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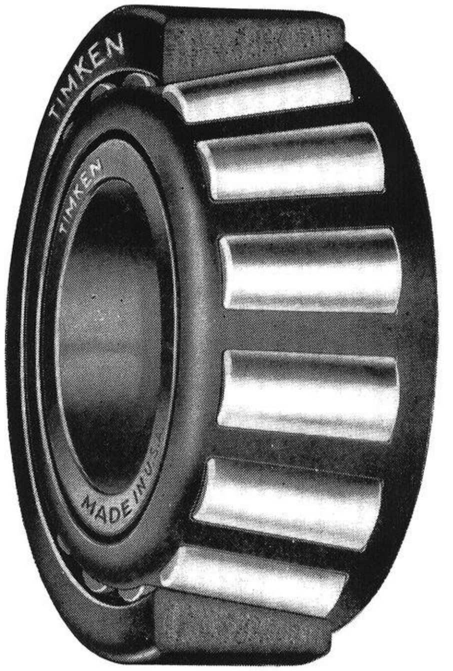

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WISCONSIN ENGINEER

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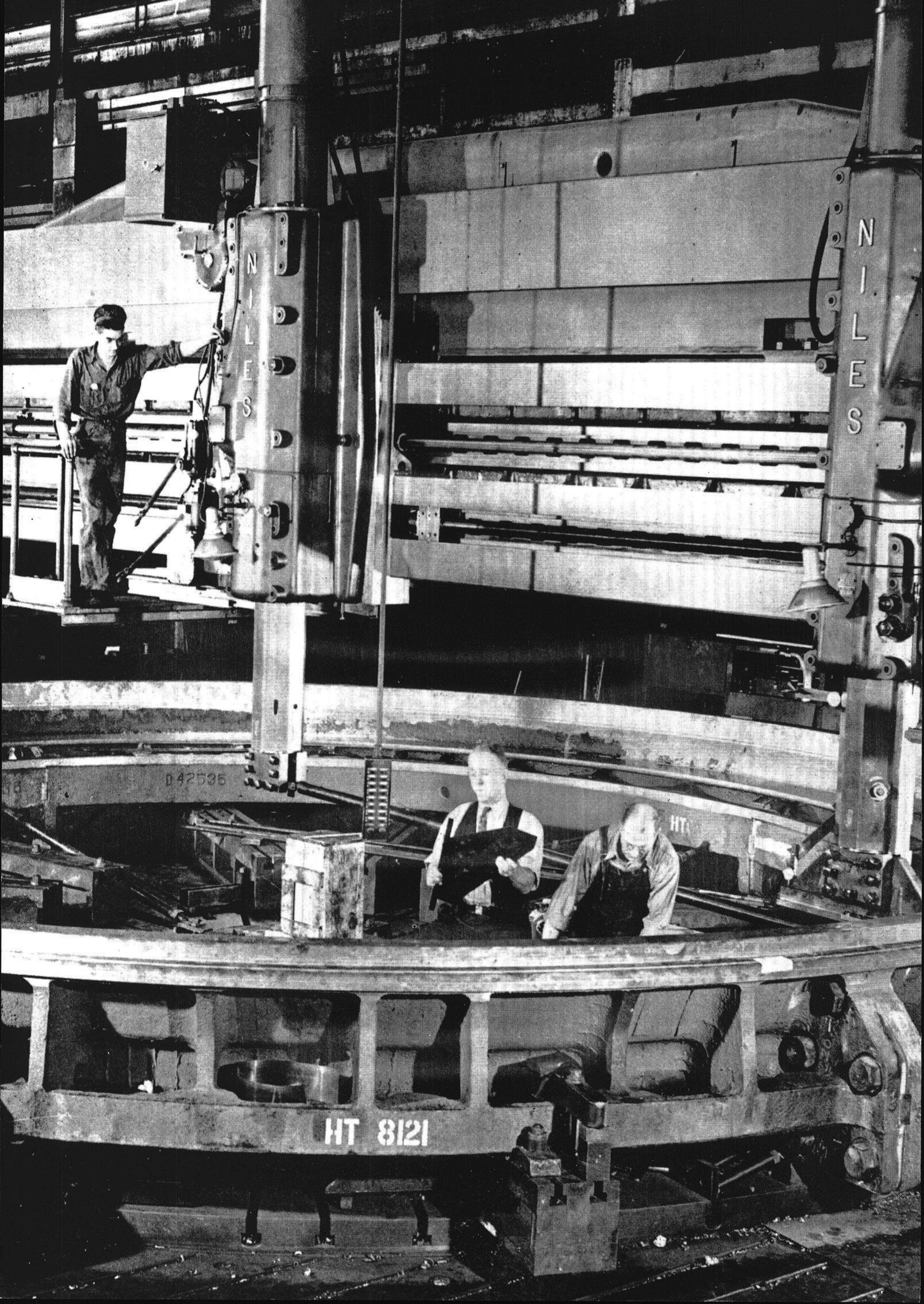
In This Issue . . .

COVER: Aviation . . . Army . . . Defense

More plane parts per day are being produced because of improved electric furnaces. For example, with a Westinghouse controlled-atmosphere furnace, a single factory shift hardened 20,000 small alloy bolts that would have taken a week in a conventional furnace, plus the added cost and delay of pickling.
—Courtesy Westinghouse

FRONTISPIECE:

This big metal ring—the base for a large gun mount—is being machined on a giant boring mill at the Westinghouse Electric and Manufacturing Company's East Pittsburgh works. Shipped in four sections, the ring weighs 92 tons. The Westinghouse boring mill is one of the few in the United States large enough to accurately machine this assembled ring. As the gun mount base ring slowly revolves, a forged steel cutting tool accurately machines a roller path surface.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A GLANCE AT THE GAS TURBINE

—Don Hyzer, me'46

THE gas turbine has been a natural development following the gasoline engine, just as the steam turbine followed the steam engine. Its actual development was started in the eighteenth century, but it never came into its own until recent years.

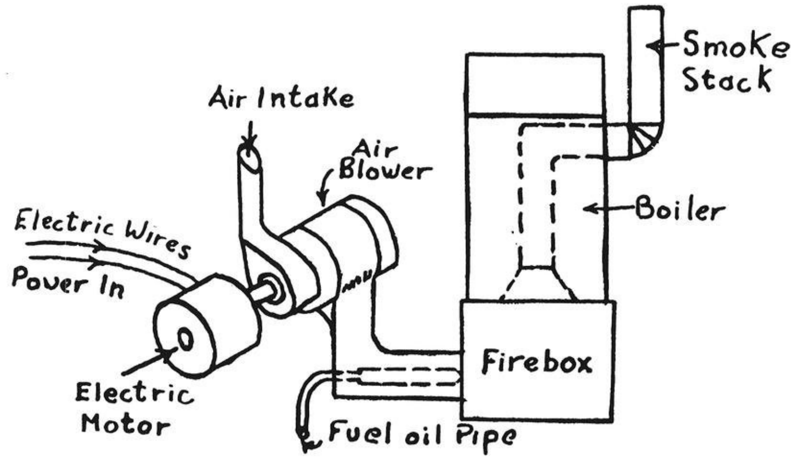
The oil burner in the home with modifications is a type of gas turbine which can be used to show its operation. A typical oil burner has an electric motor which drives an air blower. The air and fuel come together in the firebox to produce a flame which heats the boiler. In the gas turbine unit, instead of the gases escaping they go into the turbine which replaces the boiler and produce power. The power is used to operate the blower and also a generator which replaces the motor. The generator is used as a motor when starting the unit.

The gas turbine has the advantage over other engines in that it operates at higher temperatures. This advantage is because in "heat engines" if the input temperature is high the efficiency is high, other factors remaining equal. The fact that it is very simple with no recipitating parts puts its above its mate, the gas engine. Besides there is no chance of it freezing up, because of the absence of freezable liquids. Odd it is that the colder the outside temperature becomes the more efficiently the machine runs. This fact makes it especially applicable for use on airplanes.

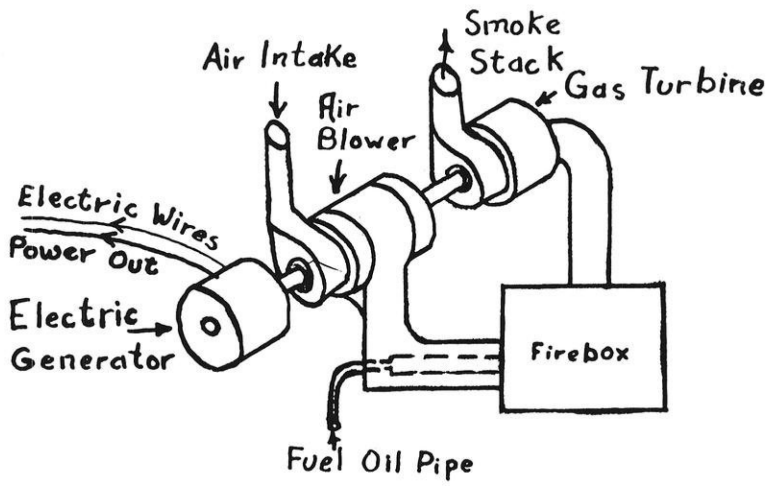
Many turbocharged diesel locomotives have been built, but the only one built using the gas turbine in place of the diesel is in Switzerland. The gas turbine is being used in industries where hot gases are given off because of some manufacturing process.

A central power station using a gas turbine as the power unit was built in Switzerland by Brown, Boveri, & Company. It is installed as a bombproof unit to furnish power in case of an emergency. The advantages are that it is cheap, light, simple in design, small, and is not dependent on any water supply. It has also shown its value on relieving peak loads, although it cannot yet compete with the modern steam plant on base loads.

One of the greatest developments of the gas turbine has been for supercharging airplane engines, a subject which will not be covered here. Its use as a prime mover and stationary engine is becoming more widespread with those in use showing good qualities which insure its growth.



OIL BURNER



THE ELEMENTARY GAS TURBINE

References:

The Basic Gas-Turbine and Some of Its Variants
By J. Kenneth Salisbury

The Modern Gas Turbine
By R. Tom Sawyer

Wings Via Mother's Pie Plate

—Ralph A. Watson, m&m'46

ALTHOUGH the facts are not yet widely known, it may be said that Wisconsin industries are letting no dust collect in their research labs. Two notable examples of pioneering in the development of new and better products are the low pressure laminates being developed by the Consolidated Water Power and Paper Company of Wisconsin Rapids and the resin faced plywood recently put on the market by the Kimberly-Clark Corporation of Neenah. Both of these companies have large research staffs assigned to the search for new uses for paper and other wood products.

The laminates are of paper or fabric impregnated with phenolic or urea resins. The layers are precut roughly to final shape by standard dies and shears before the resin is applied. Forming is done over low cost molds and the resin is cured by heat at low pressures. Some have strength weight ratios equal to metal.

Though they were first developed as a substitute for the scarce light aircraft metals, these laminates are now used for many purposes including binocular cases by the Navy, safety hats for miners and construction workers, electrical parts (principally housings), jettison gasoline tanks by the Army Air Forces, and even airplane wing tips. Many other uses are being studied. The Coast Guard is testing channel buoys made of laminates. The saving of 350 lbs. weight giving greater freeboard with consequent increased visibility, coupled with a similar saving in cost, is very convincing. Machine gun ammunition boxes made of such laminates illustrate its resistance to abrasion particularly well. Samples tested fed 1200 continuous rounds of ammunition without jamming. Metal doesn't match that performance.

Laminates now used in the aircraft industry equal and exceed the strength and stiffness of aircraft aluminum on a weight basis. Impact strengths of 20 to 25 foot pounds are obtained as compared with 2 foot pounds for most molded plastics. Fatigue tests of 10 to 60 million flexes result in no deformation and virtually no fatigue. They compare favorably with other plastics in chemical and electrical properties. Aircraft with fuselage, wing and tail sections built of low pressure laminates have been assembled and are now being tested. Top tensile strength of the molded laminates is more than 80,000 pounds per square inch obtained with fiberglass fabric. Most tests, however, run about 40,000 to 50,000 pounds per square inch. Cotton fabrics show low strengths, averaging from 9,000 to 12,000 pounds per square inch, while some paper laminates equal the strength attained by those of fiberglass fabric.

Perhaps the most significant feature to be noted when considering the use of the laminates is their low cost and ease of fabrication. It is said that "they mold as easily as dropping a wet handkerchief over a pie tin". Large and small, simple and complex shapes are easily formed over inexpensive, easy to tool-up dies of wood, Kirksite, Formrite, cast aluminum, concrete, sheet metal, cast iron, or even molded laminates themselves. The forming techniques used in production are the autoclave, hot press, metal to metal, or variations of these. Perhaps the method most widely known is the autoclave. The layers of resin-impregnated paper or fabric are placed between the mold and an inflated rubber bag before the entire assembly is sealed in the autoclave. Steam, hot air, or even hot water is forced into the autoclave under pressure to cure the resin in the laminate. Curing takes only 15 to 30 minutes after which the cured shape is removed and set aside to cool. The autoclave has the advantage of being able to form large complex shapes in one operation thus saving assembly costs.

The simple "hot press" principal is used for molding smaller parts. The press consists of a heated lower die of aluminum or Kirksite and a rubber bag which is inflated as the upper die. The resin coated layers are put into the lower die and the upper die lowered. Air or water is then introduced into the rubber bag forcing the impregnated layers to conform to the contour of the heated lower die. The resin cures in five to nine minutes depending on the thickness of the material.

When using a method utilizing a rubber bag as one side of the die, only that part of the laminate which is in contact with the formed die is given a smooth finish.

A third method of low pressure laminating, that of using presses with heated metal male and female dies, similar to the conventional compression molding of plastics, gives both sides of the finished shape a smooth finish.

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Why Not Better Lubrication?

—J. D. Krummell

ADEQUATE lubrication, although one of the most important factors affecting the design, operation, and maintenance of every machine today, is probably the most neglected subject in the field of machine design and operation. No mechanism could run more than a few minutes without lubricants, yet in its design often the last thing to come to the draftsman's mind is the all-important provision for satisfactory lubrication of the moving parts.

If there were perfect lubrication, a machine would never wear out. For wear is due to friction — the greater the friction the greater the wear. And since friction results in wasted power, we are actually buying the power to wear out our machines! In a test conducted this spring in the repair shop of a major railroad, fifty-four of the shop machines in everyday use, planers, shapers, etc., were idled with no load and a recording wattmeter was attached to determine the frictional power required to turn them over. It was shown that 109.9 horsepower was necessary just to overcome the friction between the moving parts, power wasted as far as useful output is concerned. The oil in each machine was then replaced with a grade of lubricant recommended by an expert as better suited to the task, and clogged oil holes were opened. Nothing else was done, yet when the same machines were again idled at no load under exactly the same conditions the wattmeter showed that friction losses had fallen to 83.5 h.p., a drop of 25%. Thus, by merely giving proper attention to the lubrication of the machines friction was cut one-fourth; this reduction effected a saving in power costs of $970 per year in that one shop alone! Other advantages in addition to the direct saving in power include greater production, since time lost for repairs and adjustment was reduced, an increase in the useful life of the machines, for they now required less maintenance, and incidentally, a saving due to the lesser amount of lubricant now necessary.

A film of oil of microscopic thickness is all that is necessary to lubricate a moving part — any amount in excess of this minute quantity is a waste of oil and money. However, in most shops oil is applied to the bearings at intervals of several hours or even days in a haphazard and

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Side Glance at the V-12 Unit

—Gerald Brown, ph e'46

Looking across Observatory Hill to Navy Barracks.

WITH no Purple Hearts, no DFC's, the Battle of Lake Mendota continues with unabated fury for the Navy slipstick shovers. But don't confuse these fellows with the pre-war engineers, for thick lens glasses, studious looks, long hair and social hermitage of the old engineer-stude have met their end.

The battle may be described as figurative and graphic. Burning the midnight oil is casualty of war for even the Beavers, since rise and be bright comes at 6 a. m. After an excrutiatingly hard period of calisthenics, the breakfast of milk and ground glass is attacked, the dust rearranged in the rooms and the V-12 is off to class. The lack of sleep is quickly made up, with only minor interruptions by intermittently ringing bells.

Of the afternoon courses, Rathskeller 180—Individual Study, leads in popularity and, as a consequence, most V-12's are often full of school spirits.

The evenings are studious and quiet except for breaks now and then in the normal roar.

A V-12's weekends vary from the week-days only in the subject being pursued. While the Navy insures that any degree will be a Bachelor's degree, the Navy slipster is not backwards socially. But necktiques are so diverse that space does not permit consideration.

So there we have the pound of vinegar, 10^{30} electrons, etc., that make up the Wisconsin engineer, individual component of the Battle of the Lake.

Diesel Fuel Testing

—William R. Wendt, Jr.

WITH the Diesel engine increasing in popularity as both a source of community power and railroad locomotion, the importance of rating Diesel fuel oils proportionately enlarges.

Two main factors for preventing detonation in the compression ignition engine are the ability of the fuel to burn smoothly and the ability to ignite quickly.

It is customary to rate fuel oils according to "cetane number" as a means of classifying their ignition qualities. A 70 cetane number indicates that the fuel has the same ignition characteristics as that of a mixture of 70% cetane (cetane rating of 100) and 30% alpha-methyl napthalene (cetane rating of 0).

The need for a method of testing fuels for ignition qualities rapidly and correctly was recognized in the early '30's. At this time extensive research was being carried on by a committee of the Society of Automotive Engineers.

From this research came the forerunner of the current standard test engine built in this country solely by the Waukesha Motors Company.

The test equipment consists of a small single cylinder Diesel engine with a special variable compression cylinder. The speed is maintained constant by a synchronous motor belted to the engine.

In order to measure the ignition lag, both the start of injection and the beginning of combustion must be indicated. The former is attained by having the injector needle valve close electrical contacts when it leaves its seat at the instant injection begins. The combustion indicator consists of two other contact points connected to a pressure diaphragm located in the cylinder. When the pressure increases to just above compression pressure, electrical contact again results. Adjustments may be made on the indicator to compensate for varying peak compression pressures.

Both of the sets of electrical contacts are wired by means of slip rings to neon bulbs placed on the flywheel, 13° apart. Since standard test conditions call for a 13° ignition lag, the lights flash simultaneously through a pair of slits in the flywheel cover when correct conditions prevail.

The test procedure may be outlined as follows:

1. An unknown fuel is placed in the engine, being run

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Ethyl Alcohol From Wood

—Elwin A. Harris

DURING peace time, the alcohol that came from the fermentation of grain supplied most of our needs in this country. Now in war time, however, this source of alcohol has become inadequate and new methods for its production had to be brought to the fore.

A method utilizing as a prime raw material the heretofore wasted sawdust from the nation's saw mills has been developed and is being put into operation. Upon hydrolysis with dilute sulfuric acid, the cellulose and hemicellulose of wood is decomposed, and of the resulting products, the carbohydrates and the simple sugar glucose can be converted to alcohol by fermentation. The method has been used in this country before, but only the carbohydrates were converted and the yields were low. By a German process, the cellulose was also hydrolyzed, but the time required for hydrolysis was long—from 15 to 20 hours.

At the request of the War Production Board the Forest Products Laboratory investigated wood hydrolysis. They tested many kinds of both hard and soft woods, obtaining from 50 to 55 gallons of alcohol per ton of softwood and from 35 to 42 gallons per ton from hardwoods. The hydrolysis was made in much less time than by the German process.

An important matter to be considered was the fact that the products of the hydrolysis, glucose and carbohydrates will also decompose by hydrolysis if allowed to remain in the reaction chamber. Therefore some method had to be devised to remove the sugar as it was formed. This was accomplished by passing several different charges of dilute acid through the sawdust consecutively and removing each at the time which permitted the greatest hydrolysis of the cellulose and the least decomposition of the resulting sugars. The use of more and shorter treatments gave more rapid extraction of sugar and higher yields than one long treatment. It also permitted the use of a higher temperature which would increase the rate of hydrolysis and lessen the time in obtaining the same yield of sugar. The charges of acid were passed through until the yield of fermentable sugar was small enough so as to render further extraction unprofitable.

The hydrolysis is carried out in a stationary vertical digester. The sawdust or wood chips that are used are

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Engineering In Post-War Planning

—Sheldon E. Kulakow

WHEN the business of subjugating the Axis was just beginning, M. W. Smith, vice president in charge of engineering for Westinghouse Electric Manufacturing Company, made the following statement in a radio address . . . "Research is seldom wasted, and few developments are ever valueless. It is true today that the nation's industries are concentrating on the rather grim materiel of warfare, but we never lose sight of the fact that any new improvements we make in industrial processes can and will be applied to the products of peace . . . " When that statement was made there was little fact to support it. It was made largely on faith, on confidence that research and engineering, because they have in the past always engendered undreamed of benefits, will do so again. It is with much satisfaction now, after more than three years of war effort, that we can begin to point to evidence that this statement will be borne out.

The number one job still is to win the war. That end has been prosecuted without restraint. But even casual inspection shows that as by-products of that effort have come answers to many of the problems of our number two job.

What is this number two job? It is the assurance of satisfactory conditions following the war, under which the ideals and principles for which we are fighting can be expected to thrive. Any satisfactory social and economic conditions must assure at least normal employment. To replace war activities means new jobs, new ideas, new products and new applications. Plans to meet these requirements and thus begin the number two job must start now.

During the emergency, apparatus development for military uses and applications have been carried through at a rapid rate. The needs were apparent and the acceptance of successful projects by the armed forces has been prompt and spontaneous. This is contrary to the normal peacetime conditions under which it is difficult to visualize and forecast accurately a long range need and then develop equipment or devices to fill it. Furthermore, public acceptance is not usually so spontaneous. It is difficult to predict and must be cultivated.

Nothing should be done to discourage a long - range viewpoint. Promising new ideas should be kept alive. But at present, when so little time can be spared from the war effort, special emphasis should be placed upon the study and review of the technical progress and developments for the purpose of selecting the ones which show promise of early commercial application. The importance of the viewpoint is emphasized by the fact that the average industrial development requires about seven years from the idea or invention stage to its practical applications. Industry can do well to utilize to the fullest extent the momentum gained under wartime conditions to meet peacetime requirements.

The specific form that some of these new developments will take and the fields and applications in which their impact will be felt to the greatest extent after the war is difficult to predict. The most that can be done is to point out in some of the major fields of applications a few specific trends that may be considered representative of post war technical improvements we may expect to see.

Power Generation

The post-war influences on power generation will probably come from many directions. They will be political and economic as well as technical. While the change to peacetime activity will no doubt result in short-time interruptions in power requirements, it seems reasonable to expect a continued growth in the demand for electrical power and equipment. Following the release of governmental restrictive orders on the manufacturing of electrical appliances a wave of buying should result. The load created by new devices intensified by the availability of other markets such as air conditioning, automatic laundries, and the other commercial and home equipment, will create new power demands. In addition to new markets there will be favorable changes in the existing fields. Because war equipment is quite generally constructed of heavier and thicker materials than commercial equipment, less power per pound is required to produce it. For example, the induction heating of steel for automobile bodies and fenders will require much more electrical energy than a corresponding amount of steel for tanks using heavy armor.

During the past few years a great deal of progress has been made in the development of high strength material for high temperatures. To obtain high output along with light weight on special gas turbines such as those driving superchargers is the object of intensive research. Much of this work must be treated confidentially from a military standpoint and hence little information is available. In the interest of accelerating the war effort various industrial and technical institutions are pooling their knowledge and experience so that rapid advances can be made. Results of this work will undoubtedly be instrumental in extending the limits of operation on temperature and performance of various forms of prime movers. The progress on steam units has been gradual and in the nature of individual improvements. Turbogenerators with unit ratings of at least 100,000 kw. at 3,600 rpm have been attained without exceeding the normal margins of safety and reliability.

The advances toward the development of commercial gas turbines for peacetime application has been rapid. The initial step will probably be in the use of small high speed geared units (say 3000 kw. at 15,000 rpm) of the open-cycle type located near load centers close to the point of utilization of the electrical energy. Such prime movers would be convenient for small generation plants.

For larger blocks of power as those required in the main power stations, a battery of small units may be used with the individual units started and stopped in push-button fashion to operate at a peak of efficiency. A second and larger step may be in larger capacity, individual gas turbines of the closed-cycle type complete with modern heat exchangers and having efficiencies approaching modern steam units, along with weight and space reductions that will possibly make them attractive for ship drives.

After examining the great number of new projects now in production as well as those under development, one is inclined to believe that the fields of communication and transportation are the ones most likely to be radically affected by wartime development. Moreover, congested conditions found on trains and buses suggest that the public is becoming more "travel conscious" and there will be ever increasing demands for more rapid means of communication and transportation.

Communications and Electronics

Most of the new developments in the communications field are being applied to military uses and are still in a secret category, but it is apparent that the horizon is being greatly expanded and that the new radio circuits, vacuum tubes and various other electronic devices will find many peacetime uses and applications. For example, many of the recent improvements are in the same frequency as television and it is apparent that the knowledge and experience being accumulated will add materially to its technical quality and value.

Many of the anticipated post-war applications for communication purposes now being stimulated through military developments will likewise be in the field of electronics; however, that statement is by no means to be taken to imply that the increased use of electronic devices will be limited to the communications field. For example, the mass spectrometer, a kind of "ionic centrifuge" used to separate and identify the mass of small particles of molecular or atomic size, which was formerly looked upon as a research or laboratory tool now promises to be an important tool for identification and control of certain phases of chemical analysis and processes such as those used in petroleum and synthetic rubber production.

Another promising post-war outlook for electronics is in inductive heating. These possibilities vary from the processing of the so-called non-conducting materials such as curing of plastics, bonding of plywood and shoe soles, cooking of hams, and killing of weevils in grain, to the annealing and heat treating of steel and other conducting metals.

A recent example of progress in this field is found in high frequency heating of tinned strips. Makers of tinplate learned how to deposit the tin in the steel electrolytically thereby reducing the tin required in the steel by sixty per cent. Electrolytic tin plating initially is dull in appearance and porous in body. To make the process a success, it becomes necessary to flow the tin slightly by heating it to the melting point, then allowing it to "freeze" into a hard shiny surface. Various methods had been tried, but to overcome objections inherent in each of these methods, an inductive heating process was developed. Electric currents are induced in the tin by the use of high frequency oscillators (similar to those used in radio broadcasting stations) as the source of power. This system is now being adopted for many electrolytic tin plating lines, the largest of which requires 1,200 kw. oscillators. This experience will probably encourage the metal-working industry to look for other applications of high frequency power in their operations and procesess.

Transportation

In the field of transportation the post-war impact is likely to be particularly noticeable. The most violent reactions will probably result from somewhat ruthless competition between modes of transportation.

Under existing traffic demands railroad equipment is being strained to the limit under conditions that make it difficult to provide normal high standards of maintenance. An abnormal rate of equipment deterioration is consequently inevitable. At the same time, the increased traffic is providing a source of increased revenue, some of which it is hoped can be retained to replenish depleted reserves. Both of these conditions should encourage purchase of new equipment following the war.

The high sustained running speed and faster operating schedules maintained by the Diesel electric and the modern straight electric locomotives have demonstrated the advantages of high power concentration, and thus demand for increased power at high speeds is now exceeding that available from reciprocating steam locomotives. The solution may be found in the recent development of turbine-driven locomotives with the turbine geared directly to the drivers. Locomotives of this type have already been put to good use on the Pennsylvania Line. They have a rating of approximately 6500 horsepower and use some

25% fewer pounds of steam per horsepower-hour than the conventional reciprocating steam locomotive. The high speed gas turbine offers the possibility of another form of motive power for locomotives using either mechanical or electrical drives and transmission.

As other forms of transportation bring competitive pressure to bear, more consideration will be given to riding comfort. This will not be limited to more pleasant conditions and surroundings but will be directed toward body comfort through smoother riding qualities of equipment. Experiences in this war soon disclosed the need for holding guns on tanks steady while the tank was in motion over rough terrain. With this previous experience as a starting point the solution of this problem was undertaken and the successful result is indicated by the following quotation: (United States News, July 17, 1942 by General L. H. Campbell, Chief of Ordnance,) "The M-4 tank carries a specially developed device which is said to improve the accuracy of its fire by more than 500%. We can fire the 75 mm. gun when the tank is in motion which is more than any enemy tank, whatever its size, can do. We do fire our main armament on tanks when the tanks are in motion regardless of speed. And we hit the target".

This military application has further enlarged our knowledge and it now appears reasonably certain that some form of active stabilization system can be worked out and applied to trains and other equipment so that at high speeds it will be possible to obtain smooth operation on rough track with safety and reduction in track maintenance.

The aviation industry also shows increasing promise in the post-war era. Great improvements have been made in the field of instrumentation, engine control, and navigation equipment.

From the beginning, internal combustion engines have always been accepted sources of power for planes, and great steps have been taken in the improvement of design and fuels used. However, jet propulsion and rocket power have suddenly come to the front. Already factories are tooling up for the large scale manufacture of jet propulsion motors, and at the present time the Germans have a jet propelled fighter in operation in Europe. The use of rockets for added power in taking off under heavy bomb loads has direct application for future cargo planes. Furthermore, one might predict that in the post-war world, the gas turbine operating at high speeds will be made light enough to drive commercial and cargo plane propellers through suitable gears. Looking even further ahead, a step of particular interest to electrical engineers will be the possibility of using electric drives between these turbines and the propellers.

During this emergency the world has looked to science and industry for means of winning the war and we take great pride in the realization that these agencies have demonstrated their knowledge and ability to meet this demand. Before long the world will look to them for better methods of supplying the needs of peace and it will not look in vain because the scientific technological advances already made under the pressure of war and those that will follow during the peace will no doubt surpass the wildest dreams of the past.

WINGS VIA MOTHER'S PIE PLATE . . .

(continued from page 8)

The most interesting of all the laminates, however, especially to the smaller plants, are those bonded with the "contact resins". Little or no pressure is needed in forming and curing articles made from them, hence the expensive autoclave, rubber bags, etc., are eliminated. Only enough pressure to keep the layers in contact is used, increased pressure does not yield improved properties. The Columbian Rope Co., Auburn, N. Y., has further reduced cost by impregnating a felt (corolite) of low cost cordage fiber and molding this directly; thus avoiding the cost of spinning and weaving, costs inherent to the fabric products.

Newly developed and now scheduled for mass production, plastic faced plywood is expected to be used for many purposes for which plywood has not been considered suitable. Its strength, rigidity, and moisture resistance is far superior to conventional plywood products. The surface is smooth, scuff-proof, non-splintering, and attractive in appearance. It can be made in various colors and designs or even transparent so that the grain of good woods will show through. Paint can be easily applied and gives a better appearance than plain plywood. It is resistant to abrasion, impact and cracking and withstands water, termites, acids and steam.

The resin faced plywood resulted from a search for a way to utilize the large amount of scrap left after the laminates are trimmed. These scrap laminates containing uncured phenolic resins are ground to a fine pulp and then rolled out in huge sheets .007 to .009 of an inch thick before being applied to the wood. High strength sulfitebase paper is also used.

The new plywood is 15 to 25% more costly in thickness of ½ inch or less. Prices are nearly the same for both faced and unfaced plywoods in the thicker sections.

Most of the present output of resin-faced plywood now goes into shipping containers for military use. It is well suited to this work for its scuffless, splinterless surface promotes ease in handling. Since its impact strength is high such containers are used for dropping equipment and supplies by parachute. Invasion forces find it indispensable for floating supplies ashore through the surf. Its impervious coating keeps contents 100% dry. It has also been used to a limited degree as flooring and doors in bomber construction, a use which suggests its application to post-war boat decks and cabins as well as pre-fabricated floor and wall sections and possible furniture in the future home.

What the '44 Grads Are Doing

—*Mel Sater, ch'44, and Ralph A. Watson, m&m'46*

Ed. Note: This review of 1944 graduates will involve largely the June and October classes, with the exception of a few February grads on whom we had no report at the time of the April 1944 reporting. Members of the class of 1944 who were inducted into service during their last semester of training will also be noted.

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Chemicals

ADAMS, ALFRED L., is located with the Eastman Kodak Company in Rochester, N. Y.

BREMER, HOWARD W., was inducted into the navy.

CALDWELL, DONALD B., received a commission in the navy as ensign.

CONRAD, DAVID M., also received an ensign's commission in the USNR.

EBERSOLE, ALVIN J., is with the Standard Oil of California Corporation in El Segundo, Cal.

ERICSEN, ARNOLD J., is production engineer for Cutler and Hammer Co., of Milwaukee, Wis.

FULWILER, STANLEY S., is with the Rochester, N. Y. plant of Eastman Kodak.

HICKMAN, CLIFFORD J., is with Pan American Refining Co., in Texas City, Texas.

HOFFMAN, KENNETH P., is on the chemical engineering staff of Victor Chemicals Co. in Chicago Heights, Ill.

JEDAMUS, PAUL E., remained in the state of Wisconsin to work for the Marathon Paper Mills at Wausau.

JOHANN, JOHN, resides with his family in Los Angeles, Cal., and is connected with the Richfield Oil Co.

JOHNSON, MARTIN H., is at present with the Ray-O-Vac Co., in Madison. Martin plans on returning for graduate studies.

LANDRY, JOHN W., is with the Tennessee-Eastman Corp., in Knoxville, Tenn.

LANG, BILL G., a graduate of the V-12, is in Midshipman School.

LUDWIG, WILLIAM A. H., is now in service after serving as a graduate assistant on research work in the chemical engineering department.

LUELL, RICHARD E., was inducted into service.

MANTEUFEL, ROBERT J., is working as corrosion authority for Eastman Kodak Co., in Rochester, N. Y.

MILLER, WILLIAM S., is also with the Rochester plant of Eastman Kodak Company.

NOWAK, TED J., works in the research and development laboratories of the Atlantic Refinery Co., of Philadelphia, Pa.

RAHN, WALTER H., resigned his position with Abbott Laboratories in North Chicago, Ill., to enter the navy.

SKOWLAND, DAVID T., is with the B. F. Goodrich Corp., of Akron, Ohio.

SMITH, ELMER R., is in the infantry at Camp Wolters, Texas.

TSCHERNITZ, JOHN L., holds a fellowship with the University of Wisconsin in the chemical engineering department.

TURNER, ROBERT L., was inducted into service.

VATER, WILLIAM A., recently received his commission in the USNR as ensign.

WALLACE, JAMES C., was inducted into service.

WILLIAMS, JOHN R., is in the U. S. Army.

YAKER, CHARLES, a V-12 graduate, is in Midshipman School.

Electricals

BOETTCHER, HAROLD P., is in training at the radio technicians' school, College Station, Texas.

EHLERS, WALTER H., announces the blessed event, a baby girl, born last December 15.

HYLAND, FRANCIS G., is in navy radio technician training at Hugh Manley, Chicago.

NEUBAUER, DAVID J., has been assigned to the midshipman's school at Annapolis, Md.

RICE, JAMES M., also a student midshipman, is at Columbia University.

RIEDERER, CLARENCE F., recently entered the naval training school at Navy Pier, Chicago.

SEROTA, RUDOLPH M., spoke briefly before the December meeting of the National Electronics Conference at Chicago. He reports rapid progress with the Electronics department of the Allis-Chalmers Co., of Milwaukee.

SCHREIBER, ENSIGN OTTO W., is making a study of underwater sound at the Naval Operating Base, Key West, Fla.

SHAW, JOHN L., received his boot training at Great Lakes Naval Training Station before qualifying for his present ensign's rating.

Mining and Metallurgicals

BENSON, ENSIGN C. GORDON, Indoctrination, tactical radar, and destroyer schools claimed most of Gordon's time after he entered the Navy. He is now at the Norfolk Navy Yard waiting assignment to a destroyer before going into active duty.

ERSPAMER, ENSIGN E. GORDON, After leaving the Amphibious Training Base at Solomon's, Md., Gordon and his crew went to Miami to await assignment to an LCI. He will go to the Pacific Theater in the capacity of an Engineer Officer.

EVANS, MARVIN S., is studying the subject of electronics and radio in the Radar Technicians branch of the service. Eventually he will be able to service all types of electronic equipment in the Navy.

FOLTZ, ENSIGN ROSS C., After preliminary training, Ross was sent to San Francisco and assigned to the USS Pensacola. He is now in active combat somewhere in the Pacific area.

FRISKE, ENSIGN WARREN H., is completing advanced indoctrination training at the Navy indoctrination School at Hollywood, Cal. He hopes to qualify for Diesel Engineering training at Raleigh, N. C., before he goes on amphibious or destroyer duty.

GOLDFEIN, HAROLD ALLEN, is now an Apprentice Seaman, but having been classified as a Radio Technician in Radar he expects to receive the rating of Seaman first class at the end of his boot training.

HAKES, LAVERNE GLENN, is working as assistant metal finishing engineer on radar equipment at Western Electric. He finds his work very interesting, especially since he began to work with a former Wisconsin man.

MICHAEL, ARTHUR B., employed as a research metallurgist, is fully applying his university training. Most of his work is on the surface treatment of aircraft steels in the laboratory of the Allison Division of General Motors Corp.

PATSFALL, ENSIGN RALPH E., was commissioned last September at Cornell University in the class of Electrical Engineers. He is now studying diesel engines, steam and electric powered units used in naval craft. He expects to be at sea in a few months on his own LST or LSI.

PAZIK, PVT. GEORGE J., is waiting for an Ordnance O.C.S. quota to come through, which will give him an opportunity to apply the things he learned at the University. He expects an overseas assignment soon and until then will continue his basic training at Camp Butner.

PUHL, ENSIGN JOHN M., is taking an engineering officer training course specializing in Destroyer Escorts. His base is, however, a replacement center and he could be assigned to any type of ship. He finds his work both practical and interesting.

WICEN, ROBERT, worked for a company in Louisiana after graduation. Later he obtained a position with Consolidated Vultee Aircraft. He had the chance for a commission when he was drafted but preferred the course, Radar Technician, which he is now studying at Navy Pier, Chicago.

WOLLERING, ENSIGN WALTER, is also in the Navy but is a student officer aboard a training submarine. He was stationed in the Caribbean but is now attending the submarine school at New London, Conn., where he will remain for four months.

ZAHALKA, HAROLD, is working as a research metallurgist at Houdaille-Hershey Company of Decatur, Ill.

ZIELKE, HARVEY, on completion of his boot training, began training as a radio technician. He completed pre-radio at Chicago and is now studying at Secondary Radio School in Gulfport, Miss.

Mechanicals

BOLZ, ROBERT M., works with the Los Angeles plant of Lockheed Aircraft.

BUEHLER, RALPH T., is with an infantry training battalion at Camp Wolters, Texas.

CANNIZZO, WALTER M., is ensign at the U. S. Naval Training Base at Fort Pierce, Fla.

CAREY, THAIN H., is with Bell Aircraft in Buffalo, N. Y.

CERUTTI, BERNARD C., works for the Chicago plant of the Chrysler Corp.

COSGROVE, DAVID F., is employed with the Douglas Aircraft Corp., of Santa Monica, Cal.

DIELS, MELVIN F., works in the N. A. C. A. Laboratories at Cleveland, Ohio.

DZIRBIK, EDWARD M., is a pilot in the Army Air Forces.

ENDRIZZI, GILBERT D., accepted an instructorship in the department of mechanical drawing at the University of Wisconsin.

EVANS, LEE D., received a commission as ensign and at present is at the Hollywood Beach Hotel, Hollywood, Fla.

FINK, JAMES E., no report.

FRIELAND, HARVEY J., works for the Rex Chain Belt Co., of Milwaukee, Wis.

GEIGER, FELIX E., is doing work for the War Department in Los Angeles, California.

GRAHAM, I. WALTON, is in the U. S. Naval Reserve.

GRAPER, FRED E., works in the N. A. C. A. Laboratories.

HEDSTROM, ROBERT E., is employed by the Cherry Rivet Co., in Beloit, Wis.

HIRCHERT, WALTER F., is in the U. S. Naval Reserve.

ILLE, WILLIAM B., works for General Electric Co., of Schenectady, N. Y.

JACOBS, ROBERT B., is in the U. S. Naval Reserve.

JOHNSON, ADELBERT B., is at Beloit, Wisconsin, working for Fairbanks-Morse and Co.

LAHIFF, ROBERT F., is employed at the Grand Rapids, Mich., plant of General Motors Corp.

LARSON, ARLEIGH G., works in the N. A. C. A. Laboratories in Washington, D. C.

LOEF, JOHN P., is in the U. S. Naval Reserve.

LOVELL, JOHN C., is in the Air Corps Enlisted Reserve stationed at the laboratories of the N. A. C. A. at Langley Field, Va.

MAIER, MICHAEL W., has been stationed at the Great Lakes Naval Training Station, Chicago.

MANN, RICHARD A., is also with the N. A. C. A. Laboratories at Langley Field, Va.

MUELLER, F. WILLIAM, has accepted a position with the West Bend Aluminum Co., of West Bend, Wis.

NILES, DONALD E., has joined his classmates at the N. A. C. A. Laboratories at Langley Field, Va.

NOTBOHM, WILLARD C., is working for the Carrier Corporation of Syracuse, N. Y.

OTJEN, CARL N., ensign in the Navy, is attending the Ammunition Handling School at the Naval Ammunition Depot, Hingham, Mass.

POSSELL, CLARENCE R., is employed by the North American Aircraft Corp., but has recently applied for a commission with the U. S. Naval Reserve.

PUIDOKAS, STANLEY V., is now in the U. S. Naval Reserve.

RASMUSSEN, DONOVAN E., has been employed by the Standard Oil Co., of California.

REHR, HENRY W., is also in the U. S. Naval Reserve.

REID, MARSHALL G., has a position with the Goodyear Tire and Rubber Co., of Akron, Ohio.

ROGERS, BENJAMIN T., has been accepted for service by the U. S. Army.

ROHDE, ROBERT L., finished Diesel Engine Training at North Carolina State College, after receiving his commission as ensign, and is now waiting further orders at Solomons, Md.

ROHLING, PAUL V., is with the Volwrath Company of Sheboygan, Wis.

SMITH, JAMES W.. is doing experimental work in the Wheel and Brake Section of the Goodyear Aircraft Corp., Akron, Ohio.

TEUSCHER, FRED L., has been accepted by the Naval Reserve.

TURNER, ORREN M., is also in the Naval Reserve.

WACHTL, WILLIAM W., also joined the Naval Reserve.

WINKLER, WILLIAM J., has recently been employed by the Allis-Chalmers Manufacturing Co., at Milwaukee, Wis.

YOUNG, WARREN C., was called for service with the Navy shortly after graduation.

Civils

BAUMAN, MERRITT R., is in boot training at Camp Bennion, Faragut, Ohio.

BECK, EARL J., an Air Cadet, is in training at the USNR Preflight School, Iowa City, Ia.

BERG, RAYMOND L., Seaman first class USNR, has been ordered sent on to further training as a radio technician at Chicago.

BIRKETT, RICHARD B., is stationed at Lowry Field, Denver, Colo.

CLARK, MARLYN E., is doing research at the Forest Products Laboratory, Madison.

ERICHSEN, ROY H., Ensign in the Navy, has been assigned to an LCS in the Pacific Area, as its Engineering Officer.

HENKEL, WALTER A., is employed as a stress analyst by the Convair Co., of San Diego, Cal.

JENNERJOHN, DALE J., was accepted by the Army and assigned to the ROTC post at Ohio State University, Columbus, Ohio.

JOHNSON, DONALD B., is in training as a radio technician at Oklahoma A. and M., Stillwater, Okla.

JOHNSON, KENNETH F., Seaman second class, is studying at the Naval Training School, Norfolk, Va.

KLOMAN, EDWARD J., is stationed at the Naval Training School at Harvard University, Cambridge, Mass., studying communications.

KRUEGER, EARL A., was last reported working for a contractor somewhere in the East.

LARSEN, ELWOOD M., is in training at a diver's school at Fort Screven, Georgia.

McVEIGH, RAYMOND J., Apprentice Seaman, is at the U. S. Naval Hospital, Sampson, N. Y.

MAAS, ALBERT W., Ensign in the Navy, is stationed at an amphibious training base.

NEEDHAM, HAROLD C., was commissioned 2nd lieutenant in the Army and assigned to Fort Lewis, Washington.

NELSON, ELWYN F., received his commission as Ensign in the Navy and reported to San Francisco.

PORATH, DONALD A., Ensign in the Navy Sea Bees, was in New Caledonia at last report.

REINECKE, DURWOOD D., reported for duty at Camp Endicott after receiving his commission as Ensign in the USNR.

ROBBINS, ALBERT B., also received his commission as Ensign in the USNR and reported to Camp Endicott.

ROBECK, GORDON G., is a 2nd Lieutenant in the Army on duty with the U. S. Public Health Service in Chicago.

SCHMIDT, ARTHUR E., Seaman first class, is in training as a radio technician at College Station, Texas.

SCHMIDT, RICHARD E., has been employed by Consolidated Vultee Aircraft, Fort Worth, Texas.

SCHMITT, FRANCIS J., Army Lieutenant, is at the Administration School, North Fort Lewis, Washington.

SCHOLBE, JACK L., has his Ensign's commission and is now on board a minesweeper.

SCHOTT, LELAND W., reported to Camp Endicott, after being commissioned Ensign in the USNR.

SILBERMAN, MAX, accepted a position as instructor in the Extension Division at this university.

SPITZER, ELROY F., also last reported in New Caledonia, was commissioned Ensign and is serving as Assistant Transportation Officer in the Navy Sea Bees.

STREIT, JOHN H., obtained his Ensign's commission and reported to Camp Endicott.

ZEHRT, WILLIAM H., Ensign, USNR, is personnel officer of his unit in the NCB.

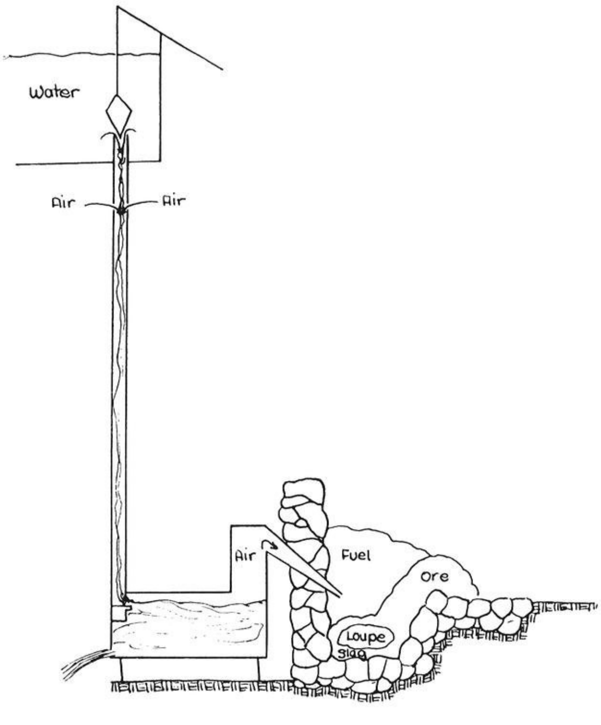
ZUEHLKE, GEORGE H., is in primary training as a radio technician in the Navy, in Chicago.

Ancient Iron Smelting

—*John B. Opfell*

THE history of ferrous metallurgy is divided into two distinct periods. During the first period, iron was obtained from its ores by processes of reduction while in the solid state. In China, this period was at an end by 300 B.C., for these people had early discovered methods of making and utilizing cast iron. This discovery is explained by the fact that Chinese coals are rich in phosphorous, which condition causes the charge to fuse at temperatures considerably lower than the melting point of pure iron. The cast iron era did not emerge in Europe, however, until 1340. The European metalsmiths used wood and charcoal as fuels. Since these fuels have low flame temperatures and low phosphorous and sulphur contents, the fusion temperature was seldom attained. When it was obtained, the product was considered to be ruined because it was brittle and not capable of withstanding forging operations. The second period is characterized by the production of this brittle, "unforgeable" cast iron from the ore as the initial step in the refining process. The beginning of this period, in the Orient, is rather indefinite, but the use of cast iron is known to have been well established before the Christian era in the West. A discussion, then, of the equipment and methods of the ancients as well as the extent of usage is of importance.

Even in prehistoric times, iron ore was reduced to metal. The peoples then employed methods similar to those used by the savages of the upper Nile during the last century. The hearth was simply a depression in the ground. A fire of wood was built in the depression. Small lumps of ore were "tossed" into the fire. The metallic iron would form as a ball in the bottom of the depression. Two men could produce about twelve pounds of a very impure iron per day by this method. Various methods of supplying air to the fire were devised. Goat skin bellows were the most common method. The air was supplied at the top or midsection of the furnace as was also the case with the Catalan forge. The Catalan forge supplied all the iron used in the Western world for several centuries and continued to be a major source of refined metal long after partially supplanted by the blast furnace. The annual Statistical Report of the American Iron and Steel Association, 1908, suggests the extent of the 'Age of the Catalan Forge', "No forges for the manufacture of blooms and billets direct from iron ore have been in operation in the United States since 1901, in which year the blooms and billets so made amounted to 2310 gross tons, against 4292 tons in 1900 and 3142 tons in 1899. All Catalan forges in the South have been abandoned; so have those in the West and North." The Catalan forge is, though, but a refinement of the previously described primitive hearth. The Catalan forge is described in the accompanying diagram. The product of this hearth, the loupe, contained much slag which was removed by squeezing and hot working. The iron so made had a carbon content such as to identify it as wrought iron. The production of this material sometimes reached two tons per week per hearth. The range in size of the hearths is from 20 x 20 x 16 to 40 x 30 x 27 inches.



Schematic Diagram of Catalan Forge & Trompe

In the eighth century A. D., a new design in hearths was introduced in the form of the Osmund furnace. The significance of this furnace lies in the fact that it was the first to charge in the manner of charging a modern blast fur-

(please turn to page 24)

Radio Improvement

—Richard Laubenstein

WHEN the radio industry tried to expand as all industries would like to do, it found that it was necessary to build a cheap enough product so that the majority of people would consider it within their means to purchase a radio. Henry Ford proved this principle in the manufacture of automobiles, but mass production alone was not the solution for radio.

The first logical step in this direction was the substitution of alternating current power for the costly and inconvenient batteries by the use of a rectifier, and from there the reduction of this rectifier from a very bulky unit weighing several pounds to a compact part of the radio adding only a few ounces to its weight. A large advance was the development and substitution of the electrolytic capacitor for the paper condensers formerly used, enabling much larger values of capacitances to be used, with a saving in weight and material. Adequate filtering could still be obtained in the impedance offered to the load a low frequencies.

Next, attention turned to the elimination of the power transformer, with much opposition however, due to the failure of most manufacturers to adequately protect against shock and fire hazards. When no power transformer is used one side of the power line must be connected to the chassis either directly or through a large size capacitance, making it very unsafe if not properly covered. The following two diagrams show the two most common rectifier circuits used in radios today, the full wave rectifier being used in the larger radios requiring more power. There is still plenty of room for advancement in development of a means of rectifying and properly filtering enough power to operate a good sized radio.

For even relatively small power output, the half wave rectifier requires much more filtering than the full wave rectifier, as in the former the output from the tube is zero during the entire part of every other cycle. This places a limitation on the rectifier, as with the necessarily high value of input capacitance C, the peak currents through the tube become too high for the tube to handle.

FIGURE 1

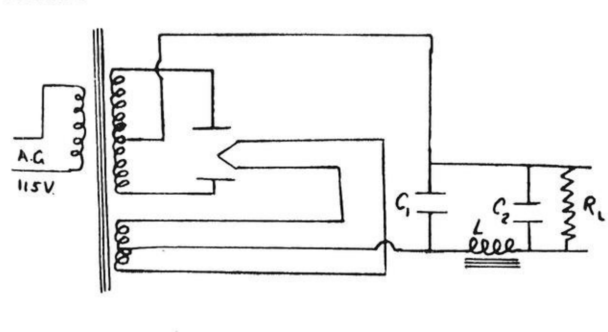
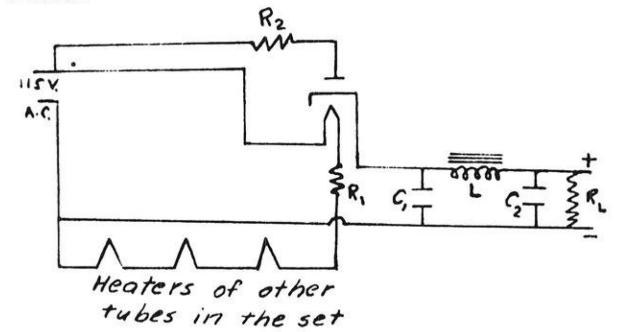


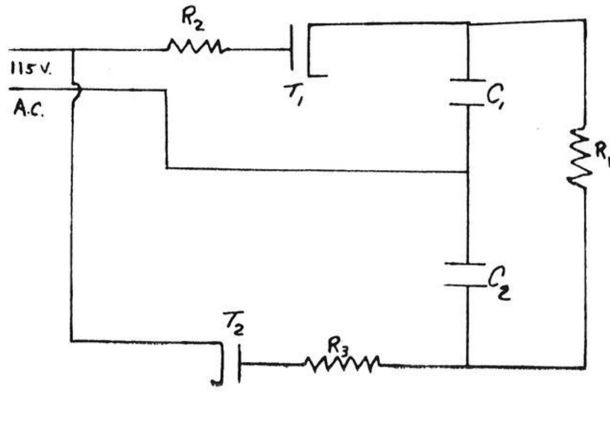
FIGURE 2



With the introduction of the 25Z5 tube which consists essentially of two separate diodes in one envelope, it became practical to increase the power output by using some type of voltage doubling circuit. Figure 3 shows the symmetrical type of voltage doubler where the condensers C_1 and C_2 are charged during alternate half cycles and are allowed to discharge in series. With no load the output voltage with this circuit is twice that of the peak of the supply voltage and in practice this circuit supplies the same current as the half wave rectifier at almost twice the voltage.

(please turn to page 32)

FIGURE 3

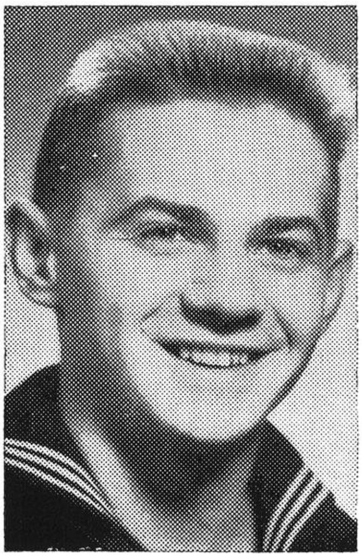


New Staff

—Mae E. Zimmerman, ch'46

Recently Francis Tennis (we know him as Fran) was appointed to fill the vacant assistant editor spot. In January Toru Iura, who was the business manager, left for the army and Edward Daub (it's Ed) has now taken over Toru's place as business manager. Following is a brief life resume of each . . .

FRAN TENNIS



EDWARD DAUB

ON April 19, 1923 another engineer made his entry into the world in the city of Waukesha, or a star was born. Francis Tennis spent a normal childhood including all the mishaps that accompany children of his young age and at four or five entered into the scholastic world by starting grade school. Evidently everything went well with the boy as he graduated from high school in 1940 at the age of 16. While in school, Fran was on the high school track team. Maybe that had something to do with his graduating at such an early age.

After graduation, Fran worked for the NYA Center in Waukesha. He taught machine shop for the Center. Upon reaching the age of 18, he got a job in The Industrial Clutch Co. He worked there for about two years, becoming supervisor and general manager. The company, being very satisfied with his work, sent him to Madison to take a position in their office here.

In the summer of 1943, Fran entered the university of engineering, and now is an M. E. 3. While here he has been as active in extra curricular activities as his school will allow him to be. He went out for the rifle team, joined M.E.S.W., pledged the Theta Chi fraternity, and is now vice-president of the same, and is assistant editor of the Wisconsin Engineer. Keep up the good work, as we are expecting great things of you some day, Fran.

A BOMBSHELL exploded on May 17, 1924, in the fair city of Milwaukee, for that was the day Edward Daub came screaming into the world—and he hasn't been silent since.

Ed attended North Division high school in Milwaukee. His activities there included cheerleader, business manager of the school's annual, basketball, forensics, and dramatics. His role of Henry Aldrich was the crowning touch of his dramatic career.

In September of 1942, Ed enrolled in the Engineering School of the University of Wisconsin. He is now a Ch.E. 4. While on the Wisconsin campus, Ed has made a name for himself scholastically and through his many activities. As cheerleader on the football field or basketball floor he is one big explosion of energy. He is a member of A. I. Ch. E, president of Tau Beta Pi, president of Phi Eta Sigma, a member of Phi Lambda Epsilon, and Alpha Chi Sigma. He is also a member of the Senior Council, chairman of Senior Ball, was ticket chairman for Pre-Prom, and master of ceremonies for 770 in the summer of '44. Ed has put a lot of good, hard work into The Wisconsin Engineer as he is business manager of this magazine.

When asked what his number one pet peeve was, Ed stated briefly in two words—"stupid women." After the war he wants to come back to Wisconsin to get his doctor's degree in Chemical Engineering. That's hitting for them high, Ed, but we all know you can do it.

Campus Notes

—Mae E. Zimmerman, ch'46

Past—Christmas vacation—the fond memories still linger on; New Year's Eve—the hangovers, 'nuff said; Prom—ah, bliss.

Present—Preparations for the Winter Carnival; Posing for pictures for the Badger; . . . . . school work????

Future—FINAL EXAMS!!!! (And now past.)

Distant Future—Leaves for the navy, vacations for the civilians.

Far Distant Future—A new semester in engineering . . . . what a wonderful school.

AIChE

A field trip was made by members of the AIChE to the M. E. Building to inspect a project on diesel engines in the steam and gas lab.

February 3rd is the date set for a dance and sleighride for AIChE members and their dates.

AIEE and MESW held an informal "After the game" party and dance in the M.E. Building after the Ohio State game, Friday night, the 9th of February.

Dating

The V-12 method of dating is entirely different, unorthodox, and positively unique—but then look who we have in the unit. In the last issue we told you about the two fellows dating the same girl—sounds like a very good set up for the girl. In this issue we have the case of the two Delts taking out two Phi Delt women due to an impending initiation.

The editor of this magazine is still making her weekly trips to Chicago. One more trip and she will be qualified to write "My Day".

Overheard

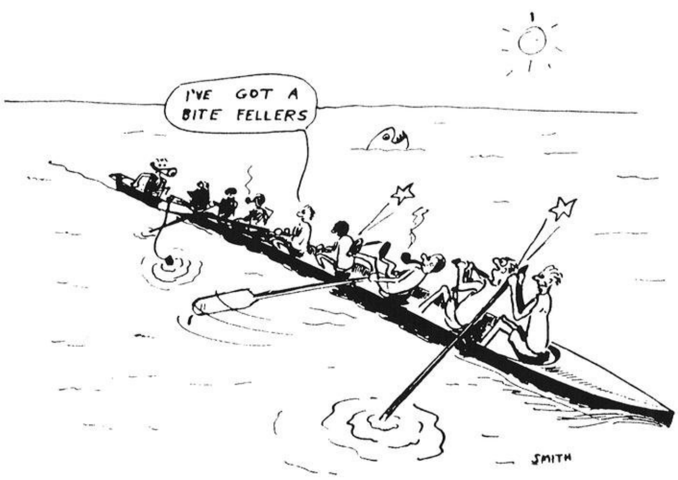
from da mob . . . dat about 15 fellows are making visits three times a day for the rest of their natural lives to the M. A. shack for "beating" the chow line and being out of uniform. (At embarrassing moments??)

What's this

that we hear about a new romeo in the Mack Barracks? It seems that a certain member of that unit by the name of Jim Kusa is reported to be quite the "operator". Next issue we report the reporter if we are still able to.

A bunting, a rattle and a blanket

were gifts to Harold Kane, the proud "papa" of an 8 lb., 3½ oz. bouncing baby boy. Mother and son are reported to be doing nicely. Harold is an M. E. 2, which doesn't mean a thing when it comes to walking the floor with junior. I'm disappointed . . . not even one cigar . . . and the cigarette situation the way it is.



Well—Scratch It.

Visitors

John Houmes and Ed Fischer, former Wisconsinites and fellow engineers, have made pilgrimages back to ye old alma mater. Did you find the old place the same, fellows? Answer in next issue. (Aren't all you little eager beavers anxious to get the next issue? I'm going to have so much to tell you!!—right, June?!!!)

Yours truly is now working on "Nitrobenzene" in organic lab. If there is no column in the next issue you'll know the reason why . . . don't laugh, I may not be kidding! (Ed. note—but we're all hoping!)

DIESEL FUEL TESTING . . .

(continued from page 10)

at a constant speed of 900 rpm. The compression ratio is adjusted until the injection begins at 13° before TDC and ignition beginning at TDC (lighting the two neon bulbs simultaneously.) The compression ratio is thus fixed and the variable compression plug locked in position.

2. Next, reference fuels of known cetane rating are tried in the cylinder until an ignition lag approaching 13° is again obtained for the previously fixed compression ratio.

3. When two reference fuels are found which bracket the unknown fuel, interpolation is used to determine the cetane rating of the test sample. The reference fuels must be within eight cetane numbers of each other for a suitable bracket condition.

In actual practice, cetane and alpha-methyl napthalene are not used for reference because of their excessive cost. Instead secondary reference fuels which have been calibrated against the primary fuels are used.

Principle outlets for these test engines are at present with the petroleum manufacturers, with some truck fleet owners investing in their own testing apparatus. However, as Diesel engines continue to attain greater prominence, an increased number of outlets will appear for the all-important "cetane rating" test engine.

ETHYL ALCOHOL FROM WOOD . . .

(continued from page 10)

packed in layers by means of sudden steam pressure until the digester is full. Steam is then admitted to displace the air and heat up the charge to about 150°C. Hot dilute sulfuric acid (concentration 0.8 per cent) is added and allowed to stand for several minutes to penetrate the chips and hydrolyze the hemicellulose. The liquor is removed from the bottom of the digester with the aid of a small amount of steam pressure. This steam also serves to heat up the charge for the next treatment. The liquor, after removal, is sent to a tank where flash evaporation and cooling take place. The resulting liquor is run to storage tanks and is now ready for fermentation.

More 0.5 per cent sulfuric acid is added to the digester and the process repeated until the concentration of the sugar solution goes below 2 per cent reducing sugar, gradually increasing the temperature to 185°C. Then the bottom of the digester is opened and the residue left is discharged due to the pressure inside. Complete hydrolysis and extraction requires from 3 to 4 hours. For softwoods, the yield of reducing sugar is from 45 to 53 per cent.

The various sugar liquors are all combined, neutralized with lime, and fermented to produce solutions containing from 2 to 3 per cent alcohol by volume.

SHORT CIRCUITS

—Fran Tennis, me'46

Bob Clayton, me'46

Voter: "Why, I wouldn't vote for you if you were St. Peter himself."

Candidate: "If I were St. Peter, you couldn't vote for me. You wouldn't be in my district."

•

Love is a funny thing
It catches the young and the old
It's like a plate of G.I. stew
Before you turn 'round, it's cold.
It makes you feel like a fresh water eel
And causes your head to swell.
You lose your mind, for love is blind
And you spend your money as well.
If married folks have lots of cash,
Their love is firm and strong
But when they have to live on hash
Their love don't last so long.
Oh boys, keep away from girls, I say
But give them lots of room,
For once they're wed they'll bang your head,
With the bald-headed end of a broom.
So young man, take my advice
And don't hurry to wed
For you'll think you're in clover 'til your honeymoon's over
And then you'll wish you were dead.

—Sandy Hook Foghorn

•

Dean: "Is this your likker?"

Freshman: "No, sir."

Dean: "So that's your likker then?"

Second Freshman: "No, sir."

Dean: "Well, I don't give a damn whose likker it is; I'm going to take a drink."

•

"I'm going to quit dating engineers; they always leave prints on my neck."

"Yeah—but lawyers are always contesting your will."

Mistress: "You know, I suspect that my husband has a love affair with his stenographer."

Maid: "I don't believe it. You're only trying to make me jealous."

•

Instructor: "How old is a person born in 1925?"

Engineer: "Man or woman?"

•

Two gentlemen had just been to church and were discussing the different happenings that took place.

"Say, Jim, what is that little bowl of water at each aisle?"

Jim: "Oh, that's holy water."

"How do they make holy water?"

Jim: "I guess they just boil the hell out of it."

•

Parson: "Goodbye and God bless you and be careful that the rowdies in town don't play any tricks on you."

Newlyweds: "Don't worry, Parson, they won't catch us napping."

•

Barber: "Was your tie red when you came in?"

G.I.: "Certainly not."

Barber: "Gosh."

•

All the working girls want from a man is his seat on the bus, his salary every payday and his job.

•

Bub: "Did he die a natural death?"

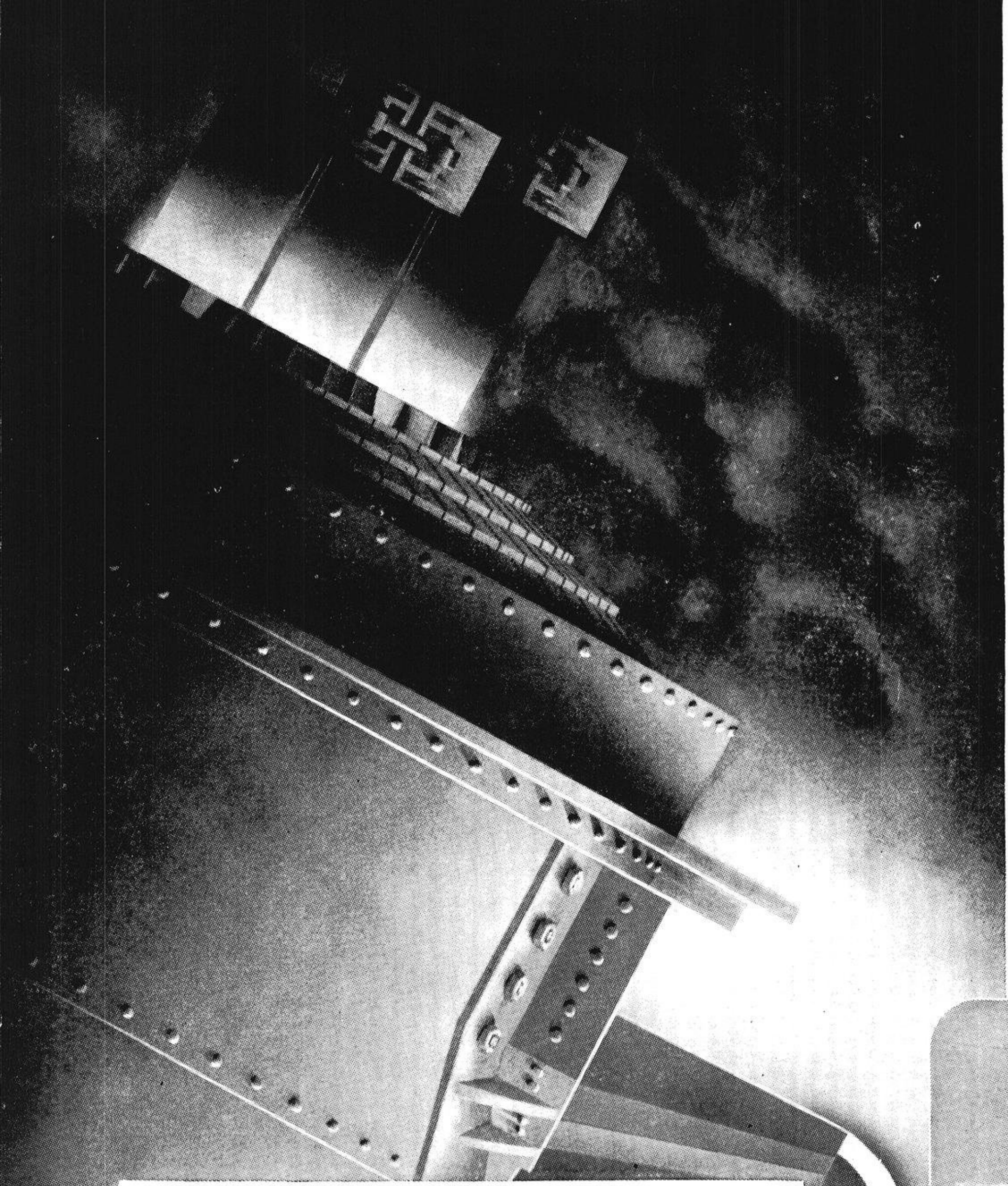
Uub: "No, he had a doctor."

•

"Some of the best cooks in the world are in the army."

"What are they doing?"

(please turn to page 30)



When is FIRE *too* COLD?

FIRE was both a tool and a limitation for the ancients. With it they made things of tin and lead, silver and gold. But their fires were never hot enough for the sterner metals.

Man's progress through the ages has been accelerated each time he has learned to create and control a higher temperature.

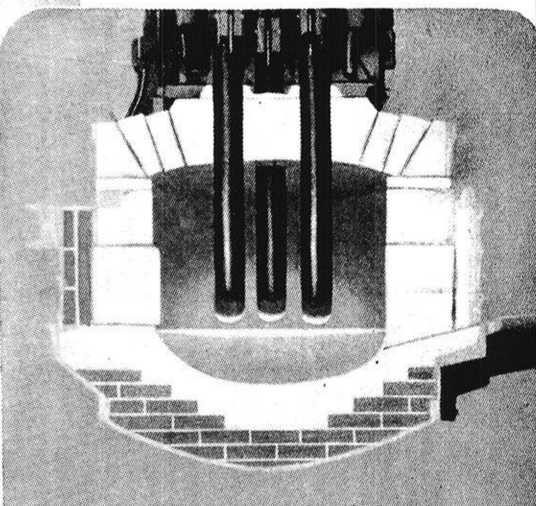
With the electric arc came heat hotter than any fire. And, by means of carbon or graphite electrodes—developed by research of NATIONAL CARBON COMPANY, INC., a Unit of UCC—man put the electric arc to work in furnaces such as the one you see above.

Born in the terrific heat of the electric furnace are many of the alloy steels used in ships, trains, planes and other equipment, and also the ferro-alloys that give strength, toughness, hardness—or the quality of being stainless—to these steels. These materials—and the intense heat that produces them—are vitally necessary to American industrial progress.

▼

Coming from the electric furnace—in addition to alloy steels and ferro-alloys—are phosphorus, abrasives, calcium carbide for acetylene used for welding and cutting, and many special alloys.

For further information write for booklet P-2, "The Story of the Carbon Arc" . . . there is no obligation.



Cross Section of an Electric Furnace

Electricity comes *to* the furnace on metal bars. It is carried *into* the furnace by carbon (or graphite) electrodes, which you see projecting down into a brick lined bowl. Carbon is used because, unlike metal, it will not melt.

You see carbon in many forms other than electrodes. Diamonds are pure carbon. Graphite, which is the "lead" in pencils, is carbon—and so are coke and charcoal. This material is the subject of unending research by the National Carbon Unit of UCC.

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

PLASTICS—Bakelite Corporation

ANCIENT IRON SMELTING . . .

(continued from page 16)

nace; that is, the introduction of alternate layers of fuel, flux, and ore. The furnace was built entirely above the ground. This feature permitted the placement of the tuyere at the bottom. The shape of the inside varied from a simple square to a shape resembling that of a modern blast furnace. The size of the hearth and the fuels used were not, however, sufficient to attain fusion temperatures. In spite of the fact that the product was the same as that of the Catalan forge, the design of the furnace was a step forward in the direction of the blast furnace. The Stuckofen was in common use in Germany for the smelting of iron about the year 1320. Though this furnace was not designed to produce liquid metal, occasional fusion occurred—much to the dismay of these early foundrymen. The fused metal, which often contained as high as three percent carbon, was considered unusable due to its extreme brittleness.

The literature first mentions the existence of a blast furnace in the year 1340. The location of this hearth was Belgium. The German Stuckofen, which was a modification of the Osmund furnace, is considered to be the immediate forerunner of the blast furnace. The production of cast iron from the first blast furnace was considered to be an unfortunate happening. When the operators realized that the cast iron was the natural product of this new furnace, they proceeded to devise methods for refining and using this material.

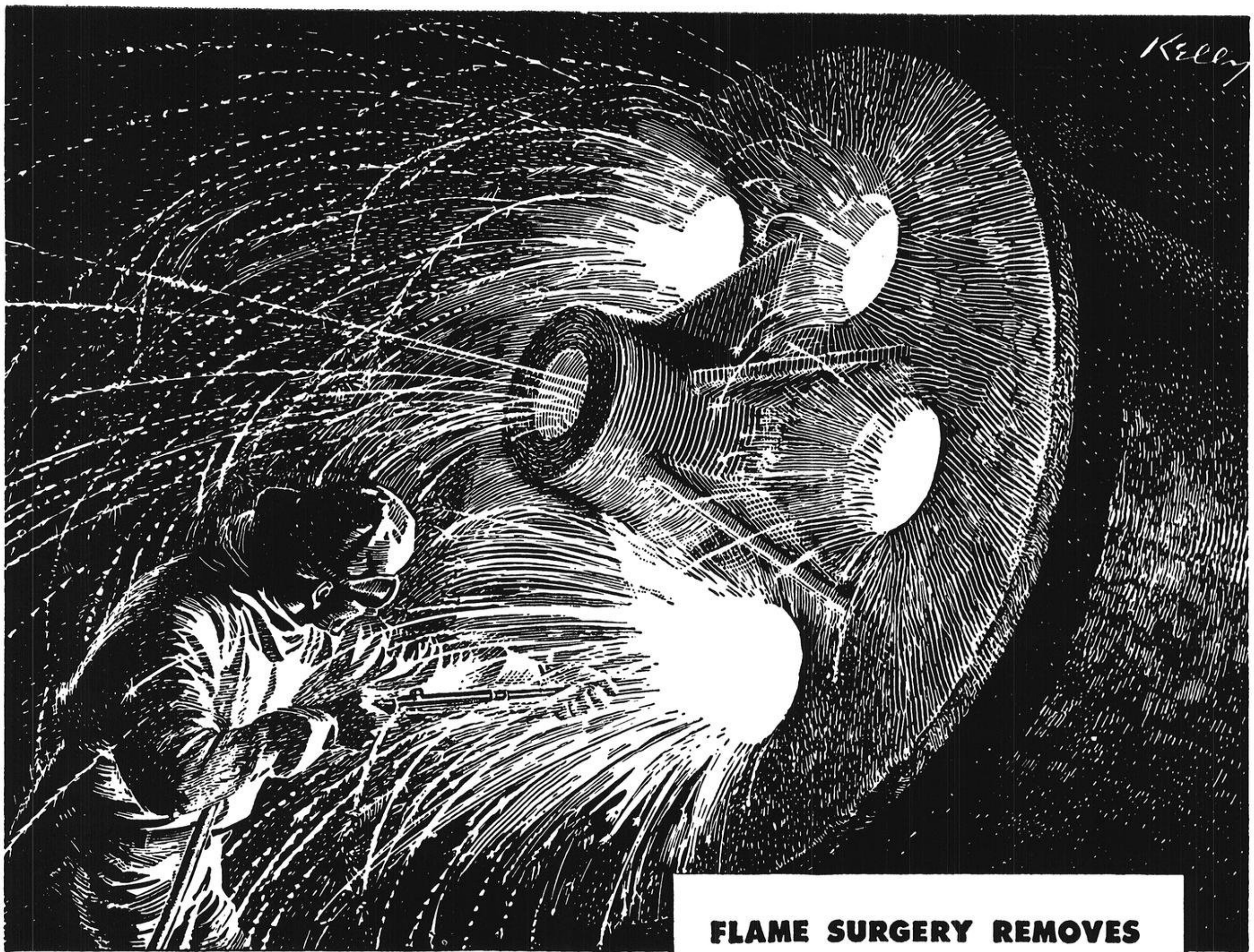
Thus, we see that the difficulty of producing fusion temperatures for iron and the relative ease of working the product of the earlier forges and furnaces were instrumental in delaying the advent of the "Machine Age", development of modern methods of manufacture of ferrous metals, of these earlier furnaces.

DID YOU KNOW THAT:

Engineers are now able to duplicate tropic humidity in insulation tests, in which the air is completely saturated with moisture?

One of the most remarkable lighting units of this war is a mobile lighting unit, ready for any emergency, and which will function as a searchlight, floodlight, beacon, or what have you?

Once upon a time there were seven brothers. The first was a lawyer and the second one didn't know anything either. The third was a politician and the fourth was a crook too. The fifth was a banker and the sixth occupied a cell next to mine. And the seventh was a bachelor like his father.



FLAME SURGERY REMOVES THREE-TON TUMOR FROM IRON INVALID

A LARGE chunk of metal, containing a mixture of coke and sand formed inside this huge drum casting when the hot metal accidentally broke through the sand during the pouring operation. This "tumor"—about two feet in diameter and five feet long—was too big to be removed through the openings in the end of the drum. The casting—costing in the neighborhood of $1500—was too valuable to be scrapped.

So a member of Air Reduction's Applied Engineering staff was called into consultation. He studied the case and prescribed cutting the tumor into pieces small enough for removal with the oxygen lance—an instrument which cuts through heavy thicknesses of metal with a jet of oxygen.

The treatment was followed; the "operation" was completed successfully in forty hours and the $1500 patient went right to work at its appointed task.

The oxygen lance is one of scores of Airco products for the shaping, joining and treating of metals with the oxyacetylene flame and electric arc. Many of these products were developed by Air Reduction for use in new and improved processes which have grown out of Airco's extensive research activities.

Through these products, through this research and through its field engineering service, Air Reduction has rendered important aid to many manufacturers in their wartime task of producing the tools of victory.

For additional information on Airco oxyacetylene flame processes and their many applications in war and peacetime industry, write for a free copy of the interesting publication "Airco in the News". Address your request to Dept. CP, Air Reduction, 60 East 42nd Street, New York 17, N.Y.

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WHY NOT BETTER LUBRICATION? . . .

(continued from page 9)

unsupervised manner. Such a condition is extremely poor practice because a machine may be running dry for a considerable part of the time, causing excessive wear, or on the other hand, more oil than is necessary may be supplied, resulting in waste and high lubrication cost. Facilities for regular, automatic feed could well be incorporated into the design of new machines to provide automatic and efficient lubrication, for in most shops a few drops per hour saved on a bearing, when multiplied by all the thousands of bearings on all the machines, may mean a saving of many barrels of oil in the course of a year.

Now the importance of careful lubrication is easily seen, for it is the effectiveness of lubrication that controls the wearing out of machines, the frequency and amount of repairs, and most important of all, the lowered production due to time lost in removing a machine from service for maintenance and repairs. Certainly lubrication is so fundamental to the operation of any machine that it merits important consideration in the designing stages; yet in very few cases does it receive the attention it deserves. If it is basic enough to be essential to the operation of every machine and of major importance in the cost of its upkeep and repair, why then, is the subject of lubrication not taught in the machine design and plant management courses in the universities throughout the country, so that young men going forth in the design field may give adequate attention to the basic problems of lubrication while those responsible for the efficient operation of the plant may fully realize the importance, especially from the all-important economic standpoint, of giving each machine under their supervision the proper lubrication it deserves?

"Digging" In

THE secret is not in how to study, it is in how to review. Try this simple system.

Take your notes as you have been taught to. Then buy some three-by-five filing cards. Look over your notes and use a red pencil. Some parts are easy to remember. There are other parts that are "the veriest devil." That formula in chemistry or name in history or declension in Latin. **These are the key points in the lecture.** Write small and enter these high spots on your three-by-five cards. One side of such a card will take care of the real posers in any one lecture.

Now you have the difficult points all together on cards. . . . Tuck those cards into your pocket. Then, during the spare moments of the day, use those cards. The ten minutes before dinner or waiting for a date, or loafing after one. Your success in that chemistry course isn't going to depend so much on getting every day's work, although that is important. It depends on your not forgetting the work that has preceded. You have the key points of this and other courses in your vest-pocket notes.

Here is where system enters. Get busy at the beginning of the term. You will find that your pack of cards rapidly grows. Mix them all together—chemistry, French, history, math., and biology. Now be careful. Every morning select a certain number from that pile for review—let us say ten. Make it an absolutely rigid point that these ten are read over carefully during the course of the day. You have got to hold yourself to a schedule. Where, when, or how you read them makes little difference, but get them read and be thorough about it.

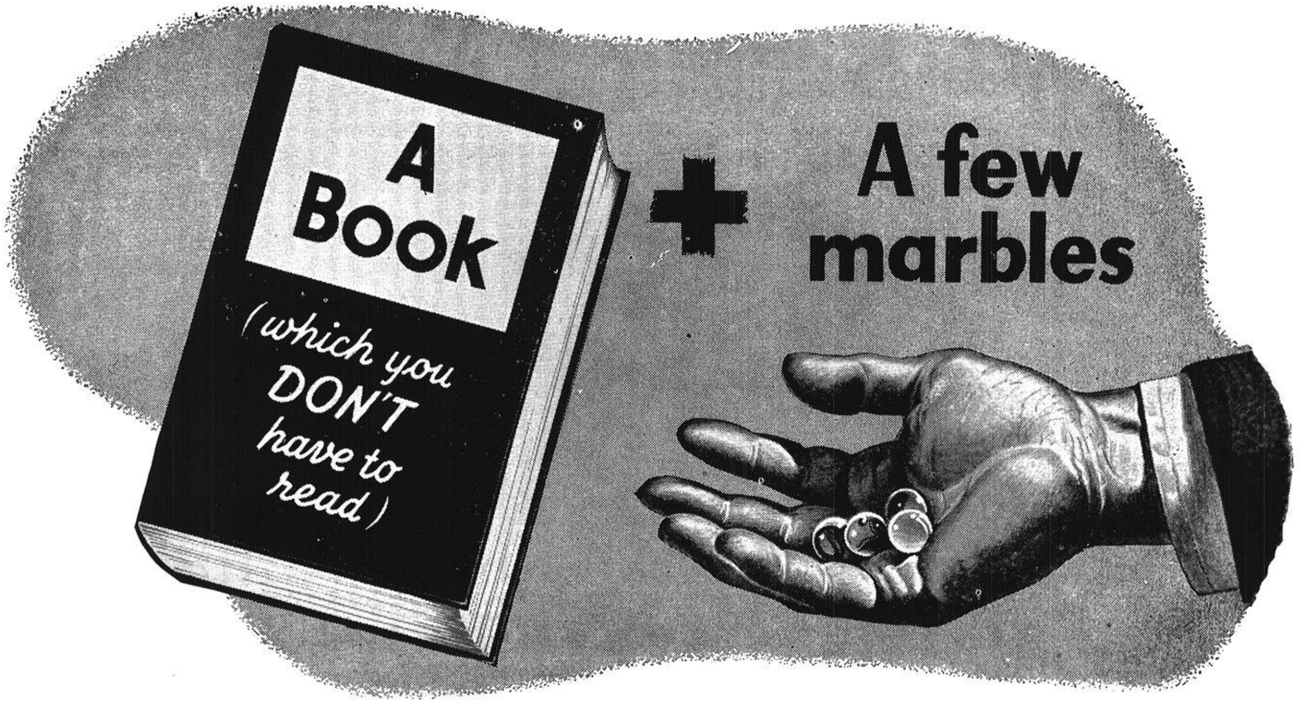
Then replace them. One card came early in the course. You know everything on it thoroughly. Place it on the bottom of the pile. It will be quite a time before you meet again. Another you are not so sure of. Put it in the middle. That means you will run across it again in, say, two weeks. Finally, you meet a card which represents a lecture of yesterday. It was difficult and you know that you have not mastered it. So put it near the top, where you will get at it again in the very near future.

The idea is to guarantee that you keep reviewing your entire work during the course of the year. Also, that you keep seeing the stuff you have mastered in rather long intervals, while you have the material you have not mastered served up to you every few days.

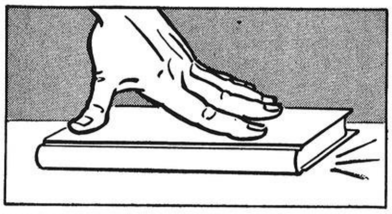
Another point. **Do exactly the same thing with the books you read.** Don't blame your memory because you read through a book once and then fail it on an examination. Anyone but a genius will do the same thing. Be reasonable—and systematic. Get the hard points of that book down on your cards. One card will generally cover from ten to twenty pages, dependent on the nature of the book. But treat your outside reading just as you would treat your lectures.

Finally, you run bump into the examinations. If you have been following my suggestions you are more or less "all set." Your review is practically done because you have been seeing to it every day. However, you take all those chemistry cards out of the key pile. Go through them and check all doubtful points with a red pencil. Do it again and the puzzlers should have a blue pencil this time. Then, finally get the points which are still beyond your ken down on separate cards and hammer away at them. There won't be more than three or four cards. Lastly, the day before the examination, read over your general notes carefully and then go to a picture the night before. — **G. H. Estabrooks, Colgate University, in "The Intercollegian."**

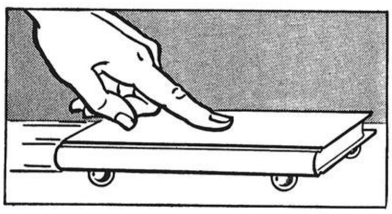
Reprinted upon request, as appeared in November '31 WISCONSIN ENGINEER.



tells the WHY of Ball Bearings



TRY THIS: Place a book on your desk and your hand firmly on it. Then try to push the book across the desk. That's the principle of *sliding motion*—hard on book, desk and energy.



THEN THIS: Place 4 marbles under the book, your hand on top—and push. The marbles roll freely, the book moves easily in any direction. That's *rolling motion*—smooth and easy on everything!

There is a simple, fundamental truth in the principle of the ball bearing: "Nothing Rolls Like a Ball!"

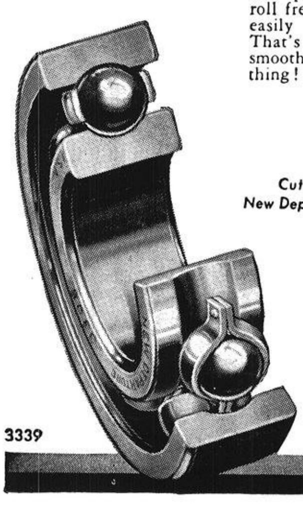
The ball possesses inherent advantages unequalled by any other rolling body. There are no *ends* to a ball—so its axis of rotation need never be artificially fixed.

Thus, a *Ball* bearing bears the loads on a circle of *free rolling* steel balls, reducing friction and wear, maintaining precise location of parts and cutting maintenance time—as does no other type bearing.

That is why over 300 million New Departure Ball Bearings are at work in this war. *That* is why designers of peace-time machinery are designing more ball bearings into their machinery than ever before.

There is really no substitute for the ball bearing—nor any substitute for the technical experience and creative engineering that go into New Departure Ball Bearings.

Ask for your free copy of "Why Anti-friction Bearings?"



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nothing rolls like a ball

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3339

SHORT CIRCUITS . . .

(continued from page 22)

A typical incident at U. W.:

Prof. Rall rapped on his desk and shouted: "Gentlemen—order! Order!"

Whereupon the entire class yelled: "Beer."

•

Beers (Chem. Class): "What can you tell me about nitrates?"

Baffled Student: "Well—er—they're a lot cheaper than dayrates."

•

Joe College (over phone): "John Smith is sick and can't attend classes today. He requested me to notify you."

Professor: "All right. Who is this speaking?"

Joe College: "This is my room mate."

•

Women's faults are many,
Men have only two:
Everything they say
And everything they do.

•

YIPPEE

"I'm tired of this routine existence", explained the fraternity brother to his roommate. "Let's do something extraordinary, startling, magnificent; something that will make our brains whirl, our pulses throb, and our hearts leap."

"Okay", said the roommate, so they studied.

•

"Cheer up me man", said the Irish doctor to a man suffering from three wounds. "Only one of your injuries is fatal; from the other two you may recover".

Said the pretty girl as she dashed for the train, "Sure my sailor's got a girl in every port—it's me."

•

Three 4Fs walked into a saloon together and immediately made for the bar. One piped up: "Give me an orangeade." The second ordered a coke. Keeping his head, the third one spoke: "Give me a glass of water. I'm driving."

•

Why peel bananas before we eat them? Why peel oranges before we eat them? It just wastes time. We know already what's inside of them.

•

In a telephone booth: "My friend is tall, handsome, and distinguished looking."

"Don't lie to her, Joe, I'm not tall."

•

TOAST

Here's to the man who loves his wife
And loves his wife alone.
For many a man loves another man's wife
When he ought to be loving his own.

•

Women give and forgive; men get and forget.

—Yellow Jacket

•

Room Apt. $16.50; 3 rooms $12.50.
Young couple with or without baby.
(Will fix.)—Classified adv. in the Denver (Colo.) Post.

WANTED:

A 1941 Summer Survey Camp Picture:

Some member of the 1941 camp who neglected to buy a group picture at the time has taken the framed picture from the hall outside of Room 105 in the Education-Engineering Building. It is not possible to get another print. Will some patriotic member of the 1941 camp please donate his camp picture so the collection from 1920 to 1942 will be complete?

Please send your camp picture to Ray S. Owen, Education-Engineering Building, Surveying Lab.

•

If anyone has a sliderule in very good condition, and wishes to sell it, would you please inquire at the Wisconsin Engineer office? We know of someone who is in great need of one at once.

It
could
happen
to
you.

RADIO IMPROVEMENT . . .

(continued from page 17)

When rectifiers of the type shown in Figures 2 and 3 were first used in any quantity in radio sets, there were quite a few cases of failures of tubes or filter condensers or both as the resistors R_1, R_2, and R_3 were not used. The cause of these failures was investigated by one tube company by manually turning on and off a radio in which there were repeated failures and finding the average number of times the radio could be turned on before a part failed. This number was found to be the same as the probability that the set could be turned on at the instant of a positive peak in the A-C wave and that therefore the trouble was probably due to the large transient currents which were possible. Resistors R_1, R_2, and R_3 serve to limit this transient, R_2 and R_3 limiting the peak tube current and R_1 limiting the current through the filaments of the tubes when they are cold and have as little as one-seventh of their hot resistance.

There are several modifications of the doubler circuit of Figure 3, each of which is designed to eliminate some disadvantage of this circuit, but most of which introduce in turn some new disadvantage. Figure 4 shows the series line feed type of doubler. During one half cycle condenser C_1 is charged through tube 1 and during the next half cycle the voltage across C_1 is in series with the line voltage with this circuit is twice that of the peak of the if no load current is drawn. This circuit, while not having nearly as good regulation as the symmetrical doubler, has the advantage that one side of the power line is connected directly to the negative side of the receiver circuit, keeping the potential between cathodes and filaments of the tubes in the receiver to a minimum, as the filaments are directly across the power line.

FIGURE 4