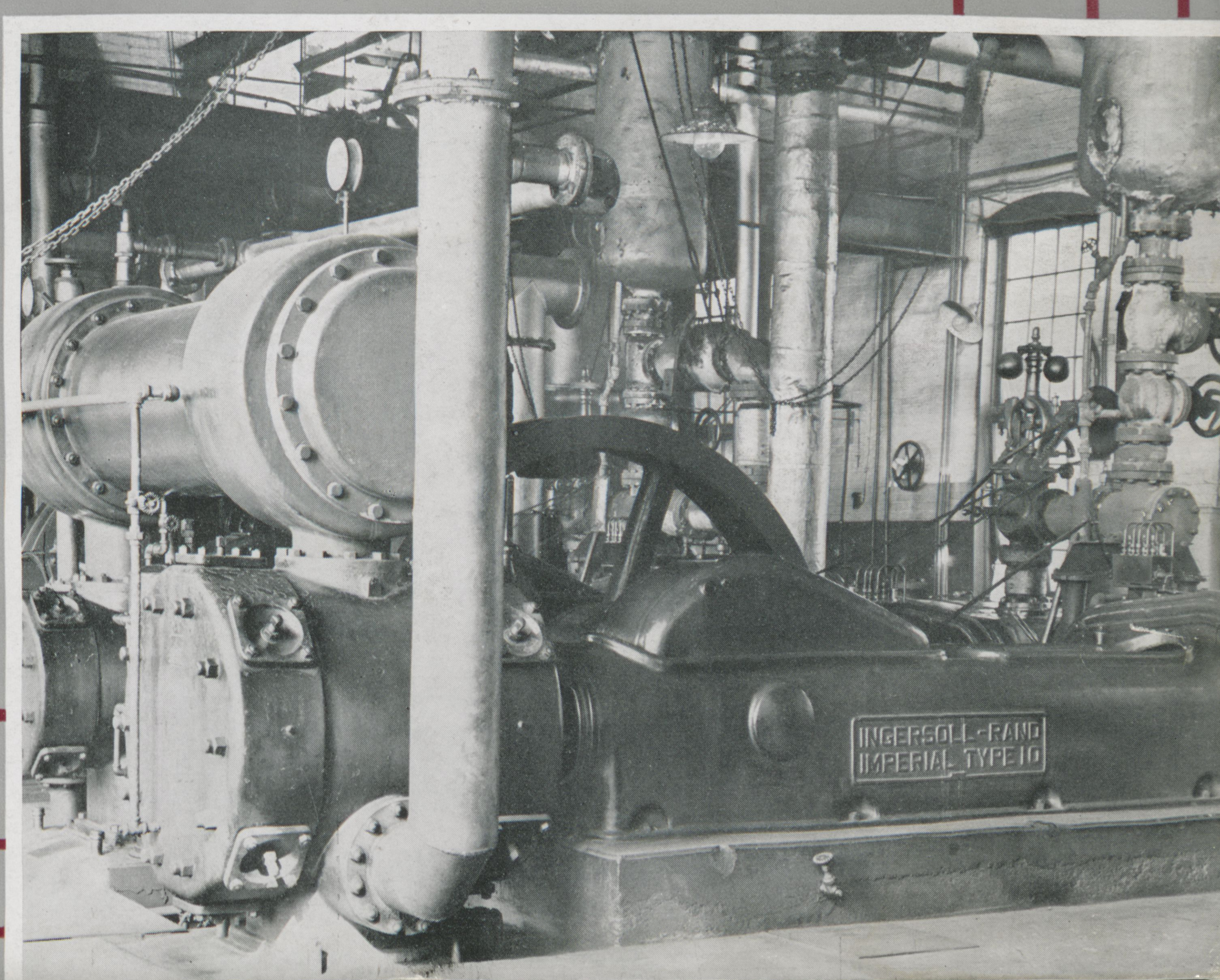
Rose Technic Staff
Rose-Hulman Institute of Technology

ROSE TECHNIC

NOVEMBER



MEMBER
ECMA

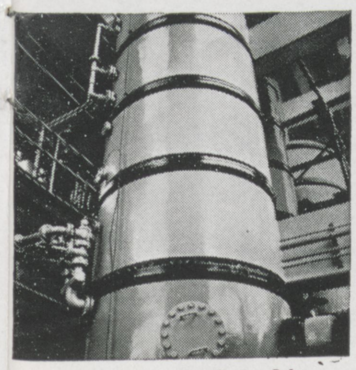
Rose Polytechnic Institute will admit a Freshman Class at the beginning of the winter term in January. The Registrar will be glad to correspond with seniors who will complete their high school credits at mid-years, and to give them information about present Selective Service procedure.

ROSE POLYTECHNIC INSTITUTE

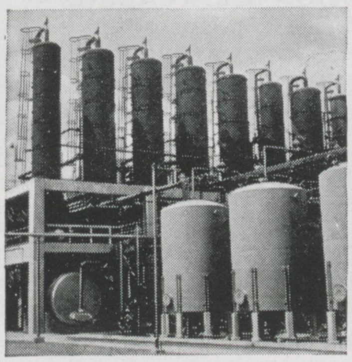
TERRE HAUTE, INDIANA

TEN YEARS' WORK IN TWO

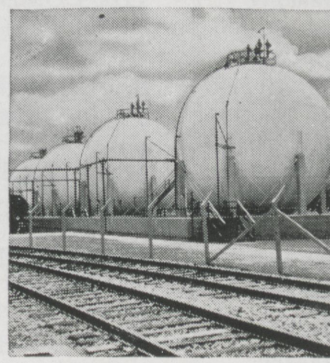
is the story behind Butadiene and Styrene for Synthetic Rubber



Distillation Column for Styrene



Where Distillation Columns separate and purify the Butadiene



Butadiene Storage Spheres

WE WISH YOU could see the first of the Government's large integrated synthetic rubber projects, complete at one location. What you see here is a night scene and some daytime views of the immense butadiene and styrene plants that CARBIDE AND CARBON CHEMICALS CORPORATION, a Unit of UCC, has designed and built at Institute, West Virginia, for the Government's Defense Plant Corporation and is operating for the Rubber Reserve Company.

Carbide and Carbon also has completed another butadiene plant at Louisville, Kentucky —and has released plans to Koppers United Company for a third butadiene plant near Pittsburgh, Pennsylvania.

Butadiene had never been manufactured in the United States in large quantities before the plants at Institute went into production. The task involved in providing the mass production facilities the Government asked for was an unusual one...but one that took full advantage of the experience and processes developed by Carbide and Carbon.

Generally, it requires seven to ten years for a company to take a process developed in the laboratory, put that process to test in a pilot plant, iron out production problems, design a full-size plant, and then actually build the plant and go into mass production.

By working at top speed for twenty months —Carbide and Carbon telescoped research, development, engineering, and construction work that would have taken 10 years in normal times. In this short time laboratory research was translated through chemical engineering into larger and more modern facilities for producing the chemicals for synthetic rubber than existed anywhere else in the world.

This achievement could never have been possible had it not been for the years of research and experimentation which, prior to the emergency, Carbide and Carbon had devoted to the production of synthetic—or manmade—chemicals of the organic series.

Business men, technicians, teachers, and others are invited to send for the book "Butadiene and Styrene for Buna S Synthetic Rubber from Grain Alcohol" which explains what these plants do, and what their place is in the Government's rubber program.

• • •

BUTADIENE, (bew-ta-dý-een). A highly volatile liquid which is the principal chemical in the manufacture of Buna synthetic rubbers.

STYRENE, (stý-reen). A liquid, like benzene, but having the property of reacting within itself to form a solid, clear, plastic mass. It is used as one of the principal ingredients of Buna S synthetic rubber.

BUY UNITED STATES WAR BONDS AND STAMPS

UNION CARBIDE AND CARBON CORPORATION

30 East 42nd Street UCC New York 17, N. Y.

Principal Products and Units in the United States

ALLOYS AND METALS
Electro Metallurgical Company
Haynes Stellite Company
United States Vanadium Corporation

CHEMICALS
Carbide and Carbon Chemicals Corporation

ELECTRODES, CARBONS & BATTERIES
National Carbon Company, Inc.

INDUSTRIAL GASES AND CARBIDE
The Linde Air Products Company
The Oxweld Railroad Service Company
The Prest-O-Lite Company, Inc.

PLASTICS: Bakelite Corporation • Plastics Division of Carbide and Carbon Chemicals Corporation

CONSTRUCTION RECORD AT INSTITUTE

June 25, 1941
Carbide and Carbon submits definite production estimates.

July 31, 1941
Design work starts on 10,000-ton-a-year butadiene unit.

Aug. 22, 1941
Government authorizes construction.

Dec. 7, 1941
Pearl Harbor

Dec. 15, 1941
Design "frozen" for 20,000-ton-a-year alcohol-to-butadiene plant.

March, 1942
Japanese occupy Malay Peninsula and Dutch East Indies; cut off about 90 per cent of U. S. natural rubber supply.

April, 1942
Construction on the first of four 20,000-ton-a-year butadiene units starts at Institute, W. Va.

July, 1942
Construction of 25,000-ton-a-year styrene plant starts.

Sept. 10, 1942
Rubber Survey (Baruch) Committee report accepted.

Jan. 29, 1943
First large-scale, alcohol-to-butadiene unit goes into operation two months ahead of schedule.

April 7, 1943
First styrene unit begins operation.

May 25, 1943
Fourth 20,000-ton-a-year butadiene unit begins operation at Institute plant.

August, 1943
Four 20,000-ton-a-year butadiene units producing at rate of 120,000 tons a year—50% over rated capacity.

ROSE TECHNIC

VOLUME LIII NOVEMBER, 1943 NUMBER 8

STAFF

FRONTISPIECE—

Stators for huge generators as seen in Westinghouse Generator Aisle.

—Cut Courtesy Westinghouse

COVER PICTURE

Source of power that pumps gas from The Indiana Gas and Chemical Corporation to various parts of Terre Haute.

—Photo by Lundgren and Weinhardt

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74 Clay Avenue, Rochester, New York

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Wayne Engineer
Wisconsin Engineer

Published Monthly except June and July by the Students and Alumni of Rose Polytechnic Institute. This publishing schedule is subject to change due to war conditions.

SUBSCRIPTION, $2.00 PER 8 ISSUES. ADDRESS ALL COMMUNICATIONS TO THE ROSE TECHNIC, TERRE HAUTE, INDIANA. ENTERED IN THE POST-OFFICE AT TERRE HAUTE AS SECOND-CLASS MATTER, AS A MONTHLY DURING THE SCHOOL YEAR, UNDER THE ACT OF MARCH 3, 1879. ACCEPTANCE FOR MAILING AT SPECIAL RATE OF POSTAGE PROVIDED FOR IN SECTION 1103, ACT OF OCTOBER 3, 1917, AUTHORIZED DECEMBER 13, 1918.

The Outlook of a Senior

Looking forward to the day of graduation was formerly a pastime indulged in by all college seniors. Soon they would be free to make as good a life for themselves as their energies and abilities permitted, abilities developed by the specialized training which colleges provide. For present day seniors, the outlook is not so rosy. The freedom of living as rich and full a life as one's abilities allow is in danger of being destroyed. A gigantic job lies ahead of us all before we can again make plans for the future with any feeling of security.

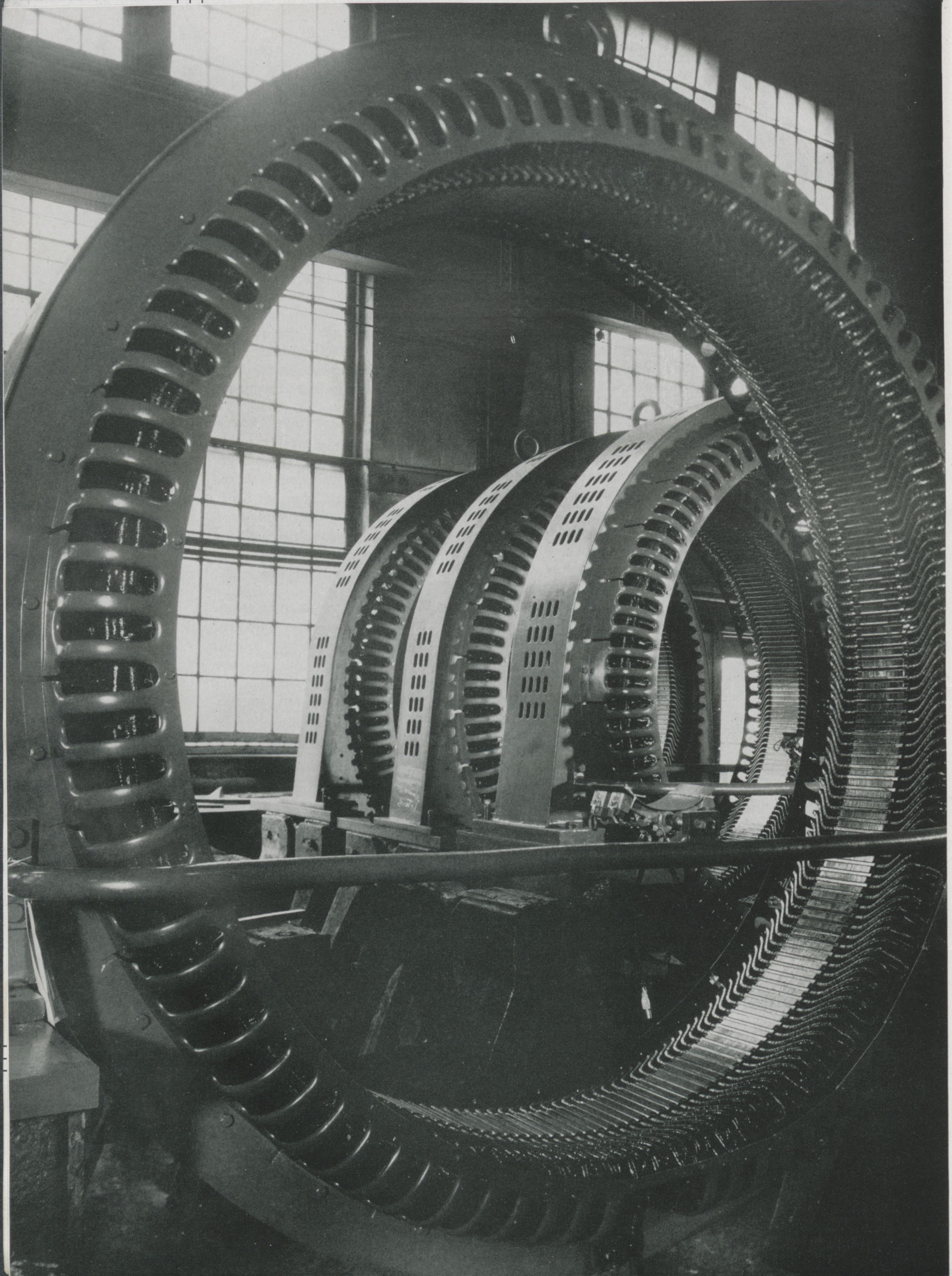
Unfortunately, there seems to be a tendency for seniors to try taking things easy during their final year of schooling. They usually overcome this bad habit before graduation when they realize that they will soon be on their own, with heavy responsibilities on their shoulders, serious problems to solve, and no convenient set of answers to these problems at the end of a text book. What then of our present situation? Should this undesirable habit be tolerated at all under present conditions? Our problems and responsibilities will be many times greater than those facing graduates during normal times. The greatest job of rebuilding that the world has known will be our task.

This disease of easing up in our work has established a foothold in many of us present seniors. We are not expected to overwork ourselves, but certainly nothing less than our best should be justifiable at this time. Of course, we will have less time for recreation and good times, but we are more fortunate than other men our age, regardless. It is only because the government considers men in our profession vital to the welfare of this country that we have been permitted to remain in school. It is our duty to fulfill the government's trust in us.

Unfortunately, our college days will not have been as interesting and fruitful as they might have been in normal times. College days formerly were ones of gaiety, good times, and activities that would be remembered all through life. A normal college life is hardly possible now, due to events over which we have no control. But this is a small sacrifice compared to that of other men our age not fortunate enough to have been training in an essential profession. Certainly the lives they have had to lead since Pearl Harbor are not exactly what they had visioned for their future.

Let us take our work more seriously than we have previously, for it is work that can not be neglected now without causing serious results in the future. It is the only way that we are being called upon to show our Patriotism. We should all be able to pass this test, for our fellow men are being called on to pass much stiffer tests every day.

by Carl Campbell, Senior, m.e.



The Indiana Gas and Chemical Corporation

by JOHN STEWART, soph., ch.e.

Several manufacturing plants in Terre Haute are playing a dominant role in the present war in production of vital war materials. Mr. Stewart here discusses the Indiana Gas and Chemical Corporation and gives a description of the various productions carried on in the plant.

THE Indiana Gas and Chemical Corporation, better known to many as the "coke plant", is one of Terre Haute's leading industries which bases it's operations on chemical processes and reactions.

The plant, erected in the early 1900's, was very actively engaged in producing materials for defense during the First World War. Now, once again, it's products occupy an important place in this Second World War. The "coke plant" could very fittingly be called a "conservation industry", because of the fact that there is little or no loss of raw materials or products in the operations which take place. Today, when one of the key words in defense is "conservation", The Indiana Gas and Chemical Corp. naturally upholds this action.

The "coke plant" operates using one main raw material, which is coal. The plant was originally designed and built to operate on Indiana coals and it did such for several years. But the economic factors involved soon made this unwise, because competitors were using West Virginia coal. The products made from West Virginia coal were of higher grade and sold more readily for higher prices than the products made from Indiana coal. Because of this, the plant changed coals and now uses a mixture of West Virginia Eagle high volatile coal and No. 3 Pocahontus low volatile coal.

The first stage in the operations of changing the coal into coke and other by-products is crushing. After being dumped from the coal cars, conveyor belts carry the coal to the crushing building where machines break it up until 90 to 95 percent of it will pass through a one-eighth inch mesh screen. After this operation the coal is ready for the coking process in the coke ovens.

There are two blocks of ovens, with 30 ovens, 40 ft. long, 10 feet high, and 16 inches wide, in each block. 12½ tons of coal are put in each oven and burned until the coking process is over, which takes about 30 hours of burning. At the end of this time a large pusher ram shoves the "red hot" coke into a special "hot car" and water is then sprayed over the coke to put the fire out. The moisture which is left on the coke is dried out by the heat which remains in the inside of lumps of coke, and the dry product results which is screened to make it ready for sale as industrial or domestic coke.

The smoke and gases which ordinarily go up the chimney when coal is burned come into play at this point. Everything removed from the coal during the coking process is collected in a hydraulic main at the end of the ovens. The next step is to remove the tar and ammonia from the coal gas. The gas is cooled down and an electrostatic tar precipitator removes the tar which is pumped into storage tanks after the water is dried out of it. The coal gas, which is now free of the tar, is then sent through a scrubbing tower where water removes the ammonia as ammonia liquor. This ammonia liquor is about 1 percent ammonia and 99 percent

(*Continued on Page* 22)

Photo by Lundgren and Weinhardt

Huge coke oven being dumped.

The Air Force Cooperates

by A. JACK HIEF, senior, m.e.

The cooperation of our ground and air forces is very essential for the success of any military unit in modern warfare. In this article Mr. Hief describbes in what ways this cooperation is accomplished by our American army.

Much has been said recently concerning our Air Force. Generally the discussion leads to great air battles or tales of valor by individuals. Other unsung heroes perform great deeds as part of their everyday routine. Cooperation with and support of ground and naval units isn't exactly a romantic or glorified type of flying duty, but it assumes vital proportions in rapid-moving present-day warfare. Unfortunately, the public is not allowed to hear the whole truth of this phase of the conflict until the information is of no use to the enemy. At this point the average layman fails to correlate the information into a complete picture. It is the purpose of this article to assemble the available information and to present it in such a way that the extent and type of cooperation of the air forces will become more apparent.

Army Air Force

Cooperation with ground forces is accomplished in three major fields. In order of their importance these are the supply of advanced bases, support of fighting units, and the transportation of personnel. Strictly speaking, the bombing of military objectives and the strafing of behind-the-lines transportation may be considered cooperation, but the effects are not immediately apparent.

Support

The blitzkrieg of modern warfare is basically a perfected cooperation of all the units involved working on a split-schedule. The role played by the airplane varies with the conditions of battle and the type of support needed. The Germans in the beginning organized the Luftwaffe as a short-range cooperation machine. They believed the best idea was to attach a small unit of planes to each division or regiment and for these planes to cooperate with their unit only. In this manner the Stuka dive-bomber became famous as the most feared German weapon. The Allies improved upon the idea and united all the cooperating units in one theatre of war. Making use of the rapid communication available from portable radios they were able to use a more flexible system of actual support. When necessary the entire force could be concentrated at one point making resistance useless at that point or, if conditions warranted it, they might disperse them evenly among the various units. In this manner the Germans were defeated in Tunisia and Sicily.

Cut Courtesy Skyways Magazine

Dive-bomber awaiting take-off signal.

Most of this ground cooperation consists of strafing the enemy immediately in front of our lines, bombing strong positions into submission, and defending our troops from enemy tanks by using light cannon such as 20mm and 37mm or skipbombing techniques. However, it is not necessary for the plane to attack the enemy to be of use. With this in mind it is not a surprising sight to see a small unarmed plane arise from a rough field near the battle to spot artillery fire. These are known as "Grasshoppers" and are playing an important part in the victory. Used in cooperation with tank destroyer units and heavy artillery, the plane-cannon team make short work of enemy targets.

The Air Corps also participates in the protection of convoys as far as it is possible. This involves the use of light bombers for anti-submarine patrols. During the invasion of Sicily and Italy land based planes provided the umbrella of cover for the ships participating in the landing.

Supply

Perhaps the most important and least heard of branch of the Air Corps is the Air Transport Command commonly called ATC. This branch specializes in fast freight service and transportation of key personnel. The pilots of ATC planes are known throughout the world for

their ability to reach isolated outposts with needed supplies. To these men journeys over seas, deserts, or mountains are routine and only part of the day's work.

The initial problem confronting the shipping of supplies was the routes to be taken. Four major routes were mapped out and the air bases were rapidly set up and put into operation. The first route was across the North Atlantic to England. South to South America, across the South Atlantic to Africa, India, and China became the second route. The third was an island to island hop across the Pacific to Australia and nearby island bases. The last was a Northwest route to Alaska.

Supplies carried by plane vary from packages of concentrated medicine to wings and motors of damaged sister transport planes. Immediately after construction or capture, airfields are put into use by these planes carrying ammunition, food, and equipment to advanced units. Hospitals too, come in for their share of much needed medicines. Quinine, anesthetics, antiseptics, bloodplasma, X-ray machines, sun lamps, and surgeon's instruments are not uncommon cargoes. Many soldiers owe their lives to the ability of a transport pilot to deliver the goods on time. Assembled motors, wrapped in moisture-proof containers, new propellers, and even entire wings have been carried across barren wastes to some isolated outpost to repair our fighting planes. Food for men such as paratroops and gliderborne soldiers often can reach them only by plane. The success of their campaign and the safety of their lives is dependent on the availability of food and ammunition dropped from the skys. Engineering equipment often carried by plane consists of specially designed tractors, runway mats, jeeps, electric power plants, and power tools. With these, airports, roads, and other military installations can be constructed.

Transportation

Besides the important item of supplies the ATC carries key personnel or supplies planes for the transport of large quantities of troops. During the initial assault on Sicily, paratroops and gliderborne troops played a vital part in the quick fall of this island. Later a small army of paratroopers was used by MacArthur to outflank and surround Lae and Salamaua. This unit was so surrounded by jungle and so isolated that supplies dropped by parachute were its only means of existence for several days. Airborne troops may carry light howitzers or anti-tank guns and jeeps to tow them.

Troops are not the only men carried by transport planes. Civilian specialists, key tacticians, and diplomats are numbered among the passengers of ATC. Wilkie flew around the world to talk with various important personages. Davies flew to Moscow. Roosevelt traveled by plane to the Casablanca conference. General Arnold and Admiral Nimitz flew to Australia to see for themselves what was needed. In this way they were able to plan a better campaign. These are just a few of the more outstanding assignments of the Air Transport Command. Others are being performed daily.

Naval Air Corps

The U. S. Naval Air Corps performs a vital role in the sea warfare of the Navy. The requirements for enlisting are the stiffest in the world and its training is by far the most thorough. And well it might be for

(*Continued on Page* 26)

Cut Courtesy Skyways Magazine

Combined operations in World War II.

Magnaflux

by PHILIP B. LORING, soph., m.e.

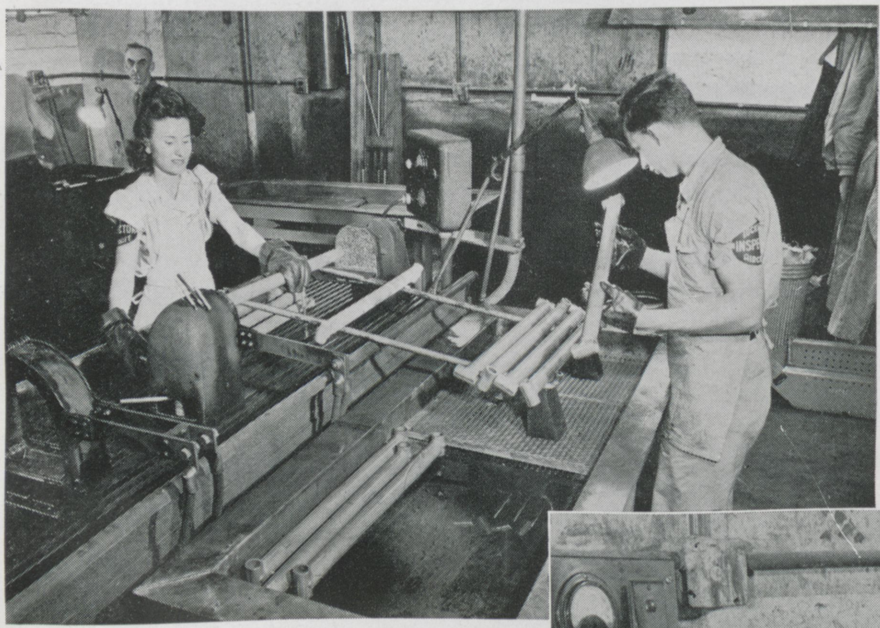
The breakdown of defective parts of vital war machines on far-off battle fronts which are sometimes thousands of miles from replacement depots has long been a headache to the armed services. A solution to this problem, as here presented by Mr. Loring, is the recent development of the Magnaflux process of detecting flaws in metal parts before they are shipped from the factory.

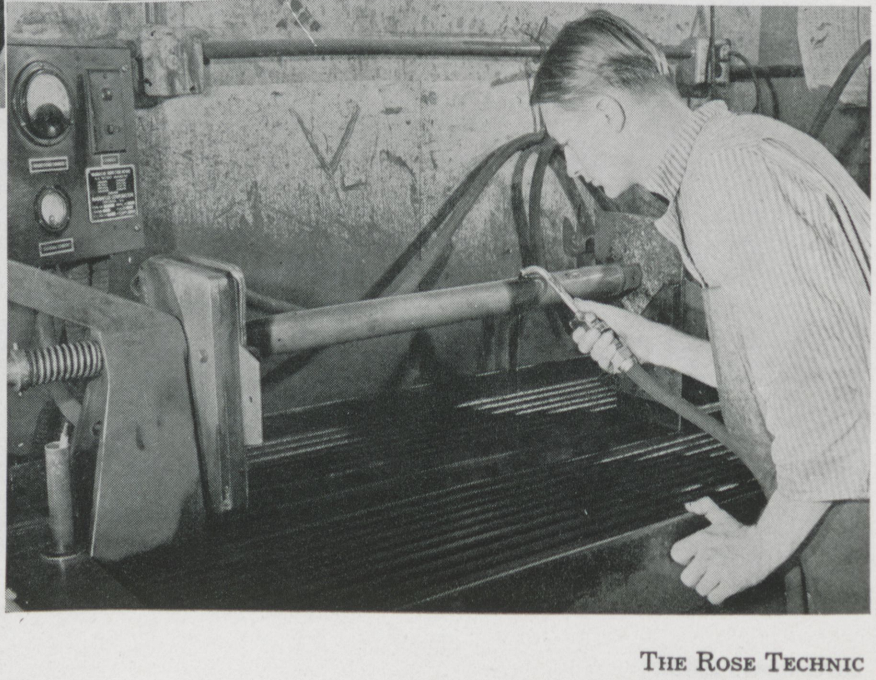
THE recent demand by the aviation industry for structural parts of increased strength and decreased weight has caused the Magnaflux method of non-destructive inspection to be one of the prime factors in maintaining our high standard of quality for aircraft.

Magnaflux has the ability to determine internal flaws without destroying the part in question. The process is readily applicable to production facilities of aircraft manufacturing concerns. The method is limited to the extent of the ferrous metals (exception Austenite), cobalt and nickel. Others, for all practical purposes, are non-magnetic.

Magnaflux, the trade name for magnetic inspection, employs the basic principle of the electromagnet. The material to be inspected, when placed in a magnetic field, assumes the characteristics of a magnet, and if the material is separated by a fissure of any sort, the resulting parts will appear as an individual magnet each with its own positive and negative poles. If these parts are rejoined, instead of becoming one magnet again, they remain two individual magnets with concentrated lines of force between them. These leakage features may be caused by differences in the structure of the metal, by foreign matter in the metal or by cracks. In practical use these imperfections are detected by covering the surface of the part with finely divided ferro-magnetic powder or a suspension of these particles in a suitable medium, usually oil. As the concentric lines of force attract the powder the faults can easily be detected. A trained Magnaflux operator can read these patterns and denote the type of defect.

The equipment necessary for Magnaflux inspection is not complicated. A machine for the wet-continuous method is rectangular in shape and contains all the necessary equipment in a unit. A rack, on which the part to be magnetized is placed, is suspended over an oil trough. A pump supplies the force to continually bathe the part being





Above—Tracks used to speed movement of part from magnetizer to inspector.

Right—Landing gear strut being inspected by the wet continuous method on horizontal machine.

Cuts Courtesy Automotive and Aviation Industries

tested. As the suspension may be used over again, a large initial volume of fluid is not necessary. The residual method of testing calls for the rack to be lowered into the suspension, thus necessitating a greater volume of fluid.

The powders used are finely divided paramagnetic substances, usually red or black, for contrast and easy visibility. The oil used for Magnaflux testing is paraffin base light oil. The ratio of powder to oil varies from one to two ounces of powder per gallon of oil. This suspension will hereafter be called the indicator.

For field work, powder alone is used as an indicator, obviously due to the difficulty of bathing assembled parts with a suspension.

Current applications are numerous for Magnaflux. Due to the nature of the testing, alternating current is not directly applicable. When discovery of surface imperfections only are desired, rectified A.C. current may be used. However, the predominant practice is to use direct current of varying intensity. Low voltage, high amperage D.C. current is supplied from storage batteries. To get a heavier indication on the part being tested, the amperage is increased. Also, subsurface defects are brought out more clearly with increased amperage.

The continuous method of testing is the most widely used. It will work equally well with high or low carbon steels. A part being tested by the continuous method will be placed on the rack lying in the magnetic field of the machine. The current will be applied in several timed intervals to provide a build up of the magnetic field in the part. While the part is being magnetized, the operator will spray it with the indicator. After the required time has elapsed the part is removed and the deposits are checked.

The residual method also uses a suspension as an indicator. The residual method of Magnafluxing uses to advantage the fact that ordinary iron and steel will retain a certain amount of magnetism, once magnetized. Ordinary iron and steel has a retentivity of from 50% to 90%. Very hard steels, such as used in aircraft construction, often have a retentivity greater than 90%. Due to the fact that the magnetic field is not 100% when the indicator is applied, the residual method is not as sensitive to deep sub-surface defects as the continuous method. For close to the surface defects, under similar conditions, the residual method will give a better indication than the continuous method, due to the washing away of some particles from the spray of the continuous method. The residual method has the added advantage of being better adapted to production methods. Any number of parts may be inspected at once by placing them on a rack and magnetizing them. The current is then shut off and the rack is lowered into the indicator. As the magnetic field or a certain percentage of it is still in effect, any defects will accumulate particles.

The same retentivity which makes the residual method possible also necessitates another step in the Magnaflux process, that of demagnetizing the part. Demagnetization is especially necessary on aircraft parts where any magnetic field would affect the super-sensitive directional compasses now in use. Complete demagnetization is accomplished by placing the part in an A.C. field while gradually decreasing the amperage.

A recent development in the magnetic inspection field makes use of fluorescence. The trade name is Magnaglo. Fluorescence is obtained from certain substances which possess the ability to change the wave length of "near" ultra violet light and alter it to rays visible to the human eye. By mixing these substances with paramagnetic powders and forming a suspension, the fluorescent particles will accumulate in defects when the standard magnetic test is applied. Much less powder in suspension is needed when the Magnaglo method is used. The part is inspected in a darkened room and defects that are difficult to locate by ordinary methods are shown clearly. As light issuing from a background of darkness is an infinite contrast, it stands to reason that it would be easier to distinguish Magnaglo defects than it would Magnaflux contrasts of black and white which have a color contrast of at the most 20 to 1. The time saved in the visual inspection is a valuable feature of Magnaglo. It takes considerable time to visually detect and interpret defects by Magnaflux that can be located instantly by Magnaglo.

In all types of magnetic inspection it is necessary for the inspector to interpret his findings. These are factors which must be left entirely to his good judgment. Factors which complicate the interpreting of indications are: the small size of some indications; masking of indications by color, background, irregular surface impurities. It is only through experience that an inspector can differentiate between true and false indications.

Each method of magnetic inspection has certain advantages and disadvantages. The wet-continuous method is capable of showing deep sub-surface defects which are not always sufficiently serious to reject the part. The continuous method is thorough but slow. The residual method will show surface defects clearly but lacks the ability to detect sub-surface defects. It has the added advantage of being faster than other methods of magnetic testing. Magnaglo testing results are readily visible to the eye and eliminate some of the human element from detecting defects. Magnaglo requires extra space and

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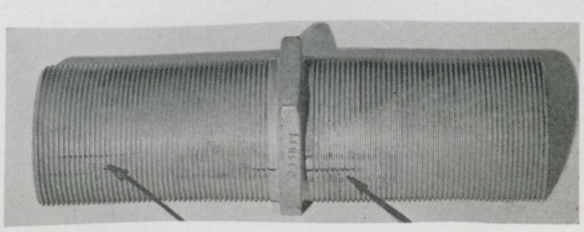


Cut Courtesy Automotive and Aviation Industries
Arrows denote power pattern indicating defect in adjustment screw.

The Combustion-Gas Turbine

by JEAN LAPE, sr., m.e.

The quest of engineers and scientists for a more efficient and more economical type of turbine has led to the development of the combustion gas turbine, the principles and operation of which are discussed by Mr. Lape in the following article.

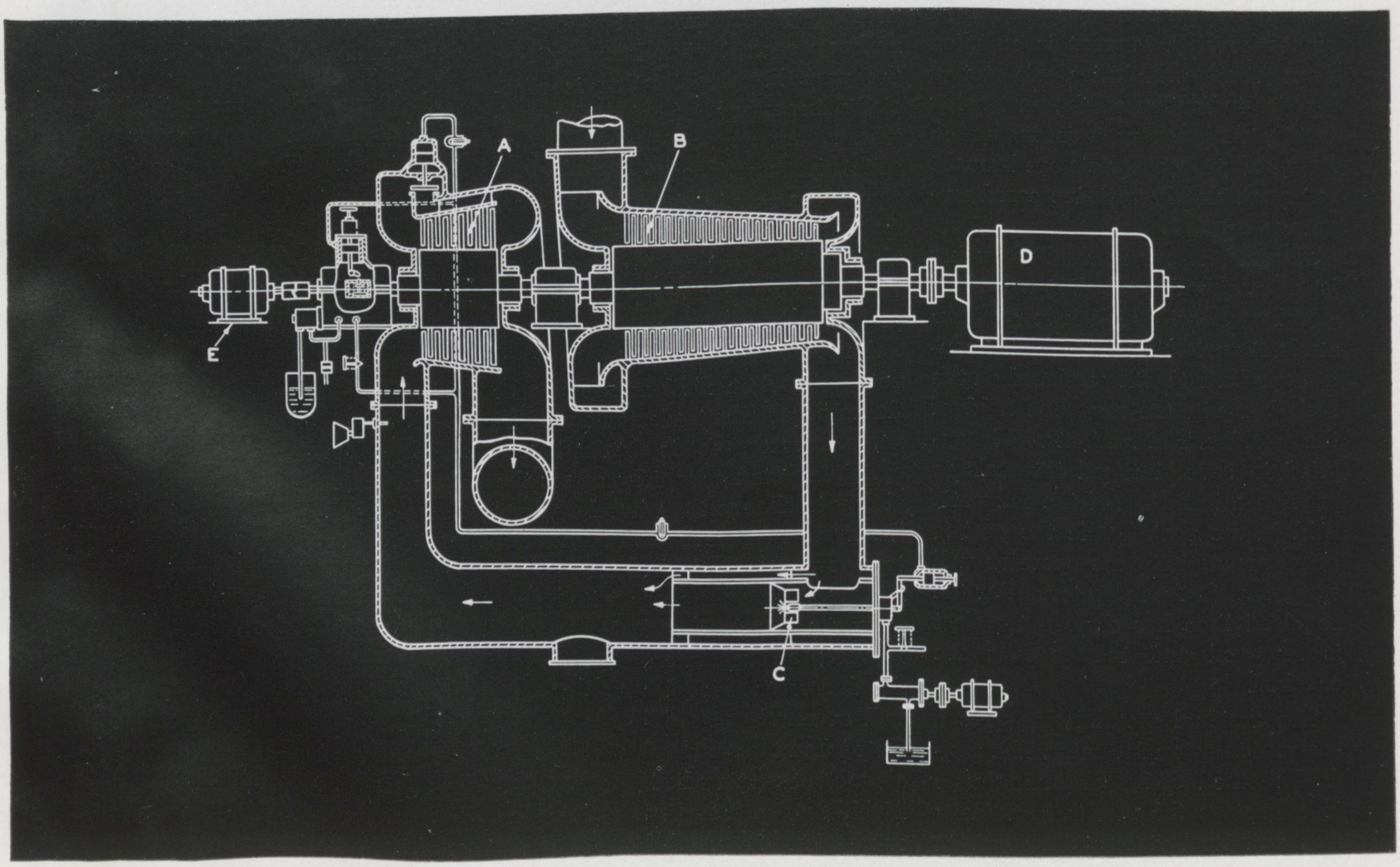
For 2000 years various scientists and inventors have toyed with the principle of the gas turbine. However, because of limitations imposed by poor knowledge of aerodynamics and metallurgy, no success was achieved in this field until the early part of the 20th century. With the development of an efficient axial compressor, the progress continued, and today there are many uses for the gas turbine.

The gas turbine has a greater thermal efficiency than the reciprocating steam engine, and does not require a site near large quantities of water. Also, fuel costs are less than for a Diesel engine. On the other hand, availability is not so high as for the Diesel, and the gas turbine is more expensive than steam. One major disadvantage of the gas turbine is that it must produce approximately four times the excess power available for external work in order to drive the axial compressor.

In all probability, these disadvantages will be overcome as the design is improved. In any event, there are many applications for the gas turbine where it can be used more efficiently than other forms of power.

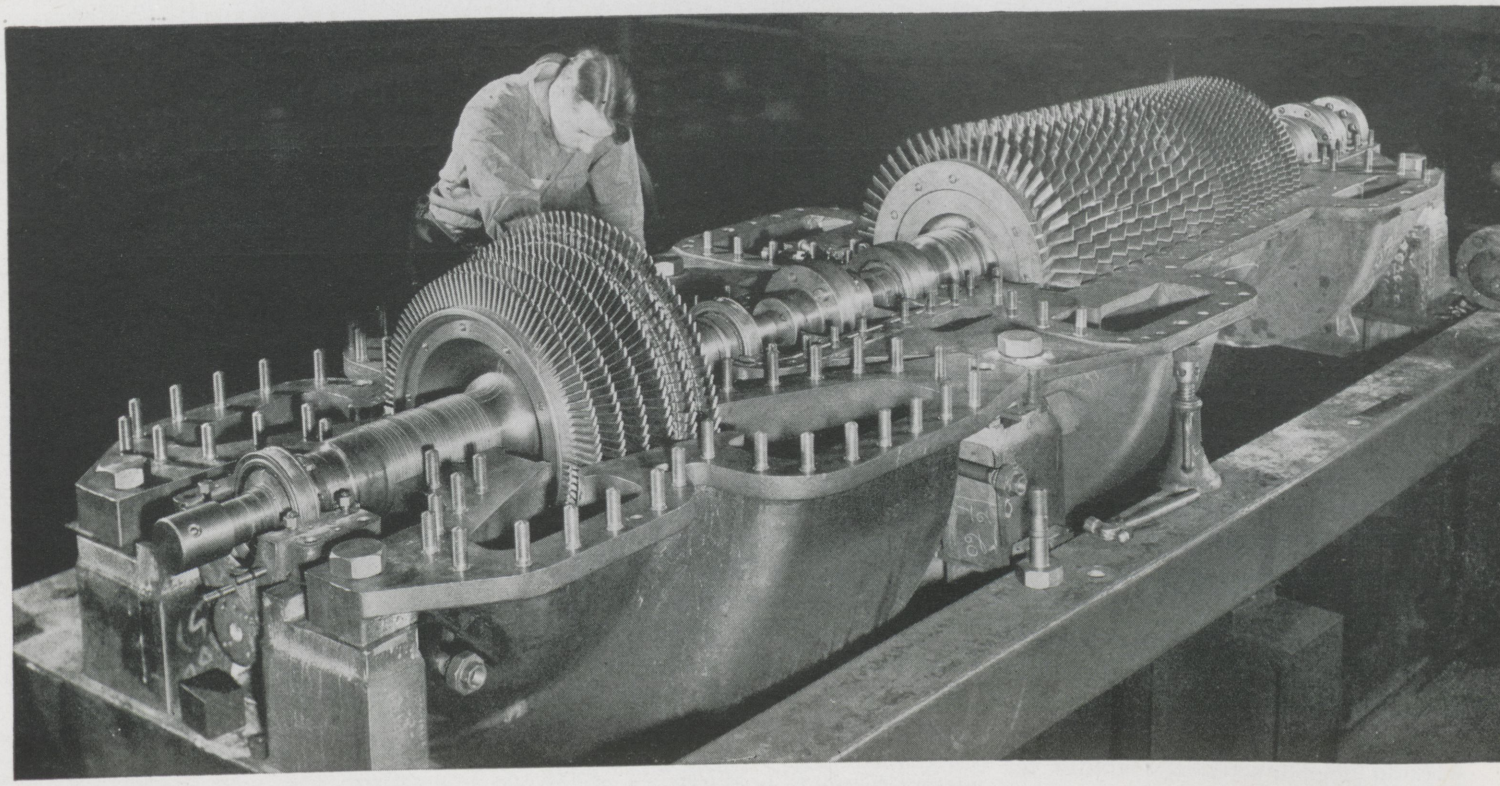
The history of the gas turbine goes back something like 2000 years to the time of Hero, who in 130 B.C. used the principle of the gas turbine in a machine to impart motion to symbolic figures on a revolving altar. In this machine, air was heated in a vertical tube and released through radial tubes to produce rotation by a sort of rocket effect.

John Barber, of England, in 1791 patented the first machine to bear an intrinsic resemblance to the modern combustion gas turbine. Barber's patent drawings show compressors for both air and gas, a combustion chamber for burning the air and gas mixture, and an impulse-type turbine wheel which was driven by the high velocity jet of combustion gases. A water cooling system was included to prevent subjecting the turbine parts to excessive temperatures.



Cut Courtesy Allis-Chalmers

Fig. 1. Diagram of modern gas turbine.



Cut Courtesy Allis-Chalmers

Fig. 2. Partially assembled gas turbine-axial compressor.

Many other schemes which might be called forms of the gas turbine were patented during this period, but all of them, as well as the types listed above, had some feature of design which made them impracticable. A "fire turbine" was patented in 1872 by Dr. F. Stolze, of Charlottenburg, Prussia. This machine was strikingly similar to the modern gas turbine. It consisted of an axial flow compressor coupled directly to a reaction turbine. Tests on this machine indicated that it was unsuccessful chiefly because of the inadequate design of the axial compressor. Such results were to be expected, in view of the limited knowledge of aerodynamics at that time.

Sir Charles Parsons obtained his original steam turbine patent in 1884, and in this patent made reference to a gas turbine. He also explained that the turbine could be converted into a compressor by driving it in reverse by an external means. The compressed air was discharged into a furnace where fuel was burned, and the resulting products were expanded through a turbine. The compressor was quite similar to the axial compresor as it is known today except for the shape and angle of the blades.

The Parsons Company produced axial compressors commercially during the years 1900-08, the largest of which had a capacity of 50,000 cfm and a delivery pressure of 11.75 psi gauge. In 1908, because of his other numerous activities, and also because of the more efficient centrifugal compressor of Rateau, Sir Charles abandoned research on the axial compressor. The Societe des Turbomoteurs in Paris made the first significant attempt at building a practical gas turbine. The work, done largely by Armegaud and Lemale, began with a 25 hp DeLaval turbine, and later led to the construction of a higher power turbine with a two-row impulse wheel. Liquid fuel was burned with compressed air from a multi-stage Rateau centrifugal compressor. The combustion gases were cooled by water injection and expanded through the turbine, giving a thermal efficiency of approximately three percent. In spite of this poor showing, this machine was significant because it was the first combustion gas turbine to produce useful work.

In 1908 Dr. Hans Holzwarth began experimentation with the explosion type of gas turbine. A mixture of fuel and air are exploded in a closed chamber and the resulting gases released through a nozzle to an impulse wheel. The expansion of the gases is followed by a scavenging action which removes the burnt gases and also cools the turbine parts. Several of the Holzwarth turbines are in use today, with a thermal efficiency of up to 13 percent.

In nearly all of the earlier types of gas turbines, limitations imposed by the lack of knowledge of aerodynamics prevented the development of a compressor efficient enough to make the gas turbine entirely practical. In addition to this, elaborate means of cooling the turbine parts had to be arranged because metals then used could not withstand the continued high temperatures of the combustion gases.

The modern gas turbine is characterized by its simplicity. In Fig. 1 is shown a diagram of a modern gas turbine. In this drawing, the five-stage gas turbine (A) is directly coupled to a fifteen-stage axial compressor (B). The air from the com-

(Continued on Page 28)

Research and Development

by ROBERT GREGER, jr., ch.e.

Amplidyne

The short circuit—often blamed for knocking out lights in homes and huge apparatus in power stations—is now increasing the maneuverability of guns on planes and ships and speeding the output of armor plate and other products of war industry.

The short circuit and a coil arrangement known as compensating field winding are features of a General Electric development, the amplidyne, a simple rotating unit which resembles a motor or generator. The device embodies magic similar to that found in the complex circuits of a radio set—namely, the ability to pick up the small whispers of electric signals and magnify them instantly into powerful commands to large machines.

Developed by Dr. E. F. W. Alexanderson and other General Electric engineers just before war broke out in Europe, the amplidyne has stepped up literally thousands of military and industrial applications ranging from mining of basic raw materials to manufacturing, maneuvering, and firing the weapons of war.

A typical amplidyne assignment is controlling guns in aircraft turrets. Although one man could not, by himself, maneuver guns against the terrific wind resistance encountered by a plane flying 400 miles an hour, with the amplidyne he controls fire power as deadly in the air as a machine gun battery on land, and with the same ease as he would sight a rifle on a target range.

Already the amplidyne is in successful operation on fire control equipment aboard ships, on antiaircraft guns, and on searchlights both ashore and at sea. The device provides accurate, sturdy control and high speed of response over a wider range than other equipment and, because of its simple construction is proving less vulnerable than other methods to bomb impact and flying splinters from enemy shell fire. Simplicity of operation is also an important factor in installations aboard planes flying at high altitudes, where atmospheric conditions frequently impair the operation of other types of equipment.

Here are some of the industrial applications of the amplidyne:

Mining

Installed on the world's largest power shovel, the amplidyne is making possible the stripping of nearly a million tons of earth a month from coal fields. By simplifying control and maintenance on hoists which bring coal from depths of several hundred feet, the amplidyne is also adding to the output of vertical coal mines.

Steel Mills

One of the first operations in steel production requires the loading of iron ore and other materials into blast furnaces. The amplidyne enables one blast furnace skip hoist to produce 49,705 tons of pig iron in a month—a world's record.

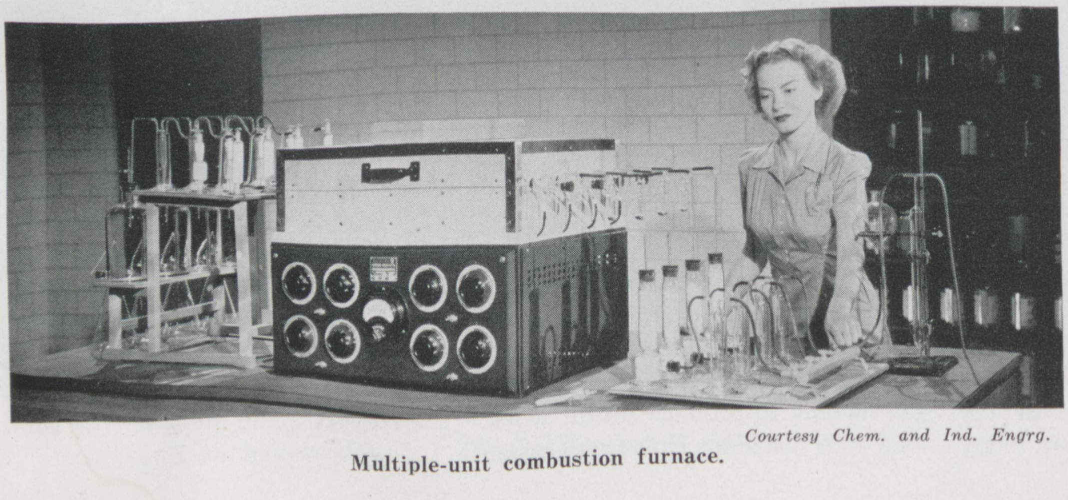
Aero Digest, New York

Amplidyne.

The pig iron is combined with steel scrap and other ingredients in either open hearth, bessemer or electric furnaces where it is made into steel. In the latter type of furnace, the amplidyne steps up output by as much as three additional heats a week.

The steel ingots thus produced are rolled into slabs in blooming and slabbing mills. In this process, the ingots are rolled back and forth, the amplidyne providing faster working of the resulting slabs as the power-driven rolls squeeze the hot metal into the desired shapes.

Many of the hot-strip mills which used to produce thin sheet steel for automobile bodies now convert the slabs—originally several inches thick—to plate from two inches to one-quarter inch thick;



Courtesy Chem. and Ind. Engrg.

Multiple-unit combustion furnace.

here again the amplidyne permits faster and simpler control. The plate becomes armor for tanks and ships or is delivered to manufacturers who machine it into parts for thousands of industrial and military products, with the amplidyne adding speed and accuracy to machining operations performed by such machines as planers and boring mills.

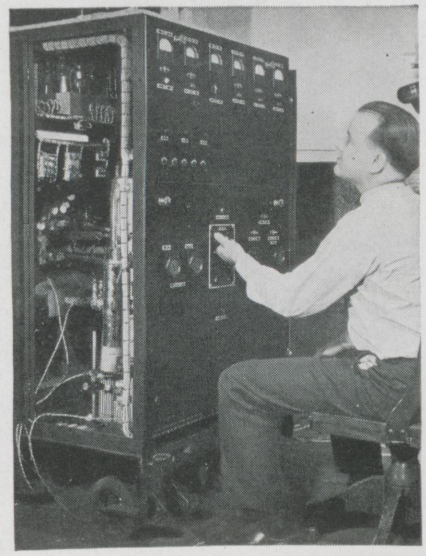
Hundreds of other applications of amplidynes have been made in the armed forces and throughout industry, all of which can be expected to play equally important roles in post-war developments.

An electronic device called the "mass spectrometer" will soon accelerate wartime chemical research by freeing hundreds of highly skilled chemists from tedious but important production testing in synthetic rubber plants. This new instrument is faster and more accurate than a dozen top-notch chemists. It is a valuable laboratory tool for scientists seeking more powerful gasolines, new plastics and improved synthetic rubber. An average college student can be taught to operate the spectrometer in a few weeks.

Developed by 32-year-old Dr. John A. Hipple, physicist at the Westinghouse Research Laboratories, the electronic "chemist" swiftly and precisely analyzes many of the complicated gases formed in making butadiene, the principal ingredient of several types of synthetic rubber. In 15 minutes this spectrometer will dissect a complicated gas molecule a twenty-five-millionth of an inch long and can be arranged to automatically produce an autograph that tells the chemist the composition of the gas.

At present, certain analyses require from 15 hours to three days of painstaking laboratory work by five to ten skilled chemists. Others cannot be done at all even by other processes. Results attained by these tedious methods are much less accurate than the molecular "portrait" that comes out of the spectrometer.

Leading research men of five major oil and chemical companies worked with Dr. Hipple for more



Courtesy Scientific American

Mass Spectrometer.

than six months to make the instrument practical for use in oil refineries, butadiene plants and other chemical industries. The project was directed by Gaylord W. Penney, head of the electro-physics department of the Westinghouse Laboratories.

Butadiene molecules, Dr. Hipple explained, are carefully built up from carbon and hydrogen atoms according to definite chemical patterns, much as a tile-setter selects colored blocks to form a design on a floor. As the molecule is being put together in a butadiene plant, its compostion must be checked at intervals to make certain that the chemical pattern is being followed.

Present methods of determining the molecular structure are so slow that a batch of butadiene has often gone through the various treatments of the process before the analysis is completed. If there is an error in the molecular design, the butadiene will make a poor quality synthetic rubber. Sometimes a batch of butadiene has to be reprocessed, causing lost production time.

The spectrometer is housed in a cube-shaped cabinet five feet high. Its key part is a yard-long glass vacuum tube shaped into a quarter-circle. This tube, lined with metal, is fixed between the poles of an electromagnet.

Molecules of the gas being analyzed are given an electrical charge at one end of the tube and are shot toward the other end at a speed of approximately a million feet a second by high voltage electricity. The electromagnet pulls at these speeding molecules so that only those

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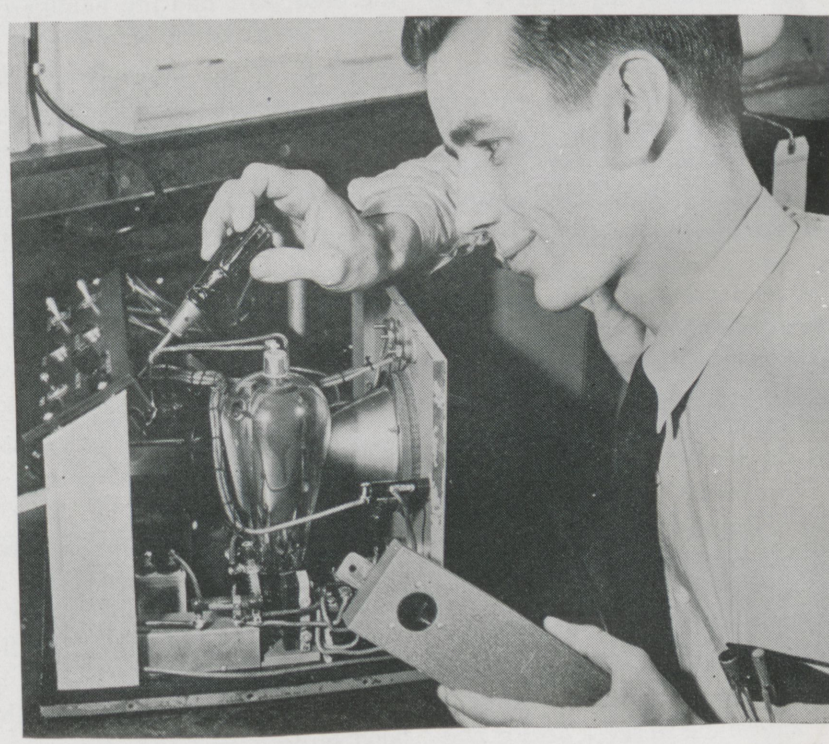

Courtesy Electronics

Internal view of flash unit for high speed photography.

My Athletic Career

by E. JAMES HEGARTY, jr., c.e.

Before telling you of my contacts with the various sports I would like to give you a mental picture of what everyone else calls their physique but in my case it is what I hang my clothes on. I stand slightly less than five feet at an angle of 70.5 degrees with the horizontal weighing 83 pounds. Starting at the bottom of my anatomy and working to the top I look like this. I have ten toes. Six on one foot and four on the other. My legs would have looked good on an ostrich but from what I am told they don't harm my appearance. I believe I am the only person whose knees knock and is bow-legged at the same time. On me, shoulders are a minus quantity. My supposed shoulders brace my neck so that I am able to hold my head erect. I have an infliction known as ingrown chest which on me looks good. I have two arms which bend at the elbows except in rainy weather. Each arm is supplemented by a hand at its extremity. I grow a bumper crop of fingernails about an inch forward from my knuckles. My head is like any normal persons with ears, eyes, nose, mouth and hair but as yet I haven't found a normal person who would trade heads with me and I don't believe this is true just on account of trading heads is so impractical. My nose covers more than half the acreage afforded by my face. My ears extend far out into the space beside my head. My mouth contains some of my dentist's better work. I thought I had bad eyesight but found out different after taking an eye test. I read the top line on the eye chart and recognized it as the name of one of Notre Dame's backfield regulars so I guessed at the other three lines that I couldn't see by substituting the rest of Notre Dame's backfield and came up with 20-20 vision. Many of you from my description of myself would advise me to see a doctor and that I did. The doctor buoyed my morale by telling me I was muscle-bound. Yep, he gave me the once over lightly and said, "Don't worry, Jim, you're bound to have muscles." I believe this description has given you enough data on my stature to understand why I am not qualified to be an athlete but I would like to tell you of my undertakings in the field of athletics.

In the foregoing descriptive paragraph any similarity to persons living or dead is purely me.

The first sport I partook of was swimming. Due to my low specific gravity at the age of one month I was rescued by a Coast Guard Cutter some 40 miles out in the Atlantic Ocean and was returned home safely to my disappointed parents. As a youngster I unleashed my athletic ability in the childs game of marbles. One damp day clad in short pants I caught a cold and got my knees dirty while playing marbles. After losing my 338 marbles in the twenty minute game I returned home. My mother, observing my knees as she met me at the door, as I had my handkerchief out in anticipation of a sneeze, exclaimed, "What happened to your knees!" and I brightly replied, "I caught it in my handkerchief. What's wrong, mom, you got a cold too." My marble supply as well as my ability to play marbles being zero forced me to give the game up. The kids in the neighborhood began to cheat at marbles and it was then and only then that people respected me. They used to point at me and say "There goes a boy without corrupt marbles." I still know my marbles pretty well because I never take anything for granite. I had my chance to make an early debut in wrestling but saved it for a later date (Can't remember her name now). I chose track to wrestling and boxing and always ran away from the neighborhood bully. I was and still am very ignorant of track. I always thought that the pole vault was a rich persons dog's bathroom.

In high school I tried out for the football team. I went to practice for three weeks before the coach realized there was anybody in what he thought was an empty uniform. He explained to me that the guy who wore it the year before had B.O., and he thought the uniform had enough strength to stand by itself. The coach didn't want to deflate my ego so he consented to let me be water boy. I used to carry a dixie cup full of water out to the players during time outs but lost my job later when someone revolutionized the H_2O boy industry by using a bucket. I couldn't lift the bucket and the coach didn't see fit to have two water boys, one for the bucket and me for the ladle so my football career ended abruptly. The coach stunted my basketball career also. He realized I was a good basketball player but dropped me from the squad the first day explaining that foul shots many times were the margin between victory and defeat and what good could I do the team being that I couldn't reach the basket from the free throw line? He put it so plain that it didn't even hurt me. The rest of the season I worked as the composer of yells for our cheerleaders and really dreamed up some doozies even if I do say so myself because I know no one else would. My chief contribution was "Give a yell—Give a yell—Give a good substantial yell — Sowcenter High School — Sowcenter High School—Yea!" You now know that I live in Sowcenter where my dad owns the hotel. I also composed the letterhead for his hotel. It is—Use your sense—Smell our scents—For less cents—Sowcenter Hotel. Back to athletics. During baseball season I was the most important factor in our undefeated season. We had an excellent spitball twirler and I used to

(*Continued on Page* 30)

The Coefficient of Lipstick Distribution

by JOEL RHODES, University of Cincinnati

This is a report by Joel Rhodes, a Ch.e., at the U. of Cincinnati, which is here reprinted by permission from the Cooperative Engineer. It is the opinion of the staff that every engineer should be cognizant of the technique and data relating to this research.—The Ed.

When two surfaces, one of which is coated with a layer of lipstick meet, a certain distribution of the lipstick takes place. The second surface which was originally clean retains of portion of the material. This paper is a study of the variables affecting this distribution and the determination of the coefficient of distribution.

Nomenclature

- P—Pressure
- T—number of applications
- C—temperature
- A_1—area of the transmitter
- A_2—area of the receiver
- i—intensity of light
- N—Newton's constant
- p—pucker factor
- t—time
- II—passion
- B—surface conditions
- $\triangle$—distribution coefficient
- D—distribution

Notes on the Variables

The most important variable in the distribution of lipstick is that of pressure. Harris reports that in 193 tests, using variations in pressure, the amount of material transferred was a direct function of the pressure. This report tends to bear out the experiments of Stockfleth, who used several transmitters under the same laboratory conditions, i.e., on the same night. Stockfleth conducted his tests in the Theta Phi Alpha laboratory in 1941. When the pressure is zero, the distribution is also zero; as pressure increases, the flow of lipstick increases rapidly up to a certain maximum. Under extremely high pressures, the equilibrium conditions are reached almost immediately. Equilibrium occurs when the amount of lipstick on one surface is equal to that on the other.

It has been found that if pressure is plotted against distribution, the curve assumes the shape of a "puckered pair" of lips. (This is standard nomenclature for this phenomenon. To say a "pair of puckered lips" infers that one lip can be puckered independently—an impossibility.) The exact shape of the curve is determined by *p*, the pucker factor (see figure 1).

B, the variable measuring the surface conditions, is an exponential function of the pucker factor and pressure. Under normal operating conditions, the surface of the contacting areas is fairly smooth. However, if the surfaces are contracted and draw up into folds and wrinkles, i.e., puckered, surface conditions are far from being ideal for complete distribution. As pressure increases the surface becomes more ideal, i.e., smooth.

Other factors are also important in the distribution ratio. The intensity of light, *i*, has an inverse effect. As light becomes brighter and brighter, less and less lipstick is distributed. The amount dispensed in total darkness approaches infinity (see figure 2).

An unusual effect of Newton's gravitational constant is noted in the following relationship. If there are only two surfaces within range, the distribution is normal. If however, a third surface is near, the distribution falls off to almost nothing. Yet, with the addition of a fourth surface of opposite gender to the third, the rate of flow is twice as great as before.

Teppig attempted a series of experiments to determine the effects of passion, but failed at first because of transmitter trouble. In another attempt the defense failed, and accurate results were obtained. The cause of *II*, passion, is as yet unknown, but it has been shown that any amount of it renders useless the consideration of any other variable. *II* causes equilibrium to be reached almost instantly and causes the number of applications per unit time to increase greatly. The study of this variable is the most difficult of all, but Teppig's work seems quite adequate.

Other variables of less importance include temperature, area of the transmitter, and area of the receiving surface. It seems that more lipstick is distributed in the month of

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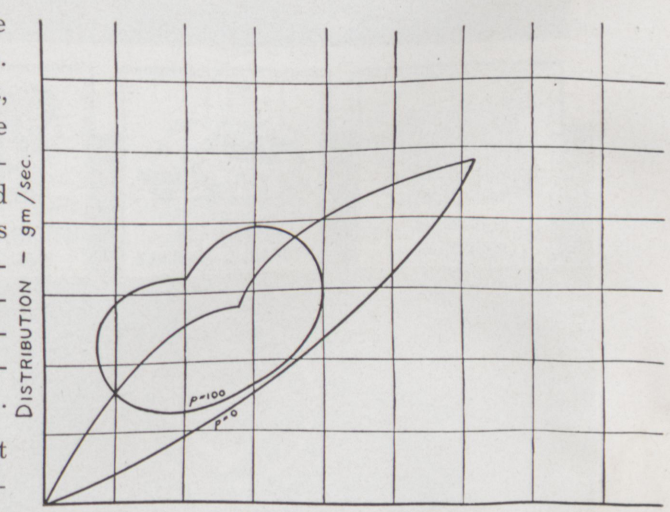
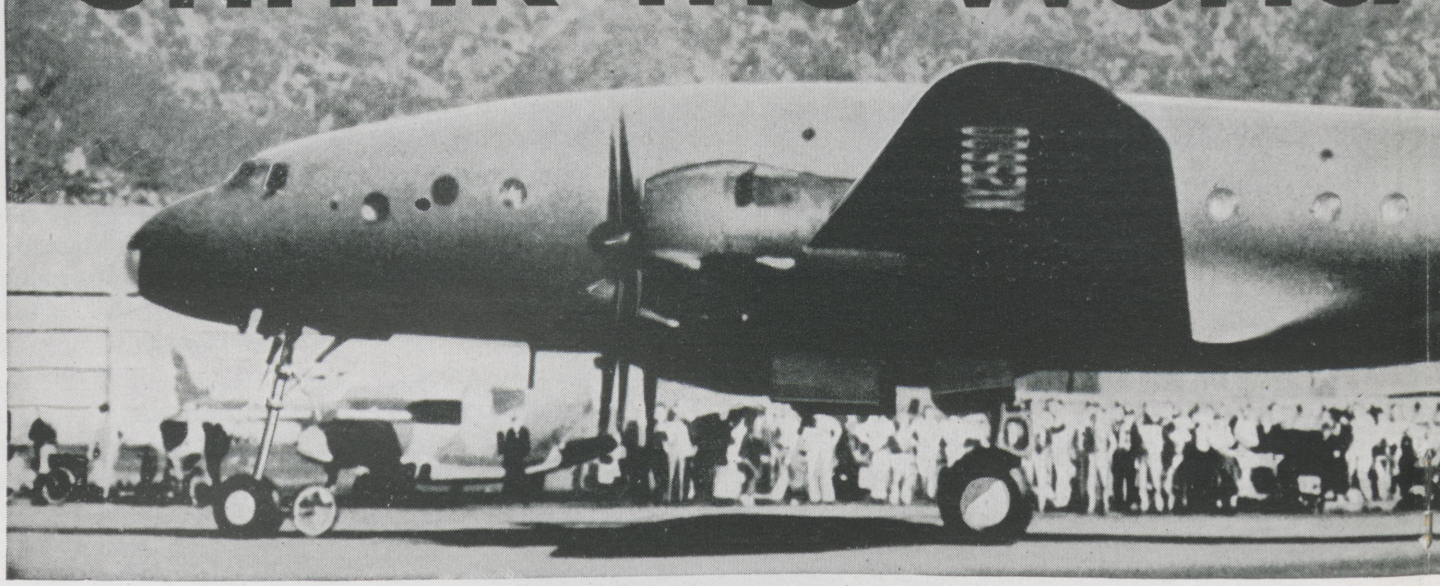
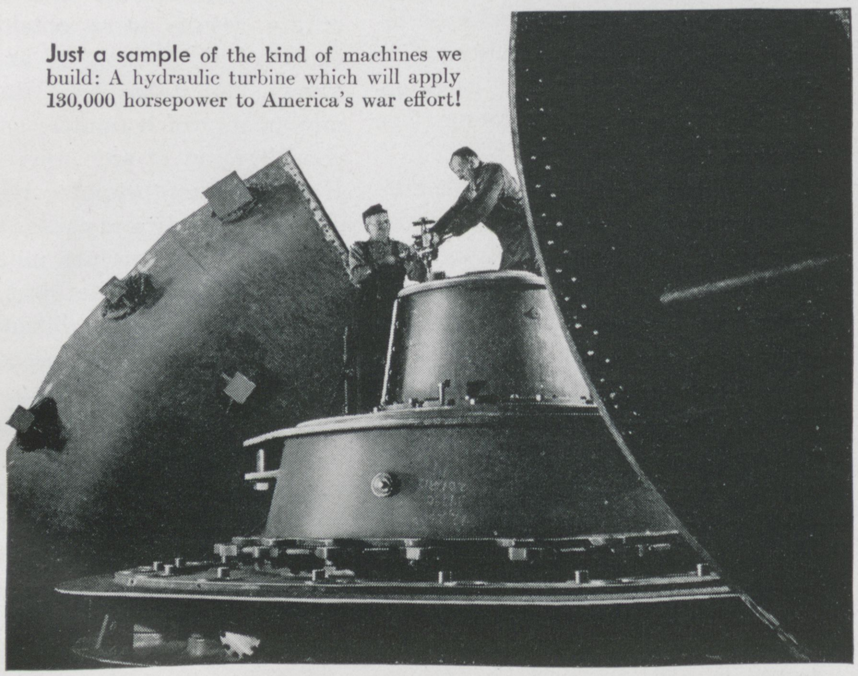


Shrink the World .



Just a sample of the kind of machines we build: A hydraulic turbine which will apply 130,000 horsepower to America's war effort!



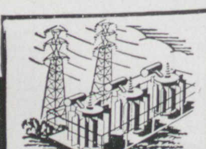
Power

TWO BIG JOBS! And Allis-Chalmers is helping do both. This unusual company makes 1600 industrial products—everything from equipment that helps make and shape steel and aluminum for U. S. airplanes to giant turbines for U. S. power plants.

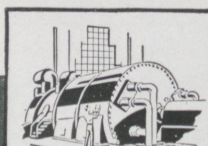
THAT SUPER CARGO PLANE is like something out of the future. You didn't expect to see it for years. Yet there it is . . .

America's great industries are cramming years of aviation advancement into months. And Allis-Chalmers is working at top speed to help them produce more and better planes.

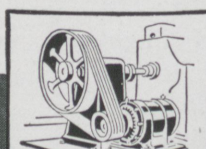
Huge Allis-Chalmers turbines help gen-



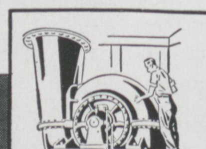
ELECTRICAL EQUIPMENT



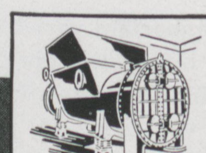
STEAM AND HYDRAULIC TURBINES



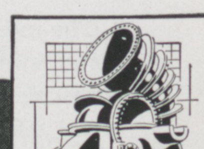
MOTORS & TEXROPE V-BELT DRIVES



BLOWERS AND COMPRESSORS



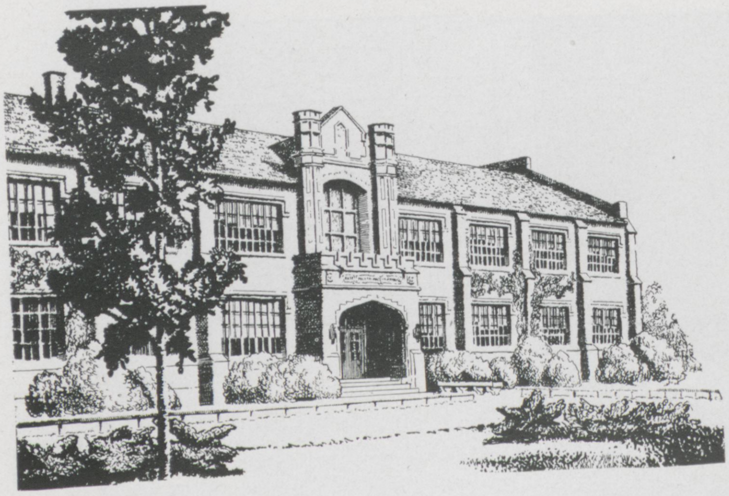
ENGINES AND CONDENSERS



CENTRIFUGAL PUMPS

ALLIS-CH

SUPPLYING THE WORLD'S LARGEST LINE



Campus Survey

Edited by JOHN MURDOCK, freshman

Graduation

For the first time in the history of the Institute, Rose has graduated a second class in the same calendar year. Forty eight seniors received their diplomas and degrees to join the ranks of the Rose Alumni. A third of these forty eight will leave for immediate service with the army, since they have been in the enlisted reserve since July. The remainder of the class will take places in private industry. The majority of these graduates will find their dream of a title of "BILL JONES. . . PRIVATE" changed to the army version of Private Bill Jones, but after the war they can well expect to take their places with the other Rose Alumni in the post-war world.

The commencement exercises were held in the Rose gymnasium at ten o'clock, Saturday, October 10th. The Alumni Address was read by Professor Wischmeyer since Mr. Schwartz, who was to give the address, could not be present. The Commencement Address, "The Engineer's Part in Post War Industry," was given by Arthur W. S. Herrington, M.E., who is President of the Marmon-Herrington Co. and who has also earned for himself the title of "Hell on Wheels" Herrington. Dr. Prentice conferred the degrees. For the second time within a year two students have tied for the Heminway Medal for the highest scholastic record for the four years of college work. Duplicate medals were awarded to Gordon MacBeth and Frank Winters, who were tied for this year. The Benediction was given by the Rev. F. LeRoy Brown. The best wishes of the Technic and of the school are extended to these graduates.

Senior class of October, '43.

Homecoming—1943

The annual Rose Homecoming was dampened by wartime shortages this year, the most notable of which were in gas, tires, and poles. The freshman class had the pole and the traditional "rural edifice" erected in time for the bonfire and after the R Men's Association had served the cider and doughnuts, the wrath of the uperclassmen was appeased and forty freshmen lived to fight another day. Our thanks to the R men. The freshmen were greatly assisted in their task by Mr. Stallman, sophomore, without whose aid and assistance the bonfire would have been much higher.

Despite gas rationing, the Homecoming was, as a whole, a success. Climaxed with the annual dance and a wartime football game, the week was one to be remembered.

Col. R. E. Cruse

Col. Cruse was graduated from the United States Military Academy at West Point with a B.S. degree in 1918. He received his degree of C.E. from Rensselaer Polytechnic Institute in 1922. He did graduate work at the Carnegie Institute of Technology from 1922-1923 and later was graduated from the Army Engineer School in 1925. Col. Cruse has been in the army for 28 years and served in the last World War. He has had six years of foreign service, having been in the Far Eastern Pacific area

from Siberia to the Netherlands East Indies. His work in the continental United States has been in River and Harbor, and Flood Control duties. He served in this type work in the Chicago, Jacksonville, and Los Angeles districts. He was chief of the engineering division in the Los Angeles flood control project. The Col. served one tour of R.O.T.C. duty at the University of Nebraska from 1938-1941. Col. Cruse came to Rose in August of 1943 and now has charge of the 1554th Service Unit, A.S.T.P. now stationed here. The Technic extends its welcome and hopes the tour of duty at Rose is a pleasant one.

Alexander Paterson

Mr. Paterson is an assistant professor of mathematics at Rose and is one of the newest additions to the faculty. He is well qualified for his position, having received a C.E. degree from the University of Cincinnati in 1920. In addition he has had about eight years experience in the field of structural engineering, construction, and surveying. He attained his degree of Doctor of Jurisprudence from the University of Chicago in 1926 and has since compiled a book on war contracts. He has had eight years teaching experience, including posts at the University of Cincinnati, Southeastern University at Washington, D. C., and at Beloit College, Beloit, Wisconsin. Mr. Paterson came to Rose in the summer of this year and now teaches the A.S.T.P. unit stationed here.

Mr. Pearson

Mr. Pearson is among the newest arrivals at Rose and is teaching in the electrical engineering department. Mr. Pearson received his B.S. degree from the Case School of Applied Science at Cleveland in 1929 and his M.S. degree from the same institute in 1933. He has had ten years of industrial experience and has been an assistant professor in the E.E. department at Ohio Northern University. He later served as head of that department. He came to Rose in October of this year and now teaches the A.S.T.P. unit stationed here.

Ralph Yeager

Mr. Yeager received his B.S. in architecture from the University of Pennsylvania in 1915. He then served with the army from 1917-1919. His first civilian experience was in construction work and with numerous Chicago architects. He came to Terre Haute as a partner in Miller and Yeager in 1923 and has since designed many buildings now prominent in the city. Amang those he has designed are the Post Office, the Y.M.C.A., the Student Union and Fine Arts buildings, and the research laboratory at Commercial Solvents. Last year he was project manager of design and construction of George Field at Lawrenceville, Illinois. Mr. Yeager came to Rose in October of this year and has charge of the army drawing classes.

Tappings

The Blue Key and Tau Beta Pi honorary fraternities held their tapping ceremonies on September 1. Bernard Vonderschmitt was tapped for Blue Key and Carl Campbell was pledged to Tau Beta Pi. The standards of these two groups are high and it is certainly an honor to be tapped. The Technic extends its congratulations to these men.

Glee Club

The Rose Glee Club held an organization meeting last semester and now meets every Thursday evening at 8:00 P. M. at the Y.M.C.A. The Glee Club is always a successful organization and this year should prove no exception. As this copy goes to press the club can still use some good tenors, so all those interested can come to the "Y" or see Jay Kress. If you do not sing tenor come anyway. An early start will insure another fine season.

Annual Rose bonfire. *Photo by Folsom*

Alumni News

by PHILIP B. LORING, soph., m.e.

The Grads Advance

'10 Henry N. Shaw, m.e., is now Supervisor of Foundry Maintenance for Sperry Gyroscope Company at Great Neck, New York.

'13 L. W. Lewis, e.e., is now Chief Quartermaster of the Panama Canal and Panama R. R. Company.

G. Gilbert Overpeck, e.e., with U. S. Signal Corps, has been transferred to Presque Isle, Maine.

'14 Charles F. Harris, e.e., is Assistant Engineer in the U. S. Engineer Office at Memphis, Tennessee.

'20 Norman A. Ruston, ch.e., has been elected a director of Emery Industries, Inc.

'21 Claude M. Gray, m.e., has been appointed General Superintendent of Equipment by the Chicago Surface Lines.

William H. Junker, m.e., has been elected a director of Emery Industries, Inc.

Milton H. Steffen, c.e., is now with the Cook County Highway Department, Chicago, Illinois.

'23 Clyde G. Raeber, a.e., is now with Ashland Oil and Refining Company at Ashland, Kentucky, as engineer.

Buford W. Tyler, Jr., c.e., with the Pennsylvania Railroad, has been transferred to Baltimore where he is Division Engineer.

'25 Edward F. Rickelman, e.e., is now Vice-President of Buhl Stamping Company, Detroit, Michigan.

'32 W. Thomas Stanley, e.e., is now owner of the Burring Production Company, Cleveland, Ohio.

'34 Maurice Tucker, e.e., with the NACA, has been made Associate Engineer and transferred to the Cleveland Airport Laboratory, Cleveland, Ohio.

'37 Hubert H. Wittenberg, e.e., with Radio Corporation of America, has been transferred to Lancaster, Pennsylvania.

'38 John R. Merrifield, m.e., is engineer with the Long Island Power and Light Company.

Robert W. Dispennett, ch.e., with the Aluminum Company of America is now Assistant Superintendent at Maspeth, Long Island, New York.

'39 John Yaw, c.e., is now in the Engineering Dept., Boeing Aircraft Company, Seattle, Washington.

'43 Howard H. Irvin, Feb., '43, ch.e., is now at the Marbon Corporation, Gary, Indiana.

Harmon E. Rose, Feb., '43, c.e., has been promoted to Assistant on the Engineering Corps, Pennsylvania Railroad. He is working out of the Chief Engineers Office, Chicago, Ill.

In The Service

'25 Ernest A. Ewers, e.e., Captain, Signal Corps, AVS, is Assistant Officer in charge of Procurement, Engineering Branch, Philadelphia, Pennsylvania.

Frederick L. Matteson, c.e., Major, Engineer Corps, is Executive Officer, 1110 Engineer Combat Group, stationed at Camp Carson, Colorado.

'28 Hubert S. Carmack, e.e., has been commissioned Lieutenant (jg), in the United States Naval Reserve.

'33 James L. Paton, c.e., assistant Engineer Officer of the 12th Corps Headquarters, has been promoted to Major.

'34 Willis S. Biggs, ch.e., Captain, Corps of Engineers has been transferred to Camp Breckinbridge, Kentucky, where he is Battalion Executive Officer, 172nd Engineer Combat Battalion.

'35 Burril F. McIntyre, e.e., Corps of Engineers, stationed at Fort Belvoir, Virginia, has been promoted to Captain.

'37 James A. Hughes, e.e., Corps of Engineers, has been promoted to Major. He is stationed at Nashville, Tennessee, Hq. 552nd Engineers, Heavy Ponton Battalion.

'42 Arthur D. Owens, m.e., Air Corps, Assistant Enginering Officer at Hunter Field, has been promoted to First Lieutenant.

Obituary:

Word has been received of the death of Orange Edward McMeans, e.e., '96. He had been for many years the head of the firm of McMeans and Tripp, Consulting Ind. Engineers.

Mr. McMeans was born in Richmond, Indiana, on July 30, 1869. After attending Richmond schools, he entered Rose, where he received the degree of Bachelor of Science in 1896 and Master of Science in 1900 in electrical engineering.

Thereafter he served as an instructor at Rose and the University of Kansas. McMeans served in various engineering capacities before establishing his own firm in 1904.

The class of '26 may remember him as their commencement speaker.

He was very active in church, civic, and engineering circles in Indianapolis.

INDIANA GAS & CHEMICAL

(*Continued from Page* 5)

water and lime is used to remove the water. The liquor is then concentrated to about 20 percent ammonia and stored in tanks ready to be used.

The next step in the process is the removing of the crude light oils. The gas goes through a series of scrubbers where special paraffin base oils, which are petroleum products, remove the crude light oils. These paraffin base oils are known as wash oils and are used because they can be steam distilled without breaking down. The benzolized wash oil, which contains the crude light oils, is raised to a temperature of 130 degrees C. by indirect steam heat. The heated oil is then sent to a stripping still where it is brought into contact with live steam which distills off the benzol oils. The residue which remains contains the wash oil and naphthalene, so it is cooled down and the naphthalene crystalizes out. After cooling down removes the naphthalene, the wash oil is sent back to the scrubbers to be used again. Very little of the wash oil is lost and it goes through the process in an almost continuous cycle.

After removal of the wash oils, the benzol oils are washed with 66 Degree Baume acid to remove unsaturates present and caustic soda is then used to neutralize the acid.

The washed light oils are now ready for distillation. A dephlegmator still or reflex column is used to fractionally distill the oils that are left. By controlling the temperature of the still and of the outlets, benzol, toluol, xylol, and naphtha will come off at successive stages.

When the crude light oils were removed from the coal gas, the gas was left in a pure state except for hydrogen sulfide which was present. Because of the objectionable odor and discolorization which it causes, the hydrogen sulfide is removed with sodium carbonate. The gas is then pumped into holding tanks ready for use.

The complete list of regular products is coke, ammonia, coal tar, fuel gas, benzol, naphthalene, xylol, and toluol.

A few products are formed which are not part of the processes upon which the plant is based. Puryidine is one of these and it is used to make one of the sulfa- drugs. Cyanide is also produced but it's recovery is very expensive and the amount produced is quite small. Phenol is also formed, although no attempt is made to recover it at the Indiana Gas and Chemical Corp.

About 600 tons of coal are used per day at the plant. Tests are made daily on the products. The B.T.U. content of the fuel gas must be maintained from around 550 to 570 B.T.U. per cubic foot of gas. Shatter tests are made on the coke to determine the amount of carbon it contains, which should be around 91 percent.

Although the "coke plant" itself is not a defense industry, around 30 percent of its customers are engaged in war work. The plant sells it's products to practically the same buyers in war time as it does in peace time. The coke sold to industry is known as "breeze" coke, and about 88 to 90 percent of the total production of coke goes to such companies as the Aluminum Co. of America and the American Smelting and Refining Co. The remaining coke goes to domestic users. Part of the fuel gas produced is used in the plant itself, and the rest is sold to Brazil, Clinton, and Terre Haute. Coal tar is sold to the Midwest Tar Products Co., which distills it to make other products. Benzol is sold to the Barrett Co. and to the Wabash Products Co. while ammonia goes to a soda ash manufacturer.

The "coke plant" sells its products entirely on a wholesale basis. Many defense plants buy raw materials on a "package" basis, so for this reason the company sells it's products to few "defense plants", although many of its customers, themselves, are engaged in defense work or have war contracts. Thus the company remains practically the same during war or peace times, although it is only natural that an even larger portion of its products be diverted into industry during war times than to the domestic users.

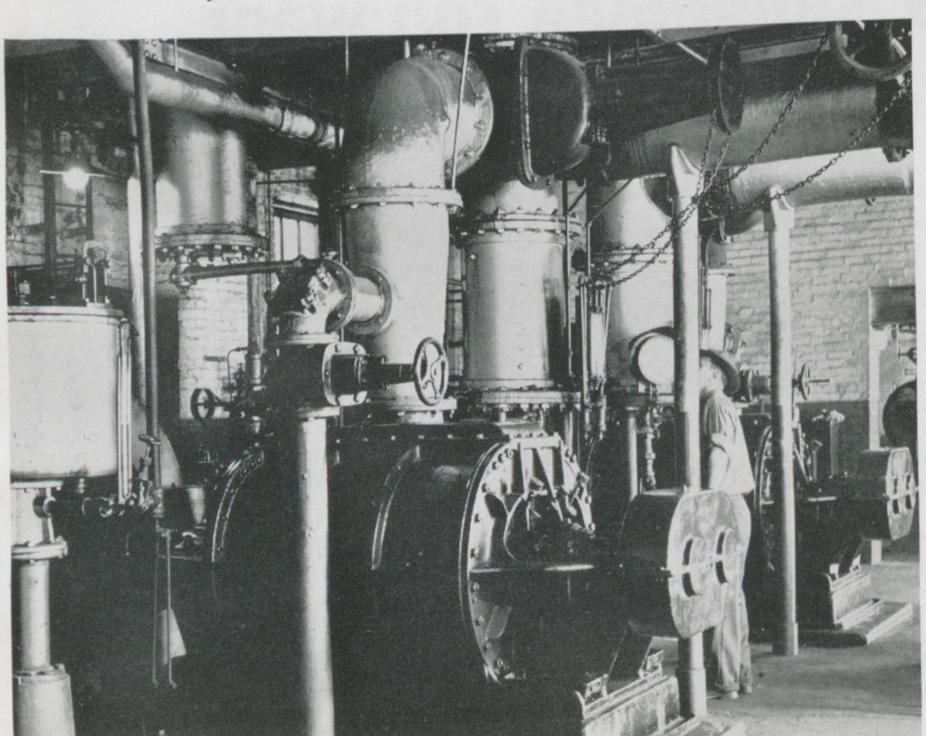


Photo by Lundgren and Weinhardt

Pumps for handling gas in coke plant.

Fraternity Notes

Lambda Chi Alpha

Theta Kappa Zeta is pleased to announce the pledging of four freshmen as a result of the recent rush week. The men are Charles Bashe, Saint Marys; George Kyle, Clinton; and Fred Maienschein and John Mitchell of Terre Haute.

During rush week, the administrative secretary of the fraternity, who is a frequent visitor to our chapter, conducted some interesting experiments in hypnosis, which were enjoyed by the two groups of rushees.

A dinner meeting was held at the Roma on October 26, in honor of the new pledges. At this meeting, final plans were made for a hayride on October 30.

Theta Xi

The Kappa Chapter of Theta Xi held rush in conjunction with the other fraternities on the week-end of October 23 for the freshmen that entered school in June. The following three men were pledged Monday evening, October 25: William Dedert, Crete, Ill.; Louis Fellwock, Evansville, Ind., and Prewitt Wehle, Louisville, Ky.

Kappa is proud to announce the graduation in October of Dean Albon, chemical, and Charles Eirk, Harry Frye, Richard Garrett, Edward Moller, James Murphy, and Russell Northam, all of the mechanical course. Albon, Frye, and Garrett were members of the advanced R.O.T.C. They were taken into the army in June and sent to Rose to complete their education. When they graduated, they were sent to Fort Belvoir, Va., to finish their officer training.

The Chapter was visited the week-end of October 23 by two former actives. George Cornelius, who left school in June, 1942, and is now a bombardier in the Army Air Force, visited the house briefly on Sunday. George has been on various bombing missions in the Aleutians. Carl Woolcott also visited the house that week-end. Carl is one of the juniors in the advanced R.O.T.C. who was taken out of school in June. He completed his basic training at Fort Leonard Wood, Mo. At that time he was stationed at Ohio State in Columbus, O. He expected to come back to school within several weeks to complete his education. Richard Pence, who also left the fraternity with the R.O.T.C. in June, expected to return to school at the same time.

Sigma Nu

After returning from a weeks vacation the chapter cast its thoughts to books and rush. The opening of the new semester brought ten active members back to the house. With the opening of the new term, the chapter's house mother returned from a month's vacation to again assume her duties.

On October 23 and 24 the chapter held rush parties for the freshman class. A new and original plan was carried out which proved a good time for all the rushees and actives. The afternoon was spent in bowling at the Vigo Recreational Alleys.

With the result of the rush parties the chapter obtained six new pledges. Henry Schoemehl, Fred Roddy, William Waldbieser, Wayne Walter, Kenneth Waters. On October 18 the chapter pledged Joseph Miller, a senior mechanical. Plans for the pledge's open house are underway.

Betty Lou Oakes became the bride of Brother Theodore Kadel, junior mechanical, on October 9, 1943.

Alpha Tau Omega

The beginning of the fall term found the actives and pledges of Gamma Gamma returning to their books with renewed vigor, following the week's vacation. It did not take long for everyone to get back into the swing of things, though, as the first week of the new term was Hell Week for the six men pledged during the summer. Ordinarily these men would have been formally initiated at the end of that week but word was received from pledge brother Bill Booth, now in active service, saying that he would be in Terre Haute on November 3, so it was therefore decided to wait until that date to conduct initiation in order that he might be initiated also.

On the week-end of October 23-24, A.T.O., in conjunction with the other fraternities on the campus, held rush for the Freshmen who entered school last July. The rush dates consigned to A.T.O. were Saturday and Sunday nights and the rushees were entertained at those times. The Mothers' Club prepared the food for both nights and they are to be especially commended for the fine lunch they served. As a result of rush, Gamma Gamma is proud to announce the pledging of five men, those men being John A. Bartholome, Robert R. LaFollette, John W. Murdock, and Floyd E. Tingley of Terre Haute; and Norman E. Servies of Indianapolis. Gamma Gamma is happy to welcome these men as pledge brothers into the folds of Alpha Tau Omega. The formal pledging of these men was on Monday night, October 25. Following the ceremony and a short business meeting, the actives and pledges attended one of the downtown theatres.

AIR FORCE COOPERATES

(*Continued from Page* 7)

the hardships endured by these men and the degree of intelligence they exhibit in performing their duties is well above that found in any other similar group. In general the Navy Air Corps performs three major missions for the fleet. Scouting and patroling, support of warships, and the carrying of supplies to naval bases are their main duties.

Scouting

As our first line of defense the Navy uses scouting and patroling techniques extensively. The Naval air forces are used more and more to accomplish the desired missions because of their flexibility. The territory to be patrolled or scouted is usually over sea. Land or ship based planes of the landplane or seaplane type perform the mission according to the job to be done. Seaplanes used for scouting may fly from battleships or cruisers as well as from land bases. It was a land based seaplane that found the Bismark. The pilot of another patrol plane gained universal fame when the message he radioed his base read, "Sighted sub. Sank same." The Navy uses landplanes to do much of its shore patrol work. Carrier based scout planes come in for their share of fame. These are the eyes of the fleet.

Support

The Naval Air Corps is the long arm of the fleet when it comes to fighting the enemy. So called "task forces" are generally built around aircraft carriers because of their striking power.

Since some of its duties are the maintaining of outposts and since so many ships are needed elsewhere, the Navy has inaugurated its own airline to keep in close contact and to supply these outposts. In its operation it utilizes both land and seaplanes. Urgent supplies, mail, and personnel replacements are carried in while hospital cases and return mail is carried out.

Close cooperation of Army and Naval air corps with sea and land units has brought much prestige to these air forces. More and more the airplane is being used as the major tool of both offensive and defensive actions. After the war the airplane is destined to play an important role in international commerce and travel.

Submarine hunt in the Chemung Valley...

NO, it isn't a gun or a new style bomb. It's all we can show you of a special glass tube that is part of our secret submarine listening apparatus.

The same kind of tubes are used in listening devices that can pick up the menacing hum of an enemy plane miles away. And they're made out of special glass, to exacting requirements, by skilled Corning workmen in the peaceful Chemung Valley in Southern New York State.

Did we say "peaceful"? That isn't exactly correct. No subs actually prowl the Chemung, but there's plenty of warlike activity going on at Corning Glass Works, just as in every glassworks in the whole United States.

For Corning, like other glassmakers, was ready to turn its skill and experience to our country's use before the smoke had cleared at Pearl Harbor. For example, since World War I, Corning has developed medical and chemical glassware that frees this nation from dependence on foreign imports. This material is now flowing in a steady stream to industry, hospitals, and laboratories.

Hundreds of other items are made by Corning to aid the war effort. Optical glass, insulators for planes and tanks and ships, heavy glass parts for the manufacture of explosives, even glass precision gauges (ring, plug and others). Many of these jobs represent new uses for glass, where glass replaces metals because it is strong, resistant to wear and corrosion, and fairly plentiful. After the war many of these uses will stay, and new ones will be added because glass is a material of endless possibilities. And then, as now, Corning will be the center of American glass research.

In your own future as an engineer, *keep your eye on glass!* Corning Glass Works, Corning, New York.

CORNING
means
Research in Glass

MAGNAFLUX

(Continued from Page 9)

the use of a darkened room for best results. A combination of Magnaglo and residual testing would be the solution for rapid magnetic inspection.

Magnetic inspection is limited in scope by the characteristics of the metals being used. Non-ferrous and Austenitic metals are inspected by radiography, thus insuring a complete scope of non-destructive testing.

Magnaflux saves much time and money in industrial plants. Castings and forgings are generally Magnafluxed before machining. Any defects located here represent considerable savings in man hours. As a safety factor the part is Magnafluxed after machining. This is especially essential in aircraft landing gear and engine parts. Essential parts of aircraft engines are removed after a certain number of hours of flying time and Magnafluxed. Thus much faith has been placed in the Magnaflux principle, both as a production factor and a safety factor.

COMBUSTION-GAS TURBINES

(Continued from Page 11)

pressor flows to the combustion chamber (C) where fuel oil is burned. The gaseous products of combustion are then returned to the turbine and expanded through it. On the same shaft as the turbine and compressor is an electrical generator (D), which is powered by the excess power developed by the turbine (beyond the power required to drive the compressor). Also on the shaft is a small starting motor (E) which is used to start the turbine and bring it up to about 25 percent of the normal speed, at which point the turbine is capable of driving the compressor.

The turbine proper is very similar to the mechanism used in steam turbines. The gases pass over the rotor blades, then over reaction blades set in the casing into the next set of rotor blades. Recent advances in metallurgy have made possible metals which will withstand continued temperatures in excess of 1000° F. at which the gas turbine operates. Fig. 2 shows a partially assembled gas turbine-axial compressor unit built for power plant use. From left to right is shown: the emergency governor which operates a by-pass mechanism upon the attainment of a predetermined speed; a turbine shaft bearing; a labyrinth sealing gland; the turbine inlet opening; the turbine proper; the turbine exhaust opening; a labyrinth sealing gland (not visible); a shaft bearing; and the solid coupling between the turbine and the compressor.

Continuing along the compressor shaft in the same direction can be seen: a shaft bearing; a labyrinth sealing gland; the compressor intake; 21 rows of compressor blading; a shaft bearing; and a coupling to a reduction gear.

To complete this power plant unit, a generator, combustion chamber, fuel controls, and a lubrication sys-

tem must be added. Note that the usual intricacies of the steam power plant with its boiler, water treatment plant, condenser, pumps, and cooling towers are missing. Note also that a power plant using a gas turbine may be located wherever convenient, without regard for sites near a water supply, as only air and fuel oil are needed for its operation.

The axial compressor as used with a gas turbine is a necessary part of the turbine. The construction of the compressor resembles the turbine in reverse. As in the turbine, the blades are of airfoil shape. The rotor is made of a hollow forged-steel drum, to which the moving blades are attached. The casing, to which the stationary blades are attached, is made of cast iron. As the compressor is not subjected to the higher temperatures of the turbine, the quality of the metals need not be so high.

As the gas turbine becomes more efficient, more and more applications are being found. One of the more recent is the development of the turbo-supercharger for aircraft. A small gas turbine is driven by exhaust gases from the engine and in turn drives an axial compressor large enough to supercharge the aircraft engine. No combustion chamber is needed as the engine itself serves as the combustion chamber.

This process of using a gas turbine driven by exhaust gases is also used to supercharge boilers and Diesel engines. In this way, it is claimed, the efficiency of the boiler or engine can be increased several percent.

The principal commercial application of the gas turbine in the United States has been in the oil refinery industry, in connection with the Houdry process. Here exhaust gases are used to drive a gas turbine-axial compressor-generator set which supplies power used elsewhere in the process.

A 4000 kw electric generating gas turbine has been built by Brown, Boveri and Company for the city of Neuchatel, Switzerland. This unit is an underground bombproof power plant. It has been operating for certain periods each week since 1940. Recently published tests indicate a thermal efficiency of 18.04 percent.

A 2200-hp locomotive has been built for Swiss Federated Railways by Brown, Boveri and Company. This locomotive employs an electrical generator in connection with its gas turbine unit. The gas turbine type of locomotive has many advantages over the steam locomotive, and some over the Diesel. In all probability these advantages will become more pronounced as the gas turbine design is improved.

In this country, the Allis Chalmers Company has made an engineering study of the larger type of gas-turbine locomotive. The design adopted used two 2500-hp units

coupled to the driving wheels by a mechanical transmission with a hydraulic clutch. Each unit is of the two-turbine type. One of the turbines drives only the axial compressor, furnishing compressed air for itself and also for the driving turbine. In this way, the compressors can be driven at their optimum speed regardless of the speed of the locomotive.

The gas turbine has been considered for marine use, but would be handicapped by the present design of ships. At times it might be impossible to obtain the great amount of air needed without also drawing in large amounts of water. Other applications should undoubtedly be developed for the gas turbine such as blast furnaces, wind tunnels, remotely controlled power plants, and other special applications.

MY ATHLETIC CAREER

(Continued from Page 14)

donate my saliva (in the form of spit) for non-league tilts, so our star pitcher wouldn't go dry for the league frays. Our hurler just couldn't partch a good game. I tried playing tennis at one time but I ruined an eggbeater, my dads snowshoes and my sisters five snoods. The family forced me to give up tennis for purely economical reasons. I have played some golf and my brother thought I was a pretty good golfer until one day last summer. I set a ball in the dimple on the end of his nose and was going to knock it off (The golf ball of course). Well, I swung and took a slight divot in the form of my brothers nose and he promptly swallowed the ball. I later retrieved the slightly digested Acushnet so at least I am patriotic. My brother was patriotic at the time too. His blood was red; he was blue over loosing his nose; and he thought it was white of me to replace the divot. The last sport added to my repertoire is bowling. I went to the bowling alley for one hour every day for the past two years and a couple of weeks ago my fondest dream came true. I finally was able to lift a women's bowling ball. Now it seems easy to be able to lift the ball but lifting and throwing it with two hands isn't quite the accepted form. The first ten times I went all the way down the alley with the ball but you meet more pin boys that way. I roll one of the straightest gutter balls you have ever seen. Now I am practicing hard so sometime in the near future I will be able to knock down a pin or so.

Sometime I will be able to find a sport that I will excel in but at present I am satisfied with being able to chew a good game of gum.

COEFFICIENT LIPSTICK DISTRIBUTION

(*Continued from Page* 15)

June, a period of high mean temperature, than in any other month of the year. The areas of the contacting surfaces have their direct effect.

Working Equations

$$(1)\quad \triangle = \frac{(T+i)\dfrac{A_1}{A_2}}{ti\ (B)} N$$

$$(2)\quad D = \triangle PII$$

Units

P=lb./sq. in.
T=number of applications
A_1 and A_2=sq. in.
t=time in seconds
i=candlepower
B—Standard Rasp, Number (ASM)

Methods of Conducting Tests

To secure the necessary data for use in the equations, tests must be

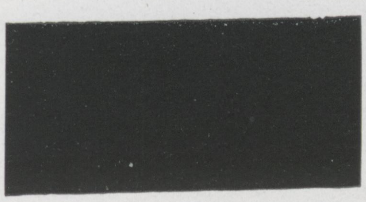


Fig. 2. Laboratory under lighting conditions permitting infinite distribution.

conducted under standard conditions. One variable alone is allowed to vary in each set of determinations. The only apparatus necessary are the lipstick, two willing surfaces, and a standard 200-mesh linen handkerchief which must be unstarched. A test of pressure, for example, will probably require twenty determinations all with different pressures. The results should be placed in order around the edge of the handkerchief with notes as to the surface conditions. If any signs of passion are present, disregard the results of the tests, but continue to run them until all signs of passion are dissipated. As many as 150-175 determinations may be run in the course of an evening under normal operating conditions. If conditions become ideal, do not hesitate to take advantage as they may be hard to duplicate.

Author's note: All information used in this report is from usually reliable sources.

RES. & DEVELOPMENT

(*Continued from Page* 13)

having a certain mass, or weight, travel down the center of the tube, around the bend and through a tiny slit in a metal target at the other end.

The molecules going through the target are collected on a metal plate where they give up their charges. Then the charges are amplified and counted by electric meters that indicate how many molecules of a certain weight are in the mixture.

Molecules weighing less than those hitting the target are pulled to the metal lining of the tube before they can get around the bend. Heavier ones offer more resistance to the electromagnet's pull and strike the other wall of the tube as they try to negotiate the bend.

The mass spectrometer requires only a thimbleful of gas for each test. Butadiene plant chemists now have to draw off a bucketful of gas for the involved laboratory procedure of breaking down the mixture by "fractionating" or distilling.

Electric Hand Grinding Tool

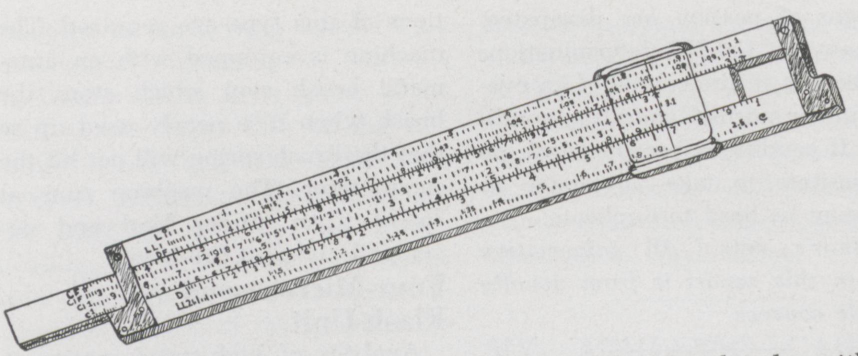
Precise Products Company has developed a high speed hand tool for grinding, drilling, and milling where delicate and accurate operations of this type are required. The machine is equipped with an automatic brush stop which stops the brush when it is nearly used up so that the brush spring will not hit the commutator. The machine runs at 35,000 r.p.m. under load and develops 1/6 h.p. at full load.

Four-Microsecond Flash Unit

Analysis of high-speed motion is now possible with a flash unit that has a speed of four millionth of a second. In this length of time an object traveling 2,000 feet per second moves but 0.096 inch and is practically "frozen" by a camera used in conjunction with the light.

The flash unit, developed by engineers in the laboratories of the General Electric Company contains 100-Watt high-pressure mercury vapor lamp about the size of a cigarette. Flashing the lamp is accomplished by charging a capacitor to a potential of 2,000 volts and then permitting it to discharge through the lamp. The rate of discharge is about 2,000 amperes, with a peak power of 4,000,000 watts, but due to the short duration of the flash, the high current does not cause serious beating.

The amount of illumination obtained from the lamp at a distance of fifteen feet is photographically equivalent to over 1,000,000 foot-candles of light from a tungsten lamp.



Sly Droolings

by JAY KRESS, sr., m.e.

"May I kiss your hand?"

"What's a matter, is my mouth sticky?"

First Frosh: "Did you see Jack's black eye?"

Second Frosh: "No, how did he get it?"

First Frosh: "He mistook his girl's asthma for passion."

Mary had a little swing,
It isn't hard to find,
And everywhere that Mary goes
The swing is just behind.

"Now," said the college man to his dad at the football game, "you'll see more excitement for two dollars than you ever saw before."

"I don't know," replied the old gent, "that's what my marriage license cost me."

All work and no play makes Jack and lots of it.

A dainty foot, a lovely torso
Can make a friendly feeling more so.

And the old maid said: "Don't put 'Miss' on my tombstone when I am gone, for I haven't missed as much as you think I have."

Colwell: "Where is the balance of your rifle?"

Wehle: "This is all they gave me."

Found on Freshman's registration card: Name of parents: "Mamma and Papa."

First Co-ed: "Jimmy is grand, but I think all men are trying sometimes."

Second Co-ed: "All the time, dearie, all the time."

Admiral Byrd took a dog with him to help him find the south pole. Wise Admiral.

And always remember, Oswald, that the difference between a model woman and a woman model is that the former is a bare possibility and the other a naked fact.

KIS$_2$

FORMULA: Kis$_2$

PROPERTIES: Ethereal in nature. Taste, sweet, color: colorless to deep red. Is not affected by water, but reacts strongly to alcohol.

Occurrence: Cars, porches, parlors, and parks. In most cases the compound has only a transitory existence, but it may exist for a considerable period of time.

Chemical Behavior: It quickly breaks when exposed to a bright light, but seems more stable by moon light. It frequently plays the part of a catalyst producing bonds of a more permanent nature. The appearance of the parent compound produces a quick and violent displacement of the individual members of the compound.

Future Development: Although it is not new, it is constantly being rediscovered. Very little is known about the nature of the compound, in spite of the fact that many heads are busily engaged on the problem until late every night.

"I would like to see some alligator shoes."

"What size shoes does your alligator wear?"

The officer of the day stopped a mess orderly as he was carrying a soup kettle out of the kitchen.

"Here you," he snapped, "give me a taste of that!"

Obediently he was handed a ladle, and he tasted it.

"Great Scott! Do you call that soup?" he roared.

"No sir," replied the orderly meekly, "That's dishwater."

I call my gal "Checkers" 'cause she jumps when I make a bad move.

The magician walked down to the footlights and asked a young lady to step up on the stage.

"Now as a climax to my act, ladies and gentlemen," he said, "I am going to saw this young lady in two, right before your eyes."

The crowd cheered and stamped its feet.

"As is customary before doing this act," he continued, "I'd like first to make sure that you all want to see . . ."

A thundering "SURE!"

"And that there are no objections to my performing . . ."

A "NO" that rocked the house.

The girl's sorority sisters—do they object?"

"Not at all, to be sure."

"How about you?" he asked, turning to the girl. "Do you mind being sawed in two?"

The girl shook her head.

"Well, then," the magician said.

And he sawed the young lady in two.

We all thought it was funny as hell, but the police made quite a fuss about it.

Campus News

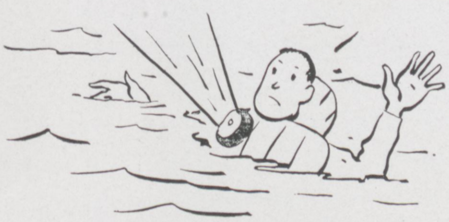
RESEARCH AND ENGINEERING KEEP GENERAL ELECTRIC YEARS AHEAD

. . . PASS THE PLASTICS AMMUNITION

INSTRUCTION instead of destruction is the purpose of the new machine gun developed recently by the Edison General Electric Appliance Company. Designed to train soldiers, the new gun uses plastics bullets and compressed air instead of expensive bullets and gunpowder.

Operated by electricity, built to the actual size and appearance of the 50-calibre Browning machine gun, the new model will fire 600 rounds of plastics bullets per minute—the same rate as the Browning. But the new bullets cost less than a cent apiece (and can be used over and over), compared to the approximately 30-cent cost of each Browning bullet.

Amplified "explosions" of compressed air accustom the trainee to the sound of actual firing and tend to eliminate the jitters he might otherwise experience in his first combat.



TO THE RESCUE

BY the summer of '43 about the only new tail lights left were those on lightning bugs. The other kind were helping to save shipwrecked sailors who were often lost at night, because rescue parties couldn't see them.

When the Coast Guard asked G.E. for a tiny lamp that could be attached to rubber life suits, that would glow all night long, the Company supplied the lamps that they had been making for bicycle tail lights—small, rugged lamps that lasted a long time and used very little current.

These were enclosed with their tiny batteries in waterproof cases, with safety pins for attaching to the suits. And now their red glow guides the rescue ships to the sailors in time.

THE SOUND GOES ROUND AND ROUND

WINDING up words on a doughnut-sized spool, the new sound recorder being redesigned for mass production by General Electric under license from the Armour Research Foundation will eliminate the use of pencilled notes by observers on reconnaissance planes.

Sixty-six minutes of continuous speech can be reeled up on the 11,500 feet of thread-thin wire within the recorder's small box. Though employing much the same principle as the dictaphone, the observer's words are recorded magnetically on the wire, instead of being scratched into a wax cylinder.

When the recording has served its purpose, the words can be erased magnetically, and the wire is as good as new for future use. *General Electric Co., Schenectady, N.Y.*

Hear the General Electric radio programs: "The G-E All-girl Orchestra" Sunday 10 p.m. EWT, NBC—"The World Today" news, every weekday 6:45 p.m. EWT, CBS.

GENERAL ELECTRIC

953-72-211

192,000 employees of the General Electric Company are on their jobs producing war goods and buying over a million dollars of War Bonds every week to hasten victory.


WHAT I CAN'T DO WITHOUT
IT'S CHESTERFIELD
When you smoke CHESTERFIELDS you know you're getting the best tobaccos that money can buy—but that's not all . . . the world's best cigarette tobaccos, yes . . . but the blend—Chesterfields' Right Combination—that's the thing.
That's why your Chesterfields are Milder and Better-Tasting...that's why they always SATISFY.
GOOD TOBACCOS, YES
—but the BLEND
that's the thing
Chesterfield
CIGARETTES