Spring 3-1957

Volume 68 - Issue 6 - March, 1957

Rose Technic Staff
Rose-Hulman Institute of Technology

Rose Technic

March 1957

In this Issue:

Robert Lautzenhiser, class of '49, speaks from experience when he says:

"The broad experience and growth possibilities available at U. S. Steel offer a great future with unlimited opportunities."

Following his graduation with a B.S. degree in Metallurgical Engineering, Robert Lautzenhiser joined U. S. Steel as a Junior Metallurgist at the Waukegan Works of the American Steel & Wire Division. Here, he became familiar with the many types of wire and wire products produced, through the practical performance of various physical tests in the metallurgical laboratory.

The knowledge Mr. Lautzenhiser gained of the characteristics of stainless steel wires led to his advancement, in April, 1950, to Product Metallurgist. In this capacity, his duties were of the customer-contact nature. His responsibilities in this work included consultation and the advising of customers regarding the proper steels for their projects.

Mr. Lautzenhiser received his appointment as Product Metallurgist for stainless steel wire in April, 1954. His work on this relatively new product, in which he developed exceptional skills and abilities, resulted in his advancement to Division Metallurgist in July, 1955.

Mr. Lautzenhiser feels that the graduate engineer gains much from the well-planned and complete training program at U. S. Steel. "Furthermore," he says, "the friendly atmosphere and unusually cooperative personal relationships throughout the company are a big help in acquiring the knowledge that leads to advancement and success in one's chosen field."

If you are interested in a challenging and rewarding career with United States Steel, and feel you can qualify, get in touch with your placement director for additional information. We shall be glad to send you our informative booklet, *Paths of Opportunity*. Write to United States Steel Corporation, Personnel Division, Room 1662, 525 William Penn Place, Pittsburgh 30, Pa.

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Paul Halpine, University of Pittsburgh '41, atomic engineer for Westinghouse, checking the operations of a model of the first nuclear reactor for the nation's first full-scale atomic power plant being built by Westinghouse for the AEC and the Duquesne Light Company.

You will have an opportunity to work with a company that is having spectacular growth in many fields . . . giving *you* room to grow.

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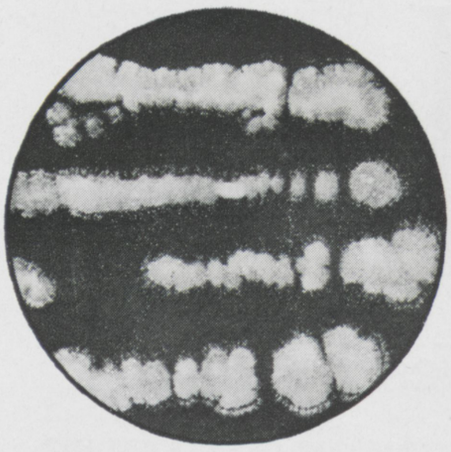

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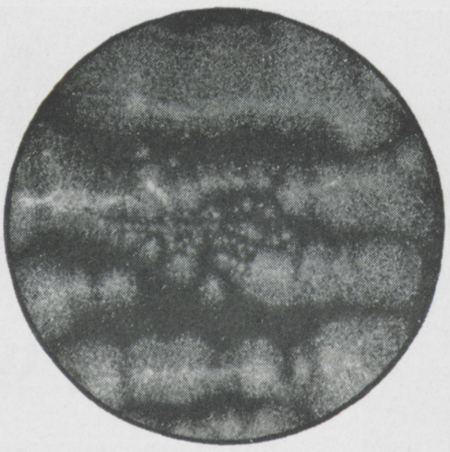
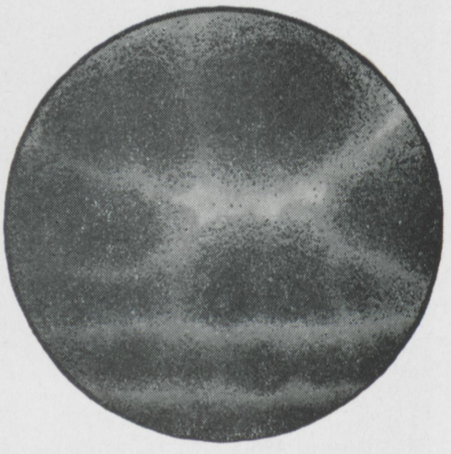


ASPERGILLUS TERREUS

CHAETOMIUM GLOBOSUM

MYROTHECIUM VERRUCARIA

FUSARIUM MONILIFORME



ASPERGILLUS NIGER

And, What Do Fungus Tests Have To Do *with Turbine Aircraft Engines?*

● It's like this. Allison engines today are flying in all parts of the world . . . in sub-zero areas, as well as in tropical areas where the climate is hot and sticky . . . where growth of fungus on electronic parts, for instance, could cause malperformance.

So, the fungus test is one of seven environmental tests conducted on engine components at Allison. Purpose, of course, is to determine whether or not the constituents of the components—such as insulation, or possibly some lubricants—will support fungus. On one engine model, some 50 parts are subjected to the fungus test.

Six types, or clean strains of fungi (above)—representative of those encountered in tropical areas—are kept growing in one of the Allison test labs at all times. Engine components are inoculated with a mixture of fungi spores; then placed in an air tight chamber for 28 days. Specified humidity and temperature conditions are maintained during the required test period. Following the test, components are subjected to a functional test; then disassembled; inspected; decontaminated and returned to the Qualifications Parts Cabinet.

Not too glamorous, this test. But, it does point out the ramifications involved in the production of modern aircraft engines which must perform perfectly under widely varied conditions.

• • •

Allison—a leader in the design, development and production of aircraft engines—is looking for young graduate engineers and technically-trained personnel. Why not arrange for an interview with our representative when he visits your campus. Or, write for information now: Personnel Dept., College Relations, Allison Division, General Motors Corporation, Indianapolis 6, Indiana.

Rose Technic

VOLUME LXVII, NO. 6 MARCH, 1957

Contents

Cover

High voltage ceramic insulators capable of holding vast quantities of electric power under control, the familiar transit and leveling rod with target, the slender but powerful lines of a swinging boom are the devices used by Stanley Meltzoff to tell the story of the growth and expansion so typical of America's responsible and progressive electric power industry. We are indebted to United Engineers and Contractors, Inc. for its use.

PHOTO CREDITS—Westinghouse Electric Corporation pp. 8, 42, Technic Photography Staff pp. 12, 16, 18, 22, General Electric Corporation pp. 14, 15, 46, National Lumber Manufacturers Assn. p. 25, United States Steel Corp. p. 36.

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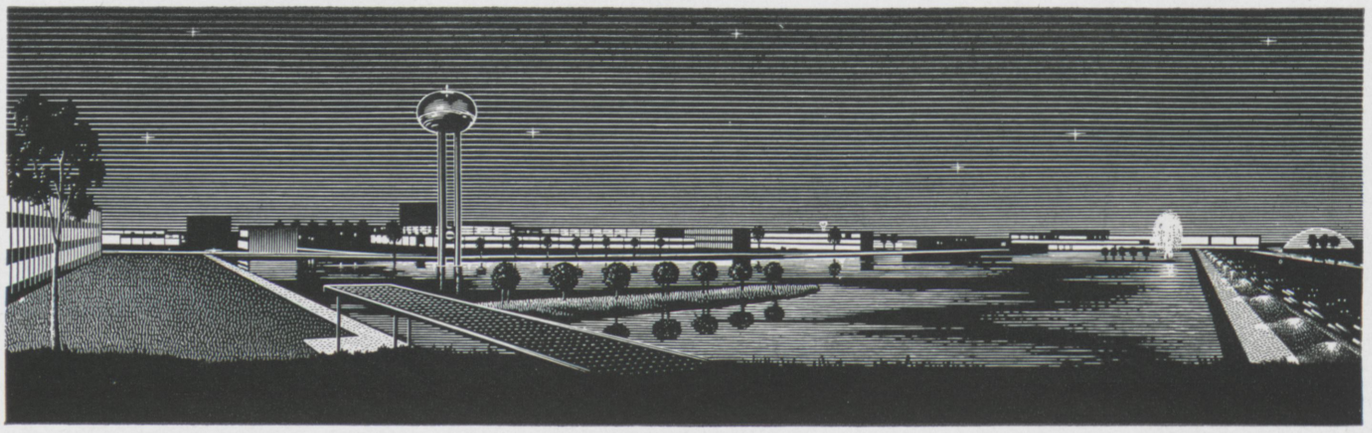

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...AND YOU

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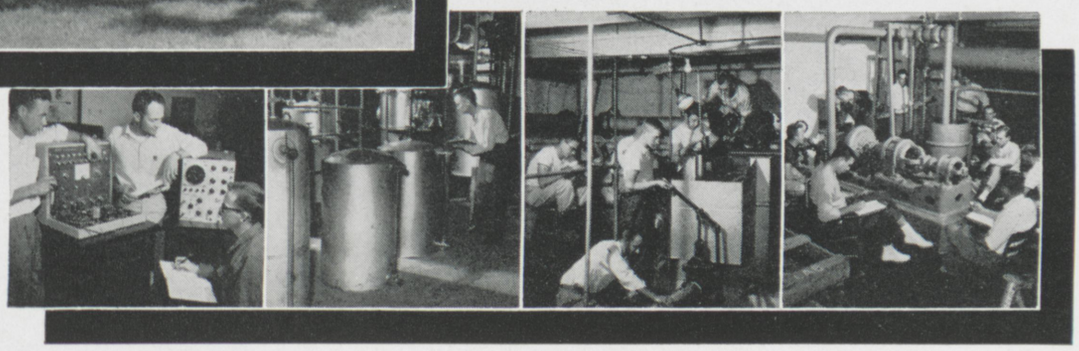

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HIGH SCHOOL GRADUATES OF 1957

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CIVIL ENGINEERING

The next freshman class will be admitted
September 9, 1957

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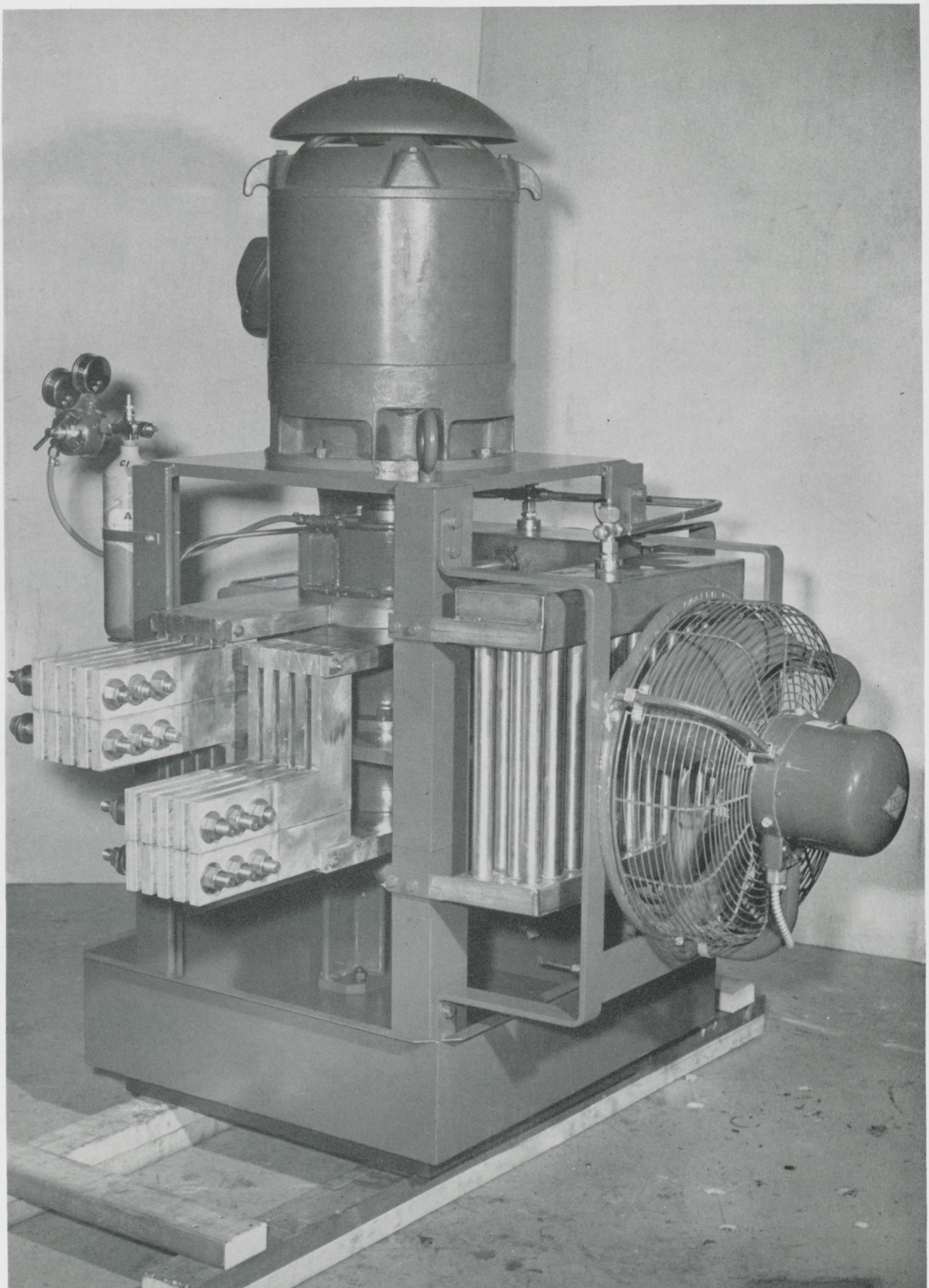


EDITORIAL:

You and Unions

You and I, and thousands like us, are preparing ourselves for jobs in engineering, management, and administration. Don't get the idea that you are going into engineering alone; it just isn't possible in the world of today. The engineer assumes all these responsibilities. In almost every direction the engineer turns in industry, he is confronted with labor and its manifold problems.

Soon we shall be working in industry where we will be forced to make decisions either for or against unions. Unluckily we can not take a middle-of-the-road stand in such an important problem. Most of us, by way of our education, and because of the position in which we are placed, will be pro-management; however, there are now unions within the professions which allow engineers to organize.

Last month the Indiana Legislature passed the controversial right-to-work bill, outlawing the closed shop. If a man wishes to join a union, because he feels that the advantages outweigh the disadvantages, he is free to do so. However, if he does not wish to join a union, he is not barred from working as has been the case in the past in a closed shop, which was in direct opposition to our Constitution. These non-union exclusions were invariably written into union negotiated contracts. The worker was then forced to accept them in order to work. What could be fairer than to write laws to protect a man from being coerced into joining unions. This is the reason for laws—to protect the people.

R. L. T.

FRONTISPIECE—This unipole Generator was designed by the Westinghouse Electric Corporation. It serves as a current source for their D.C. conduction, liquid metal pump. Rated at 0.5 volts and producing 20,000 amperes, the generator employs a liquid sodium-potassium alloy as both the brushes and cooling medium. Buss bars are nickel plated to prevent rapid oxidation of the copper. Also shown is the cooling fan and A.C. drive motor. Details of the pump's construction appear on pages 10 and 11 of this issue.

Magnetism Over

Magnetic Force

By Frank R. Denton,

On Dec. 2, 1942, the world's first atomic reactor was put into operation underneath the bleachers of Stagg Field in Chicago. This rather quiet and unheralded event ushered in an entirely new concept for a source of power.

For fifteen years the development of better reactors and associated equipment has progressed. This article deals with a small phase of the associated equipment, pumps for molten metals.

The finest reactors that can be built are completely useless unless the energy produced by the atomic reaction can be utilized to do useful work. The usual plan for accomplishing this is to utilize a heat transfer medium which absorbs heat from the reactor and in turn releases it in a turbine which converts the heat energy to mechanical energy. Previously water has generally served as the heat transfer medium, but recent development indicates a promising future for the liquid alkali metals.

The alkali metals possess a number of advantages as heat transfer fluids. They have high thermal conductivity which more than compensates for their relatively low heat capacity. This permits a reduction in heat transfer area or a reduction in the wall temperature for a given amount of heat transfered. They are relatively stable in radiation permitting their use in nuclear reactors, and they have high boiling points and low vapor pressures which permits the use of low pressure high temperature heat exchange mechanisms.

To offset these advantages, the alkali metals are extremely active chemically, they burn in air and react violently with water. At high temperatures, they attack most insulating materials and dissolve most metals. The heat exchange equipment must use the relatively few metals which are not appreciably attacked by the alkali metals at high temperatures, and the system must be completely sealed, not only to prevent leakage out of the system, but also to prevent the entrance of contaminating gases such as oxygen. These points impose severe limitations in the design of pumps to be used in the heat exchange system.

There are five main types of pumps that could conceivably do the required pumping job with the liquid alkali metals. They are rotating mechanical pumps, mechanical discharge pumps, a.c. induction pumps, a.c. conduction pumps, and d.c. conduction pumps.

Rotating Mechanical Pumps

Rotating mechanical pumps are certainly one of the most commonly used pumps today. They usually pump everything from oil to water, and do it well. However, when one considers the physical properties of the liquid alkali metals, the impracticability of this type of pump is revealed. The most commonly used metals are lithium, sodium, and sodium-potassium (NaK) alloy. None of these metals can be exposed to the atmosphere, so the pump must be completely sealed. At the present time there are no seals that will prove satisfactory against the combination of high temperature and chemical activity of these metals. Another problem is revealed when one considers the pump bearings that must run in contact with the liquid metal. There are no bearings known today which will run freely in the presence of these mediums without galling. These attendent problems would result in a high rate of shut down time for bearings and seals, and as such this type of pump is considered unsuitable.

Mechanical Diaphragm Pumps

The mechanical diaphragm pump has the same problem of seals as the rotating mechanical pump. The other main problem encountered here is the diaphragm itself. The diaphragm must be flexible and at the same time able to withstand both the high temperature (about 1100 degrees F) and chemical activity of the medium. There is a vague hope for certain types of plastics, but as yet nothing has been developed that will warrant the use of this type of pump.

A.C. Induction Pumps

There are two types of a.c. induc-

Mechanism

Pumps Liquid Metals

Jr., jr., e.e.

tion pumps that may be considered. Both operate and are governed by the same design procedures as the induction motor. The "helical flow" pump is similar to an induction motor in which the airgap is filled with a liquid metal and the rotor iron is stationary. The liquid metal acts as the rotor conductor and is confined by helical vanes to move in a circular path following the stator field. One end of the stator field acts as the pump inlet while the other end acts as the pump outlet.

The other type of a.c. induction pump is called the "straight line" induction pump. It is similar to the "helical flow" pump except that the stator is laid out in a straight line and the liquid metal moves only in translation following the stator field.

These pumps have the advantage that neither uses any moving parts and as such the problem of seals is eliminated. However both require field windings in close proximity to the liquid metal and so the problem of electrical insulation at high temperatures becomes prohibitive.

D.C. Conduction Pumps

The d.c. conduction pump is very simple in operation. The liquid metal is run at right angles to a magnetic field and a current is run through the liquid metal at right angles to both the magnetic field and the flow of the liquid metal. The liquid metal acts as the armature conductor in a d.c. motor and is therefore forced to move. (See figure 1.)

The d.c. conduction type pump is considered to be the most practical pump for pumping liquid metal at high temperature. Its pumping chamber is completely sealed. It has no bearings or moving parts to wear and require maintenance. It requires very little electrical insulation and can be operated at temperatures approaching the melting point of the metals used in its construction. The principle disadvantage rests in the fact that extremely large currents are required to cause an appreciable force and as such the I^2R losses can be considerable. Its other major disadvantage is that power supply for a low voltage and high current must be an integral part of the equipment.

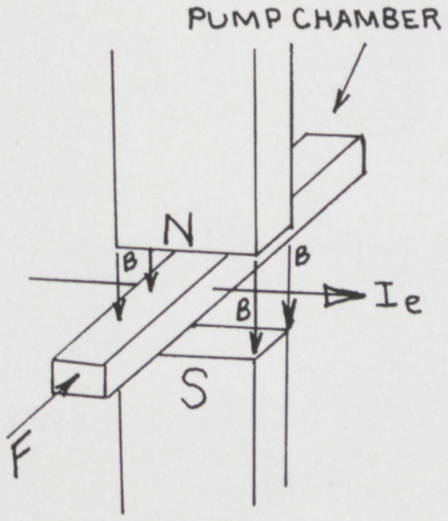


Diagram of Current (Ie), Magnetic Flux Density (B), and resulting force (F) in Pump Chamber. The force (F) is determined from the equation: F = BIeL. where (L) is the width of the rectangular tube.

A.C. Conduction Pumps

The operation of the a.c. conduction pump is similar to that of the d.c. conduction pump. The magnetic field is provided by a pair of electromagnets which must be connected to the current passing through the liquid metal in such manner that when the direction of the current reverses, the magnetic field reverses simultaneously thereby causing a continuous force in the same direction. The a.c. conduction pump has as its principle advantage the ability to operate on standard a.c. lines and as such requires no separate power supply. Its principle disadvantage is that when a large size pump is needed, the eddy current losses in the magnet laminations become so great that the efficiency of the pump drops to one or two percent. The a.c. pump is ideal for small laboratory applications, but when a practical situation, such as a nuclear power plant, is encountered it becomes practically useless.

From the past discussion it can be seen that the only type of pump suitable for a large installation is the d.c. conduction pump. Such a pump was designed by the Westinghouse Corporation for use in a power system.

(*Continued on Page* 42)

A NEW DISEASE?

MODULOSIS

By The Modulus Staff

Down in the jam-packed little cubicle known as the Modulus Office, a mild revolution has been taking place during the past two years. The Modulus staff has been trying to find a successful formula for a Rose yearbook that will be interesting and worthwhile to the student body both now and twenty years in the future.

The general idea used in planning the 1957 Modulus is to make the book as entertaining as possible and yet retain the statistics and group pictures that will grow in interest as the years go by. In other words we are trying to present the true story of 1956-57 in a more lively and interesting fashion than has been done in the past. Editors Bob Burtner, Bob Trotter, and Ron Reeves decided that the best way to do this was to cut out dead weight—the excessive number of formal photos and writeups—and use more informal shots with lighter write-ups and captions. This idea was also used to some extent in the 1956 Modulus.

There are several specific things we are doing to improve the book. One is to mention more people's names. We feel that everybody in school would like to have as complete a record of his activities as we can make. The 1957 Modulus will have a caption on every picture.

A novel idea being tried for the first time this year is a sixteen-page introduction printed in two colors. This introduction is a story of the average Rose student's daily life, illustrated with formal and informal photos and clever art work by Tom Reese and staff. Perhaps most of us presently feel that our daily existence is so miserable that we do not care to be reminded of it, but in a few years we may like to reminisce a little bit about what a heck of a life we lived when we were in Rose. This introduction is designed as an aid for some of this "reminiscing". It is already completed, and everybody on the Modulus staff feels that it will be a standout feature of the new book.

Editor-in-Chief Bob Burtner reports that the book is also on schedule, which means that the 1957 Modulus will be the first yearbook in a long time to come out before the close of the school year in the spring. The complaint that the book is never out on time has been a long-standing gripe against the Modulus. This year is the most promising for this gripe to be eliminated.

If anyone hears loud shrieks from the Modulus Office, do not be alarmed. This is merely Bobby B. or "Brownie" Williams on one of their spasmodic "mad fits". The compiling of the Modulus does occasionally present some problems, which to the ordinary human are ample justification for a "mad fit." Even a matter apparently so simple as the taking of the freshman class pictures turned out to be quite a mess. Since it is always a major problem to identify each freshman in a group picture, "Brownie" had them sign their names to a paper as the pictures were being taken. After trying diligently to keep the freshmen signing their names in the traditional left to right

(*Continued on Page* 50)

Professor Gordon Haist and Modulus Staff. From left to right: Bob Trotter, Bob Burtner, Ron Reeves, Prof. Haist, and Crone Knoy.

Fraternity Notes

ALPHA TAU OMEGA

Here's the list of pin girls and their bashful Beaus—as promised in last month's ATO column in the Technic. Leap Year, or should I say the hunting season, closed with another successful season for the girls. Those girls getting their limit, namely one Brother Tau, were: Miss Kay Moomaw who bagged John King, Miss Reba Mae Butts who caught Larry Thomas, Miss Margaret Lanham captured "Ky. Col." Jack Hunt, Miss Janice Sawyers, after a terrific chase and a thrilling capture, snared Vern Fellows, Joe Bronnert was corralled by Miss Kay Nichols, Miss Barbara Siminski caught Wilbur Steele napping for an easy trophy, and Miss Kitty Clark with the aid of an elaborate trap bagged old Joe, idol of St. Mary's, Vendel. All kidding aside though, all of the Taus congratulate our new ATO sweethearts and their pinmen.

Some of the Brother Tau's, who were already captured and sufficiently trained, have started on the road to walk the last mile of their bachelorhood. They are: John Bloxsome who became engaged to Miss Jean Lewis, Bob Travis who became engaged to Miss Lou Ann Tangeman, and Dave Thomas who became engaged to Miss Carolyn Kord. Congrats to all of you and best wishes from the chapter. Brother Hugh Lynch actually walked the last mile in February and married Miss Edia Kay Worster.

State Day is going to be held at Old Purdue this year on March 9th. 'Nuff said about this—except indications point for a highly successful State Day. More about this next month.

That period known as Rush is fast approaching. The "Brains" are working on a new super-secret weapon for the Rush Parties. But if you think Oak Ridge kept secrets, this group has a system that tops everything.

Tom Reese

THETA XI

The big house at Sixth and Park just doesn't look the same anymore. A group of the brothers really worked it over during the semester break. The floors of the first floor were sanded and refinished. The floor of the dining room was tiled. The kitchen has a new look, too. It's now a warm chocolate-brown. Racks were made for displaying our mugs and paddles. Soon there will be new tables in the dining room. And we now have an ultra-modern, completely private phone booth (Tobies' Gray Room). Participating in the efforts were: Bros. Wolfe, Blastic, Coma, Wilson, Irvin, Blickhahn, Leavitt, Mrava, and the "TX Picasso," Bro. Veach. Guys, you really did a good job.

The TX Tigers won their first ball game of the semester by defeating the Taus. This officially puts us in second place. But look out Sigma Nu, we still have plans for taking that trophy. Well, it seems that the mighty has fallen — Bro. Wolfe is pinned! She must be some kitten to snare a catman like Gordon. There is a date party planned for Saturday, Feb. 15th. Refreshments will be served. Dick Rahn is coming back to visit us at the party, so the Kappa Kats combo will be together again! He is bringing a sax man with him, so it should be quite a session. April 27th is the date of the annual Founder's Day Celebration. This year is Kappa's 50th Anniversary, so the two festivals will be held in conjunction in the Terre Haute House's Mayflower Room. Theta Chapter of Purdue and Alpha Tau of Indiana have been invited. "Wes" (Wyatt Earp) Spoonamore claims he is pinned. We haven't seen any official facts yet. Maybe it's just wishful thinking. Well, guess that's all the pertinent poop for now, so see you in the next Technic.

Holly and Ame

LAMBDA CHI ALPHA

When Spring is nearing and the seniors' thoughts are straying away from the books to the more pleasant diversion of women, the party and picnic fever gets into the air. A full calendar is planned this spring with the largest event, our White Rose Formal, coming up April 27. Other planned events are three more mixers and several picnics at the state parks to wish the seniors farewell; the underclassmen don't get left out either — in fact they are usually ready for more.

This month a mixer was held with the Delta Gamma's from State and a house party with the Sigma Nu's was a big success after Rose's last home basketball game.

As the basketball season ended so did the college seasons of two senior LXA starters—guard Harold Brown and forward Captain Bob Bright. Jim Oaks also finished a fine season as Rose's leading point maker. He will be around to help us again next season. The boys helped Rose to one of her most successful seasons with many thrills and much fine entertainment.

The inter-fraternity b-ball team loses three seniors — Don Simpson, Red Newgent, and John Bizal, but all, with the exception of Don who plays varsity baseball, will be seen in the struggles on the softball diamond. Softball coach, Hallie Brown says, "Herman is ready and so are we; bring on the contenders for the trophy."

Song practice for the I-F sing is getting underway and I never thought 45 voices could sound so

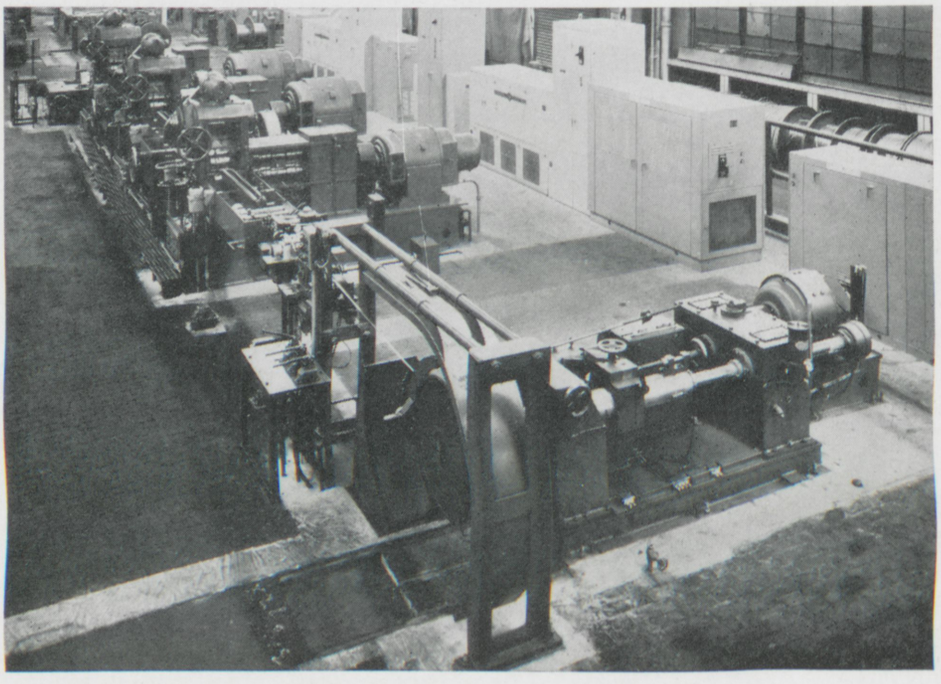
(*Continued on Page* 50)

Power For

By Norm

Increased production is not only a healthy sign in our economic system, it is also a virtual economic necessity for the very near future according to some forecasting done by Peter F. Drucker of the Graduate School of Business, New York University. Mr. Drucker states, "It is more than possible . . . that a continuing feature of the next two decades will be a labor shortage . . . therefore, increased productivity will be the paramount need of the American economy in the decades to come."

Although the full impact of such a labor shortage may not have to be faced for a full twenty years, we cannot deny that the nation's businesses are now caught in the squeeze between rising material and labor costs. It is for this paramount reason that so many of the nation's progressive businesses have turned toward automated manufacturing processes for relief. However, in addition to lowering labor costs and increasing productivity, industry has found that automation also produces a higher quality product with fewer rejects. In fact, automation techniques, properly applied, can offer so much in the way of more rapid, more efficient, operation, that a conservative estimate of a 10 percent overall increase in American industrial productivity could be attributed to automation were it applied to all processes to which it is adaptable. In dollars and cents, this would mean roughly 20 billion dollars more in goods and services available to the consumer.



Wire-Flattening Mill.

The problem, of course, in designing any automated process is to make it an efficient operation—efficient in time, money, and materials. Now, it must be understood that not every automation design can offer the same level of efficiency as every other; there are various levels of efficiency obtainable with various combinations and qualities of automation machinery. The system which provides the closest automatic control of material flow-speeds, the highest operating speeds attainable at the lowest cost in energy consumption, and providing the greatest quality control all in one unitized package is bound to be the most efficient system for any automated process. Strangely enough, this idealistic system can be quite closely approached by utilizing what was once the electrical ugly-duckling of the industrial world—DC power.

The phenomenal growth in the purchase of direct current motors in the one to 200 horsepower range (an 85 per cent increase between 1947 and 1954) is quite closely connected with the rise in industrial automation. The reason for this is clearly seen when one considers that what any other form of motive power can do in modern "continuous processing", the direct current motor can do better. According to Paul D. Ross, a General Electric marketing manager, there is no device yet dis-

Automation

Huntley, fr.

covered ". . . that is a better, more universal source of precisely controlled adjustable speed than the d-c motor. It is capable of developing vast amounts of power. It will operate over wide speed ranges, accelerate and decelerate rapidly—but perhaps the most important characteristic is the ability of this mighty muscle to accept directions and obey commands of sensitive electronic, magnetic, and rotomagnetic 'brains'."

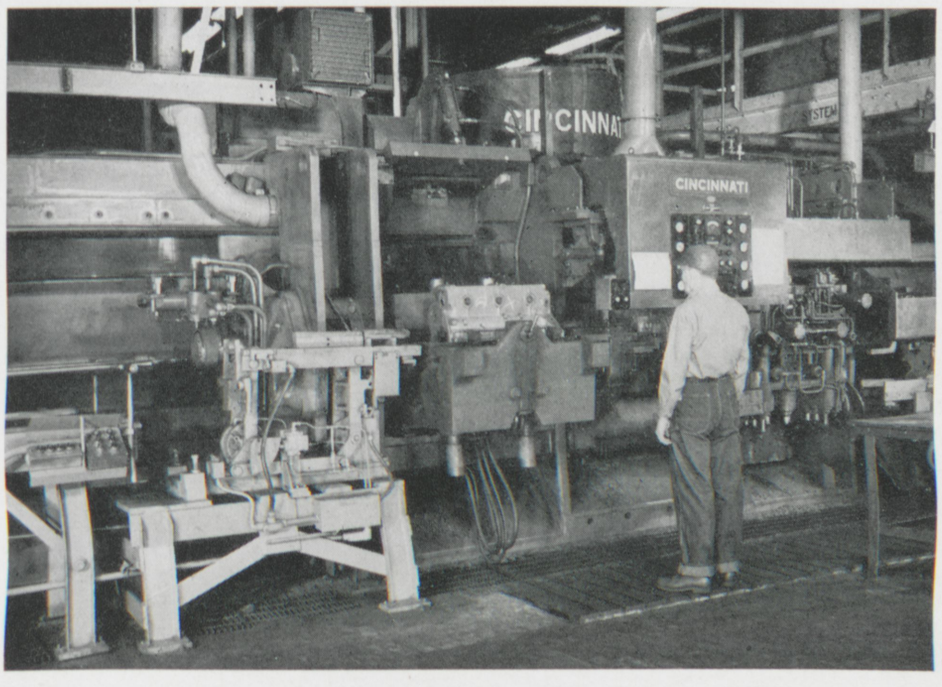
In one word, the d-c system's big advantage over any other system is "control". It is possible, by various means, to precisely control almost any production process by virtue of the fact that a d-c drive can provide adjustable motor speed over an infinite range; constant torque; economical, efficient braking; preset speeds; rapid acceleration and deceleration; and smooth response to feedback control signals. In addition, the d-c system has a high degree of flexibility in that a number of motors may be operated from the same power source despite variations in size and operating speeds, with their speed relationships controlled either individually or from a central control-panel.

Automation, or "continuous processing" as it is sometimes called, is the term applied to a production system designed to produce a continuous flow of work from one machine to the next throughout the entire system. Such a system may be set up to operate on the "feedback" principle or it may be fully programmed on magnetic tape to complete a particular process with no human control whatsoever; both methods are easily performed with a d-c drive.

The "feedback" principle utilizes an electric signal, from a sensing device on the output side of the machine, which flows to the "comparator" where a relative evaluation against the standard for the operation is made by electrical means. If there should be some discrepancy in the two signals, an "error" signal immediately flows to that device which controls the needed adjustment. Thus, control is close, continuous, and almost instantaneous.

Any of several devices may be used to provide the "sensing" signal with a high degree of accuracy. One technique is to take motor speed-readings with a tachometer, while another method measures the current-draw in the motor. A third method uses photoelectric controls. The particular device or combination of devices depends mostly upon the job to be performed and the nature of the automation equipment.

One of the most difficult processes to control with an automated system is the winding or unwinding of sheet or web materials, due to the fact that as the size of the roll increases or decreases, the tension on the material may vary over a wide



Broaching Machines.

(*Continued on Page* 46)

Campus Survey

By Dan Mook, soph., m.e.

Famed Argentine Pianist.

CONVOCATIONS

A very entertaining convocation was presented on February 14th, when Mr. Raul Spivak, famed Argentine pianist, returned to Rose for his second concert. Mr. Spivak, well known for his Latin American renditions, recently returned from a tour of Europe where he was highly acclaimed for his work.

Included on his program were: "Toccata" by Debussy—an Argentine dance, "Gato", by Guastarino, and the "Spanish Fire Dance" by M. De Falla.

Also in the line of convocations, the Franklin College Choir presented a very enjoyable concert at Rose on Friday, March 15th.

On April 11th, the annual Oscar C. Schmidt Memorial Lecture will be given. Noted orator, Mr. Glenn W. Thomson, President of Arvin Industries of Columbus, will be the guest speaker.

The DePauw Players, who last year gave a very excellent performance of "Anastasia," return to Rose on May 1st to present George S. Kaufman's "The Solid Gold Cadillac".

AIEE-IRE ELECTIONS

The joint branches of the AIEE and IRE recently held a get-together under the title of "election of officers for the year 1957". This was one of the most unusual proceedings to be called an election since the Tamany Hall ring was broken. The election started with the nomination of Max Hippensteel for co-chairman of the branch. This was followed by a second and a motion that the nominations be closed. This also was seconded and the motion carried.

Next Jack Gaughan was nominated as program chairman. Second nominations closed — second motion carried. In a like manner, Tom Reed was elected Treasurer and John Kassebaum was elected AIEE Secretary.

When nominations for IRE Secretary were opened, Harry Bitner, after being chosen himself, nominated another candidate to prevent being "railroaded". This move, being extremely unusual, was followed by a few moments of indecision as to how to carry out an actual election. When the turmoil finally quieted down, Harry, to his dismay, was elected.

There has been a proposal to change the name of the organization to the AIEE-IRE Railroad but it is doubtful that the National Organization will allow it.

RUSH

Perhaps one of the most important decisions in a college student's life

(*Continued on Page* 44)

New A.I.E.E. and I.R.E. officers. Left to right: Bitner, Kassenbaum, Reed, Gaughan and Hippensteel.

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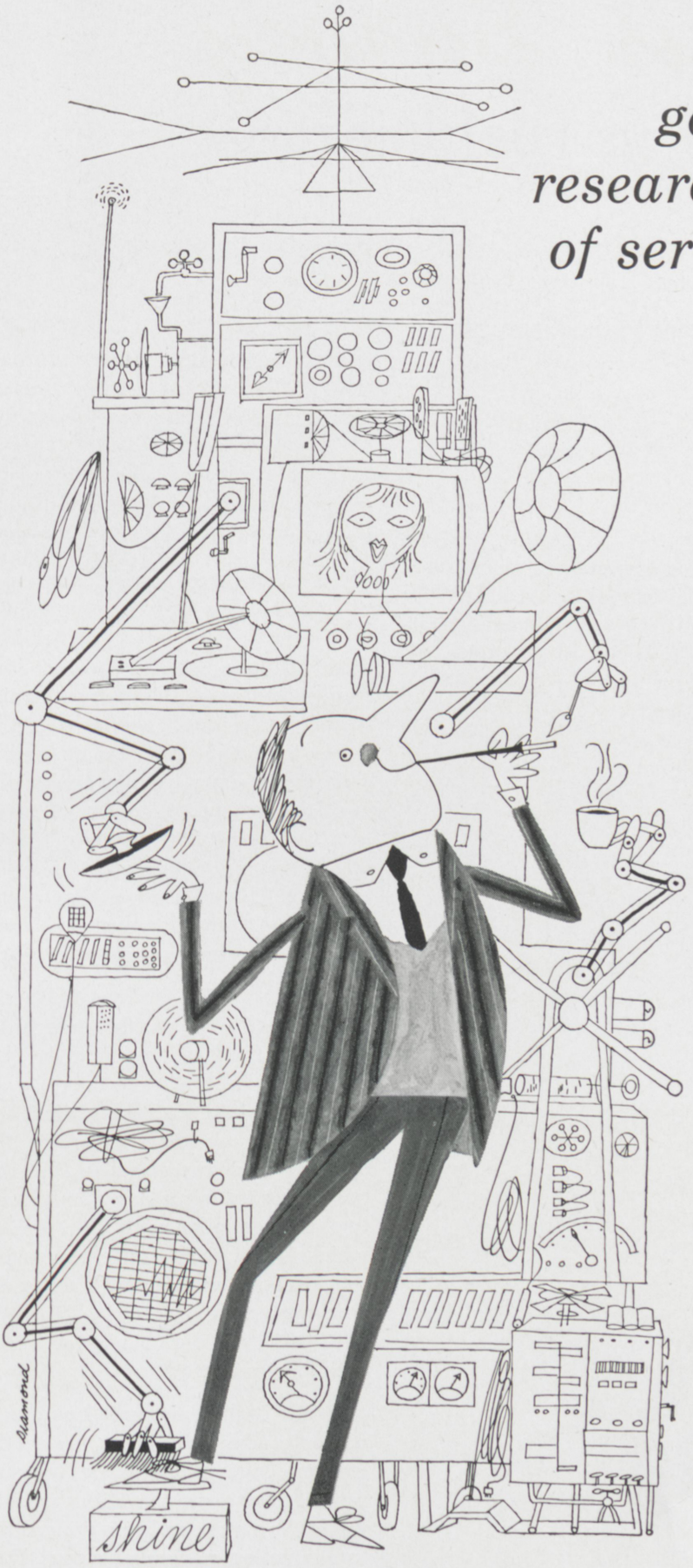

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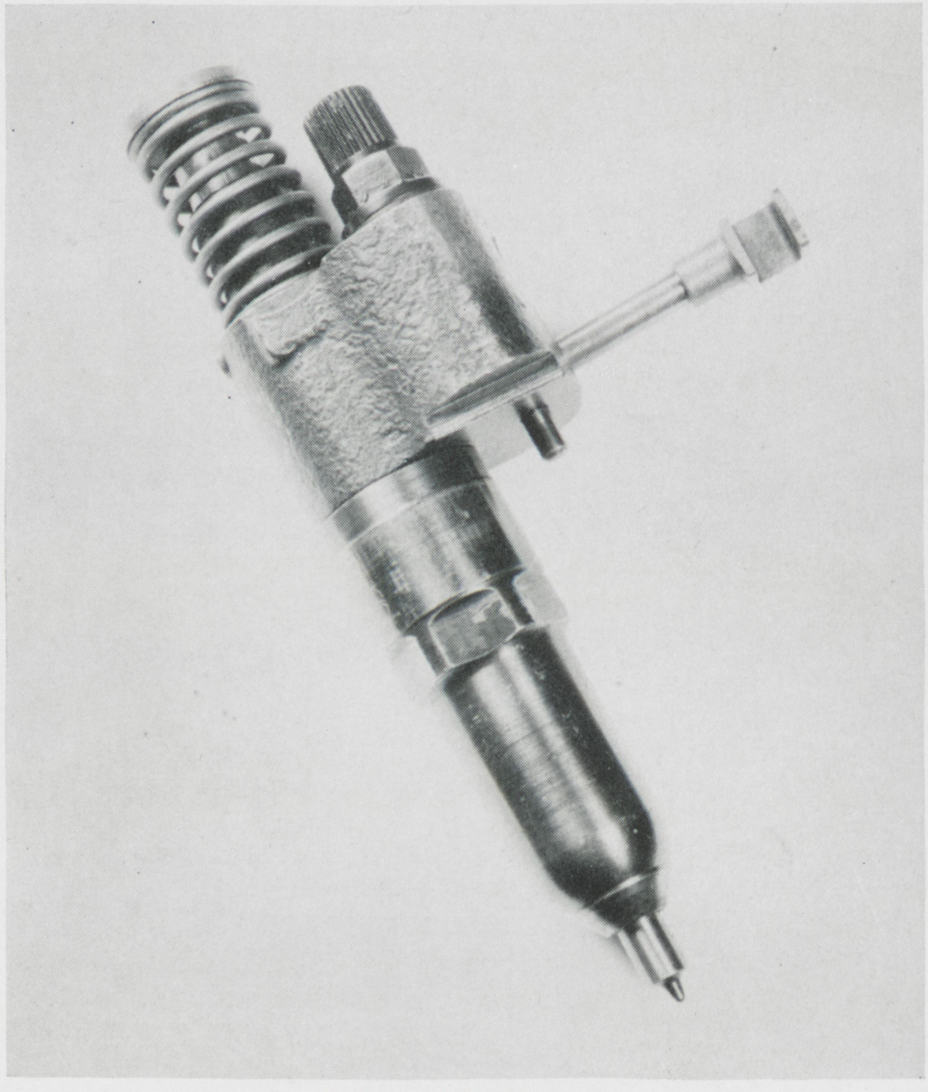
Carburetor vs Fuel Injection

By Tom Hale, soph., m.e.

With the ever increasing desire for more power, speed, and economy, there comes closer and closer the possibility that the carburetor, which has sat astride the automobile engine since its beginning, will be replaced by a system of fuel injection. While the carburetor has a long record of service, this longevity is due more to a lack of a suitable replacement than to its own efficiency.



G.M. Diesel Fuel Injector.

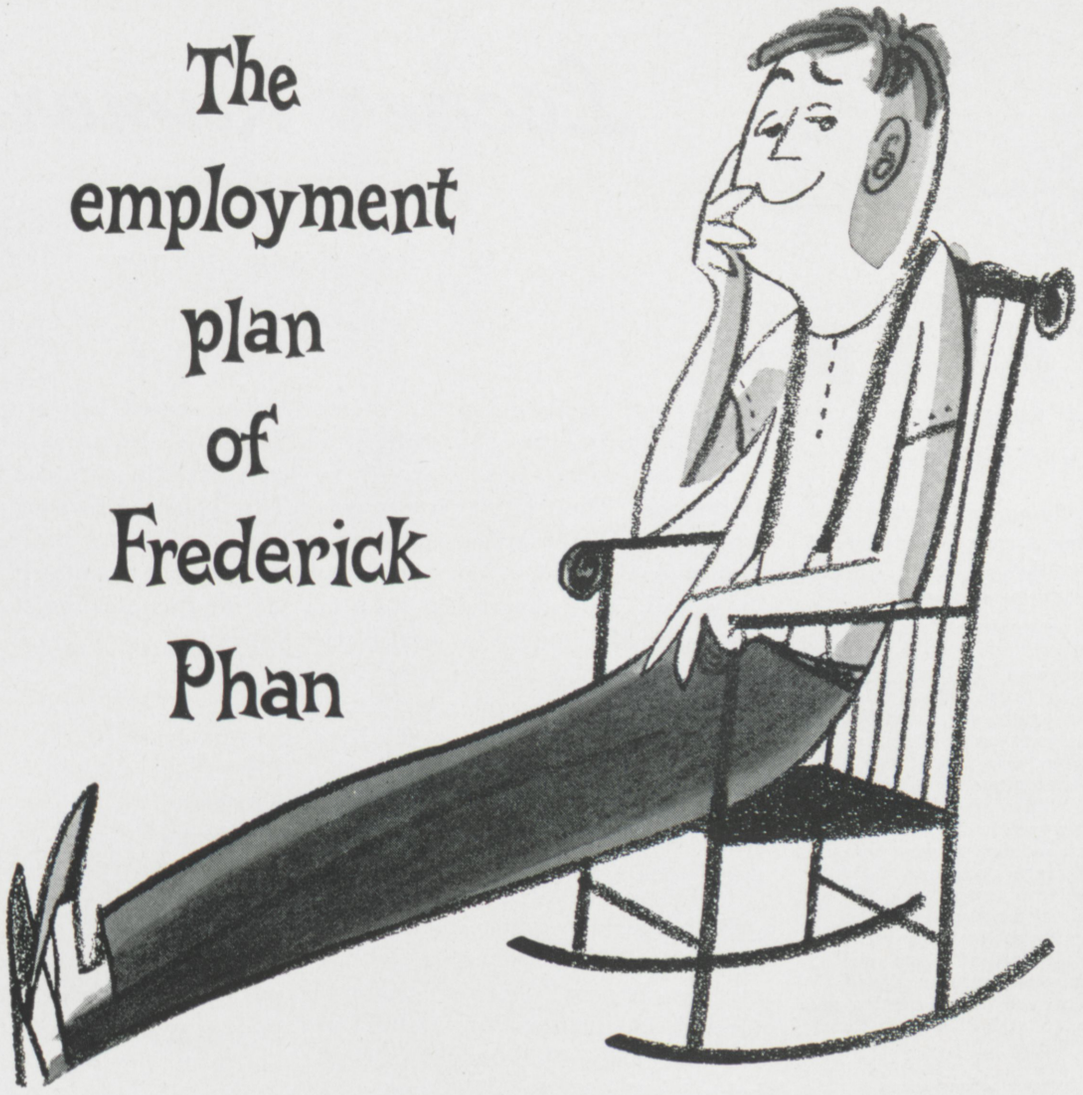
The carburetor works on a relatively simple, mixing the proportions of air and fuel in a central location. This mixture is then heated and transported via the intake manifold, to the intake ports, where it is fed to the cylinders. It is almost impossible to get equal proportions of air and fuel mixture to every cylinder, with the result that some cylinders will be too rich while others may be starving. This cuts into economy because the system must be rich enough to make the leanest cylinder function properly.

The ideal setup would seem to be to inject the gasoline directly into each cylinder, and take only air on the regular intake stroke. By putting an injector on each cylinder, the exact proportions of air to fuel can be attained. This alone should add two to three miles per gallon of fuel, which is lost to the necessary overrich carburetor settings. This is not a new principle; it is, in fact, the system used on diesel engines since their beginning.

A few earlier attempts have been made to adapt this principle to the gasoline engine. One of the first successful ones was on Hitler's Luftwaffe. This more or less standardized fuel injection on combat planes. Fuel injection is widely used in commercial aviation today.

(*Continued on Page* 52)

The employment plan of Frederick Phan



Mr. Phan had a plan. It was really a very simple thing. His idea was to let tomorrow take care of itself. And Mr. Phan, too. People gave Mr. Phan credit for courage but not for such things as groceries, rent and clothing.

Fortunately, most engineers insist on building their own futures. They're not inclined to wear destiny like a millstone. And when they come blessed with a far-ranging spirit and an extra portion of creative ambition, we like to have them with us here at Chrysler.

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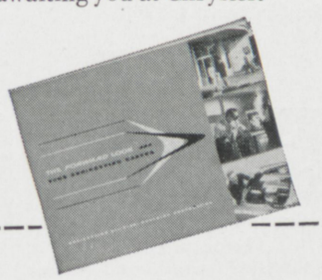

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Locker Rumors

By Gene Blastic, jr., m.e.

Varsity

The Rose varsity roundballers are really bouncing the ball right this season. So far they have compiled an 11-3 record. Their latest victory was over a tough Greenville squad who had defeated Carr's men earlier in the season. This victory put Rose in a tie with McKendree for first place in the Prairie Conference race. This tie will be broken in the near future for the "Fighting Engineers" play McKendree in their next game. Being there are only three more conference games left, this game may decide the winner of the conference.

With fourteen games in the past this season, Jim Oakes is holding scoring honors, having pumped through 241 points. Gary Giffel has 181 points and Bob Bright is right behind with 166. Harold Brown, with 125, and Sherm Smith, a freshman, with 116, are next in line.

Many of the freshmen members of the squad have contributed points, and these men are not to be denied. Larry Cunningham, a freshman forward and guard, has pulled a couple of Rose's recent tilts out of the fire with his ability to put the ball through the hoop. All in all, the freshmen members ought to be commended on their performance.

With just a few games left this season, lets all go out and boost Rose to the Prairie Conference title.

With Baseball and track seasons just around the corner, some Rose men are already out doing some throwing and running. If anyone is interested in starting early to get in shape, equipment can be checked out at any time. You can never start too early to get in shape.

Intramurals

The second half of the intramural basketball league is now well under way, with most teams having played four games. However, it is still too early to predict the outcome. Pack Horses are prominent in basketball. So far this half the standings are as follows:

	Won	Lost
Freshman B	3	0
EE's	3	0
Freshman F	2	1
Freshman D	2	1
Senior CC	2	1
Freshman C	1	2
Freshman A	1	2
Sophomore M	1	3
Freshman E	0	2
Senior M	0	4

The second half of the league ends toward the end of February or beginning of March. The outcome should prove interesting. Mr. Kelley has commented very approvingly on the way the freshmen have been performing in the intramural program.

Interfraternity

The IF basketball league is about the hottest and most competitive ever. The Greeks are really battling for that trophy. And no one is about to quit. A tough Sigma Nu squad has the lead with a 6-1 record. Theta Xi is next in line with a 4-2 record followed by Lambda Chi Alpha and Alpha Tau Omega, who have records of 3-3 and 0-7 respectively.

Already, the fraternity men are looking forward to the softball league which begins a few weeks after the end of the basketball season. And, like all other fraternity competition, it's going to be a tough league.

Plastic Of A Million Uses

By Toby Eubank, jr., ch.e.

During the last five years, over a quarter of a billion dollars has been invested to produce polyethylene. This is due to the many uses that have been found for this plastic. You have had polyethylene in your hands when you pinched a squeeze bottle or picked up a plastic bag of fresh vegetables at the store.

Polyethylene was developed in 1933 in England. Its first job came with World War II, when electronic engineers found that poly alone provided the necessary high-frequency insulation for radar devices. After the war, new uses were found so rapidly that the supply didn't catch up with the demand until a few years ago.

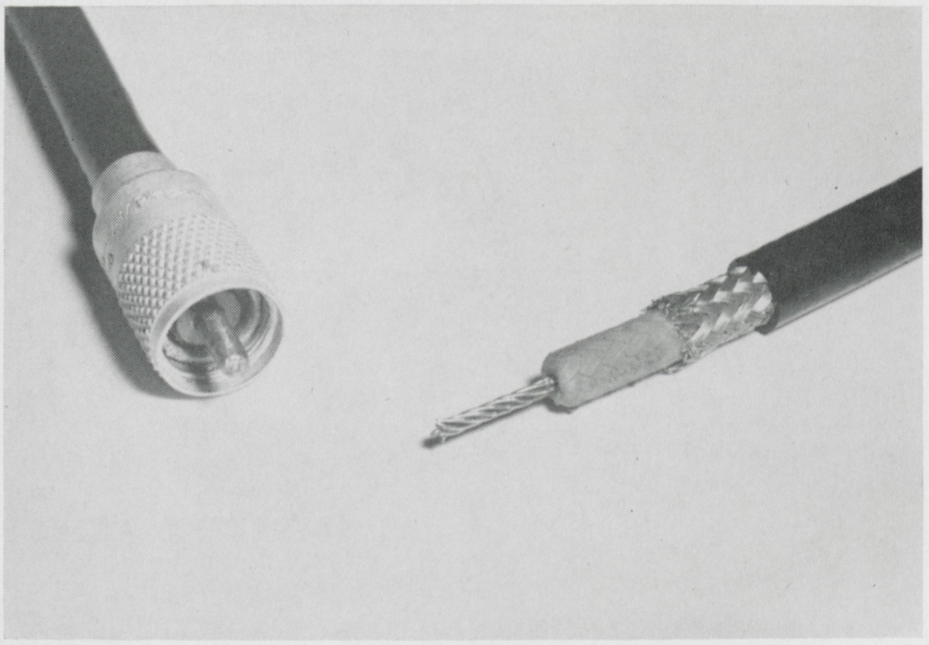
Process

Polyethylene is a by-product of the natural gas industry. Ethane is first separated from the other components in natural gas. Ethylene gas is then produced by removing a hydrogen molecule from ethane in a cracking furnace.

Pressures as high as 35,000 pounds per square inch are required to polymerize ethylene into solid polyethylene. This is known as the English or high-pressure process. Because of the high pressures, expensive equipment with thick, steel walls must be used.

Properties

Polyethylene is a pale, translucent, waxlike solid. It is the lightest of plastics and has a leathery toughness. Flexibility and shatterproofness are other desirable properties. And it has high resistance to most active chemicals, whether acids or alkalies.



Cut away view of co-ax cable showing use of poly as inner dielectric.

Uses

Electrical insulation takes approximately 35% of the polyethylene output. The plastic already is entrenched in most uses where its high dielectric constant is a benefit. Characteristic of this was American Telephone and Telegraph's decision to use poly-coated wires for the first trans-atlantic telephone cable to Europe.

Containers are another major application. The shatterproof squeeze battle is now used for over 3,000 cosmetic and pharmaceutical products. Two new markets are toothpaste and shaving cream tubes. On a larger scale, thirty-gallon polyethylene drums are now being produced to handle corrosive chemicals and greases.

Films and coated papers today account for 40% of the total market. Polyethylene film is excellent for packaging fresh produce since it is a good moisture barrier and yet is permeable to oxygen and carbon dioxide, allowing the vegetables to "breathe," thus delaying decay. Tents, raincoats, and portable garages are other examples of applications for polyethylene films. The film is so strong that it may even be used for sandbags. In the future, liquids, such as syrups, will probably be packaged in pouches made from the plastic film.

The biggest unknown in polyethylene's future is plastic pipe. These pipes have all the flexibility of hose and, for any purposes, strength equal to or greater than that of metal. Unlike metal pipes, freezing will not damage them; they expand with ice instead of bursting. Lightness and resistance to corrosive materials are other advantages of poly pipes.

(*Continued on Page* 51)

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Research and

By John Kassebaum, jr., e.e.

ULTRAVIOLET CLOSED-CIRCUIT TV

A new application of closed-circuit television is undergoing experimental examination at the National Institutes of Health. The new application provides immediate comparative data of chemical activity within live normal and cancer cells.

The new technique was made possible by a developmental RCA ultraviolet-sensitive TV camera tube. The ultraviolet TV system is being used with a high-power microscope and an electronic oscilloscope to obtain direct observations and oscillographic measurements of the metabolism of living cells.

The successful application of ultraviolet television to medical microscopy and oscillographic spectroscopy, gives promise of new speed and facility in the analysis of cells and tissue. For the first time, it enables researchers to observe and take motion pictures, simultaneously, of chemical activity within living cells. It makes possible microscopic study and analysis of hundreds of living cells in only a fraction of the time formerly required. It makes possible direct observation and rapid, accurate measurement and identification of certain chemical changes within the cells.

The ultraviolet television system utilizes a standard RCA black-and-white TV camera, type TK-21, which is widely used throughout the television broadcast industry. The camera's standard monochrome Vidicon tube has been replaced with the experimental RCA ultraviolet-sensitive Vidicon camera tube. The pickup tube and its circuitry were developed originally at RCA's David Sarnoff Research Center by A. D. Cope and L. E. Flory, under the supervision of Dr. V. K. Zworykin.

The ultraviolet absorption image, viewed by the TV camera through a microscope, is converted to an electronic signal by the ultraviolet camera tube. The signal is amplified and then viewed on the screen of the TV monitor, a few feet away. Any one of the 25 horizontal scanning lines can be selected and analyzed by a special oscilloscope, which produces on its cathode ray tube, in two ordinates, a tracing of the absorption characteristics of the specimen. This makes possible the quick and accurate measurements of ultraviolet absorption in healthy and abnormal cells.

In operation, the ultraviolet light source is focused on the specimen under the microscope. The RCA camera is mounted so that it "peers" through the eye-piece of the microscope. Sensitive to ultraviolet, it "sees" an transmits to the monitor an image of the cell and the action and reaction of its ultraviolet-absorbing chemicals, both those normal to the cell and those induced artificially or by disease.

In its present stage it is considered as a developmental technique, but one which holds important implications for future medical research. It offers significant possibilities also as an important diagnostic medium, for rapid determination of the nature of a diseased cell by direct ultraviolet TV observation and measurement of the rate, scope, and shape of abnormal chemical changes.

HIGH-TEMPERATURE MECHANICAL LIQUID PUMP DEVELOPED BY WESTINGHOUSE

A mechanical liquid metal pump built by the Westinghouse Atomic Equipment Department has just completed a successful 500-hour performance test run at more than 1000 degrees Farenheit—the highest temperature at which a pump of this type has ever operated for an extended period. It is rated 150 gpm at a 285-foot head. The new mechanical (centrifugal) pump has a hermetically-sealed "canned-rotor" which contains pump and motor rotor in one integral unit. This isolates the pumped fluid and all rotating parts from the field windings and outer atmosphere.

Production models of the pump will operate at temperatures up to 1600 degrees F, and will be applied to nuclear power plants, chemical process lines, and other applications requiring high-temperature heat-transfer mediums.

MODERN FIELDHOUSE HAS TIMBER DOME

A spectacular timber dome just completed at Bozeman, Montana, is the latest record-breaker among wood structures being build throughout the country to provide large areas of post-free space for spectator sports.

Development

and Robert Hall, soph., e.e.

With a 300-foot diameter, the main arena of Montana State College's new physical education center passes all records for long span in buildings of glued laminated timber construction, according to the National Lumber Manufacturers Association.

Large enough for football and baseball practice, the building seats up to 15,000 persons for other sports.

The dome structure is a dramatic webbing of glued laminated arches and purlins soaring to 90 feet at the center. It rests on columns standing outside the perimeter wall of the arena. Lumber required for the dome system, which was fabricated and erected by Timber Structures, Inc. of Portland, Ore., amounted to 150,000 board feet, or enough to build 15 average size homes. The giant arches were manufactured in segments 51 feet long and shipped by rail.

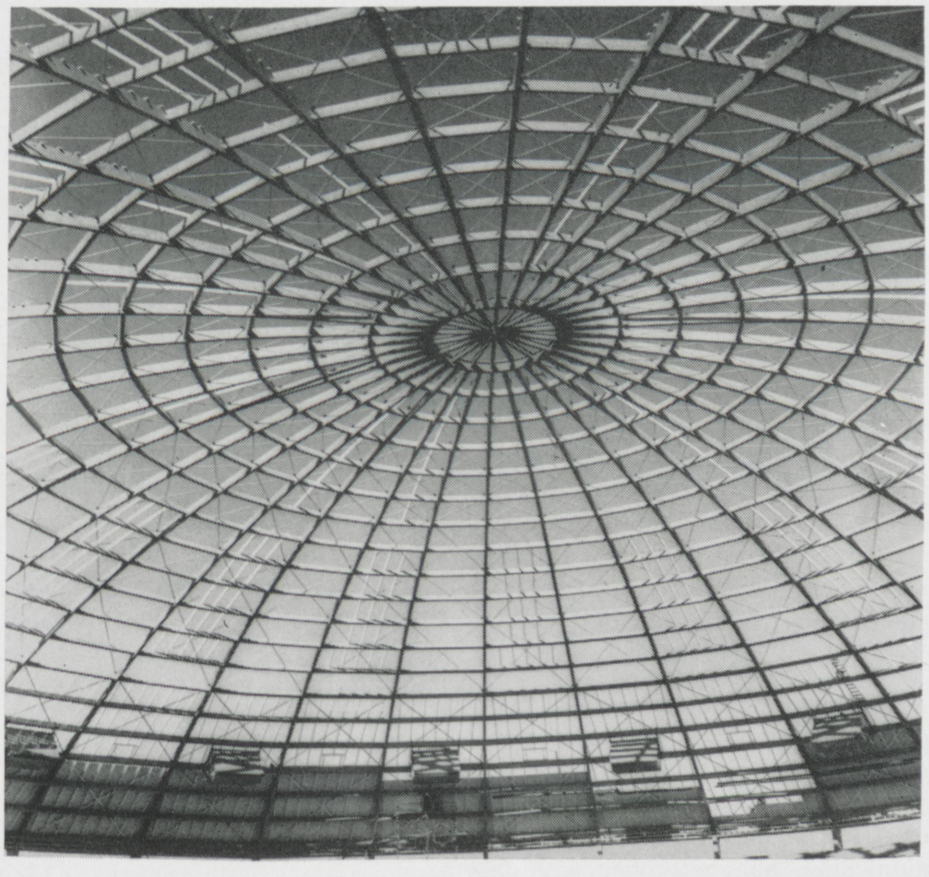
Economy was a major factor in the selection of glued laminated wood construction, according to the architects, Fred Willson and Oswald Berg, Jr., since the nearest bid in another material was nine per cent higher.

"Other factors in favor of wood were its final form and color, low maintenance, fire resistance of heavy timber construction, permanency and ease of erection," they reported. "Still other points we had to consider were humidity effects on the structure, dimension stability and changing temperatures, elimination of painting maintenance by prestaining, time factors in erection and availability of material."

Construction of the arena met a fast-paced schedule so that it could be ready for the opening of the 1957 basketball season. Erection of the dome itself took only ten weeks. The arches were assembled on the ground in pairs with purlins, subpurlins, and cross-bracing in place. The pit-cut shaped sections were then hoisted to position by two 100-foot boom cranes.

In addition to practical values, the timber dome system produced a structure of classic lines and esthetic appeal on both exterior and interior. This is acknowledged as one of the most difficult problems confronting architects in designing fieldhouses for the nation's schools and colleges. Glued laminated construction is currently being used for many types of large buildings, including sports arenas, schools, churches, hangars, warehouses, and supermarkets.

(*Continued on Page* 34)



Interconnection Of Electronic Computers

ANONYMOUS

Data-processing shared by two interconnected electronic digital computers has been successfully performed at the National Bureau of Standards. SEAC and DYSEAC, two high-speed computers designed and built at the Bureau, worked cooperatively on a common task to demonstrate program-controlled machine intercommunication in which coordinated programs were read into both machines. The problem simulated a situation where stock transaction reports are tabulated and summarized for fiscal accounting, and then forwarded for posting to inventory control records elsewhere. The experiments were carried out by the Bureau's data processing systems laboratory as part of a cooperative program with the Navy Bureau of Supplies and Accounts to investigate the application of electronic techniques to the problems of supply management. The experiments showed that two digital computers need not have identical operating characteristics to work together, provided that one of them has the necessary control flexibility.

Most general-purpose electronic computers employ a generally compatible digital language, can receive and transmit data in the form of electrical signals via standard communication channels over any desired distance, and can alter the course of processing programs in accordance with new or revised information. It should therefore be possible to interconnect two or more general-purpose machines so that they can cooperate on a common task. For example, a versatile large-capacity data-processor at a material control center might receive data fed to it automatically by smaller computers located at various supply depots. The supervisory processor (at the center) might so control the system-wide processing that it would accept data from each of its reporting sources in a scheduled sequence but would also be free to accept and handle priority requests for supply action from any of the depots at any time.

For the kind of interaction where both information and exchanges of control are transferred between computers, the question of programmed control versus automatic interruption is particularly important. Programed control depends to a considerable extent on human anticipation of when and how the interchanges occur; however, if two or more systems are to interact automatically without human intervention, provision must be made for automatic interruption of a program in process in order to turn to the new information just received from another system. DYSEAC provides such interruption properties.

DYSEAC was designed at the National Bureau of Standards for the Department of Defense to serve as the nucleus of a generalized feedback control network. This computer incorporated a number of operating features enabling it to respond automatically to information from remote external devices. These operating features include manual-monitor facilities, program control flexibility, and special input-output controls. Together they provide DYSEAC with unusual properties of concurrent operation, self-regulation, and interruptibility which enable it to interact effectively with another computer.

During a period of three weeks the two machines, SEAC and DYSEAC, were available for experiments in interconnection. The program chosen for the experiment was a new method of sorting, merging, and posting of records. In the problem, stock transaction reports were tabulated and summarized by SEAC, then forwarded to DYSEAC for posting. In the SEAC program for running this problem, as detail items were identified as belonging to SEAC was set to run but was inhibited by a control signal from DYSEAC. When DYSEAC had completed reading in the first file section and had proceeded to other independent operations, a release of control enabled SEAC to start. As soon as the SEAC-processed data

(*Continued on Page* 40)

More graduate engineers moving up in the *GAS* industry ... the nation's sixth largest

The Gas industry—the sixth largest in the nation—has a total investment of over $15 billion. Last year the industry set a new all-time record in number of customers, volume of gas sold, and dollar revenue. In fact, Gas contributed 25% of the total energy needs of the nation as compared with 11.3% in 1940. The Gas industry is a major force in the growth development and economic health of this country.

There are many opportunities for you in the Gas industry. The industry needs engineers, and does not overhire. You won't be regimented. There's always room for advancement. With utility companies and with manufacturers of Gas equipment, there's a future for you as an engineer. Call your nearest Gas Utility. They'll be glad to talk with you about your opportunity in the Gas industry. *American Gas Association.*

JOSEPH J. DRECHSLER
B.S. in Mechanical Engineering, 1948, Johns Hopkins University

Joe Drechsler, after 8 years with Baltimore Gas and Electric Company, is now Assistant Superintendent in a department with over 450 employees

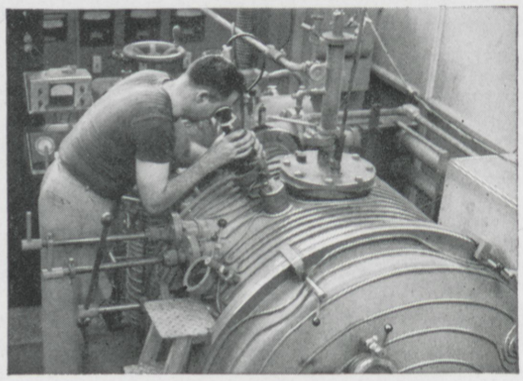
After completing the company's Student Engineering Training Program, Joe spent one year in the Gas and Steam Testing Laboratory. He was then promoted through various levels of engineering and supervisory assignments, to his present job of Assistant Superintendent on April 1, 1956. This department has over 450 employees and is responsible for the installation and servicing of industrial, commercial and domestic gas appliances on customers' property, and the installation and servicing of gas and steam metering and pressure recording equipment.

ROBERT K. VON DER LOHE
B.E. in Industrial Engineering, 1948, University of Southern California

In just 6½ years with Southern Counties Gas Company of California, Robert K. Von Der Lohe has become Manager of Commercial and Industrial Sales

After two years with a construction engineering firm, Bob Von Der Lohe joined the gas company and began his steady climb to his current position. Starting as an assistant technician in 1950, Bob has moved up through the jobs of industrial sales engineer and staff representative-industrial sales, to his present post as Manager, Commercial and Industrial Sales. Bob does more than "sell" industries and commercial operations on the use of gas. He also supervises a staff which advises restaurant and hotel owners on ways to improve their gas operations and over-all productive efficiency.

What's doing....



Vacuum melting has opened up new horizons for development of alloys. Here, a Pratt & Whitney Aircraft metallurgist is shown as he supervises preparation of an experimental high-strength nickel-base alloy, melted and cast under high vacuum.

Induction melted heat of high-temperature alloy being poured in P & W A's experimental foundry. Molten metal is strained into large water tank, forming metal shot which is remelted and cast into test specimens and experimental parts. Development and evaluation of improved high-temperature alloys for advanced jet engines is one of the challenges facing metallurgists at P & W A.

at Pratt & Whitney Aircraft in the field of Materials Engineering

The development of more advanced, far more powerful aircraft engines depends to a high degree on the development of new and improved materials and methods of processing them. Such materials and methods, of course, are particularly important in the nuclear field.

At Pratt & Whitney Aircraft, the physical, metallurgical, chemical and mechanical properties of each new material are studied in minute detail, compared with properties of known materials, then carefully analyzed and evaluated according to their potential usefulness in aircraft engine application.

The nuclear physics of reactor materials as well as penetration and effects of radiation on matter are important aspects of the nuclear reactor program now under way at P & W A. Stress analysis by strain gage and X-ray diffraction is another notable phase of investigation.

In the metallurgical field, materials work involves studies of corrosion resistance, high-temperature mechanical and physical properties of metals and alloys, and fabrication techniques.

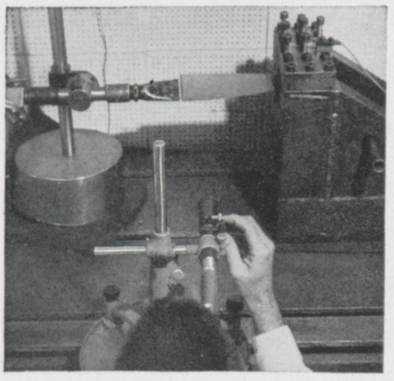
Mechanical-testing work delves into design and supervision of test equipment to evaluate fatigue, wear, and elevated-temperature strength of materials. It also involves determination of the influence of part design on these properties.

In the field of chemistry, investigations are made of fuels, high-temperature lubricants, elastomeric compounds, electro-chemical and organic coatings. Inorganic substances, too, must be prepared and their properties determined.

While materials engineering assignments, themselves, involve different types of engineering talent, the field is only one of a broadly diversified engineering program at Pratt & Whitney Aircraft. That program — with other far-reaching activities in the fields of mechanical design, aerodynamics, combustion and instrumentation — spells out a gratifying future for many of today's engineering students.

Engineer measures residual stress in a compressor blade non-destructively, using X-ray diffraction. Stress analysis plays important part in developing advanced aircraft engine designs.

The important effects of gases on the properties of metals have been increasingly recognized. Pratt & Whitney chemists are shown setting up apparatus to determine gas content of materials such as titanium alloys.



P & W A engineer uses air jet to vibrate compressor blade at its natural frequency, measuring amplitude with a cathetometer. Similar fatigue tests use electromagnetic excitation.

World's foremost designer and builder of aircraft engines

PRATT & WHITNEY AIRCRAFT

Division of United Aircraft Corporation

EAST HARTFORD 8, CONNECTICUT

Alumni News

By Don Weidner, jr., e.e.

'24 **George Y. Jean** has accepted a position as Vice President of Hujean Construction Company, Inc., in Clearwater, Florida. Mr. Jean had been retired and was formerly technical director of James Lees and Sons Company.

'25 **Joseph H. Reifenberg** has been promoted to the position of manager, in charge of dishwasher and water heater engineering, for Westinghouse Electric Corporation, at Columbus, Ohio. Mr. Reifenberg was previously a section manager for Westinghouse at their Mansfield plant.

'30 **Milo M. Dean** is now head of the quality control department for Ford Division, Ford Motor Company. He was previously manager of the technical services department with the same company.

'31 **Allen G. Stimson** has accepted the position of Senior Supervising Engineer, A & O Division, Eastman Kodak Company. Mr. Stimson was formerly a photometric engineer with General Electric.

'32 **George W. Naanes** has been promoted by Northern Indiana Public Service Company. He was previously boiler operating supervisor, and is now assistant manager of Dean H. Mitchell Generating Station, Gary, Indiana.

'33 **Russell V. Smith** is now a designer for the American Machine Company, in Beloit, Wisconsin. He was formerly associated with Fish Equipment Company.

'35 **Paul H. Reedy** has been selected for the position of Executive Vice President of Interstate Electronics Corporation. Mr. Reedy was previously Engineering Manager, Development and Manufacturing Division, with the Ralph M. Parsons Company.

'40 **Maurice W. Johns** is now employed as Sales Engineering Manager for the Dayton Military Liason Office. He was previously Account Executive with the National Requirements Service.

'42 **John H. Vander Veer,** who for the past several years has had charge of armament service for the Sperry Corporation in the northwest, with headquarters in Seattle, Wash., has been promoted to sales engineer of Sperry's electronic tube division, working out of Lake Success, Long Island, N. Y.

'43 **John A. Valente** has been made supervisor of parts, analysis, and records for the Jet Engine Development Center at Allison Division of General Motors Mr. Valente was promoted from his previous position of Senior Experimental Engineer.

'48 **William B. Blount,** formerly an engineer with the Newark lamp works of G.E., has been promoted to the position of community and personnel relations officer of the same plant.

'48 **Robert Lee Brandenburg** has been promoted to Branch Manager of Truscon Steel Division of Republic Steel Corporation. He was formerly sales engineer.

'49 **Gerald R. Stambaugh** has joined the staff of Olin Mathieson Chemical Corporation as Project Manager in explosives research and development. Mr. Stambaugh moved to Olin Mathieson from Liberty Powder Company, where he was Production Engineer.

'50 **Orren S. Hillman** has accepted a position as City Engineer, in Oberlin, Ohio. He has worked as an assistant city engineer at Evansville, Ind. and Greeley, Col., and, since 1953, has been associated with a consulting engineers firm in Chicago.

Hillman will serve as general supervisor and resident engineer for numerous proposed sanitary improvements and will also have charge of the sewage disposal plant.

'50 **W. C. Weeks** has been promoted to the position of plant engineer for Louisville Cement Company. Serving four years in the Air Force after graduating, Weeks joined the company's engineering department in 1954. He

'53 **Robert K. Kawano** is now a design and development engineer with RCA. Previous to accepting his new position, Mr. Kawano served as a Second Lieutenant in the U.S. Army.

'55 **Jack R. Hughes** recently became employed as Assistant Thermodynamics Engineer at Marquadt Aircraft Company. He was previously Associate Design Engineer with Lockeed Aircraft.

Library Notes

By Carson W. Bennett and Anita Walden

Each year the Notable Books Council of the American Library Association selects those books published during the year which it believes would affect the thinking of the American public and which present a signal contribution to the literary world. Following is a list of the books, included in the list of Notable Books of 1956, which are in the Rose Library.

Burns, James M. *Roosevelt: The Lion and the Fox.*
Catton, Bruce. *This Hallowed Ground.*
Churchill, Winston. *A History of the English Speaking Peoples.*
Ervine, St. John. *Bernard Shaw.*
Hersey, John. *A Single Pebble.*
Hulme, Kathryn. *The Nun's Story.*
Kirby, Richard S. *Engineering in History.*
Millis, Walter. *Arms and Men.*
Mills, C. Wright. *The Power Elite.*
Moore, Ruth E. *The Earth We Live On.*
Russell, Bertrand. *Portraits from Memory.*
Teale, Edwin Way. *Autumn Across America.*

Spring is traditionally the time of year when thoughts turn to the blossoming of love and marriage as well as the observing of nature's blossoms in all of their glory. We suggest these books as guides and background to such thoughs.

Adams, Clifford. *Preparing for Marriage.*
Baber, Ray E. *Marriage and the Family.*
Benoit, Hubert. *The Many Faces of Love.*
Brown, Fred. *Sex Questions and Answers.*
Ditzion, Sidney. *Marriage Morals and Sex in America.*
Popenoe, Paul Bowman. *Marriage Is What You Make It.*
Popenoe, Paul Bowman. *Modern Marriage.*
Stone, Hannah. *Marriage Manual.*
Strain, Frances B. *Marriage Is for Two.*
Taylor, G. Rattray. *Sex in History.*
Velde, Theodoor Hendrik van de. *Ideal Marriage.*
Velde, Theodoor Hendrik van de. *Sexual Tensions in Marriage.*

FROM THE NEW BOOK SHELF

Bon Voyage! by Marrijane and Joseph Hayes

Harry Willard, a rather typical father and husband from Terre Haute, Indiana, relates with droll good humor the comic and heartwarming adventures and misadventures that he and his family encountered on an action-packed vacation of six weeks in Europe.

During their twenty years of planning for this trip, neither Harry nor his wife Katie would have dared to predict that they would attend a French family picnic in Normandy, or give his sister-in-law in marriage at the altar of a small French church, or dance in the street on Bastille Day in Paris.

Add to that the chic cocktail party at which Harry got drunk, Katie's involvement with Rudolph the Hungarian, a champagne farewell party on the *Queen Mary*— and you begin to see how the Willards' high jinks differed from their regular routine in Terre Haute.

For good measure, the three children had some sprightly and surprising escapades of their own, and the whole family had a rather eventful trip to the exotic Riviera—with bikinis, chaperones, and the casino at Monte Carlo.

All in all, here's delight for readers of all ages in a book that is both a novel and a travel book, a family comedy and a love story.

The Crack in the Picture Window, by John Keats

This is an angry, brilliantly funny but deadly serious report about the housing developments that are blighting the landscape and souls of America's suburbs. The misfortunes of John and Mary Drone, who "bought" a nothing-down, life-time-to-pay box on a slab in Rolling Knolls, are simply extensions of the problems that beset nearly everyone who exists on the fringes of a city. Even if the nearest development seems safely zoned from your front door, you will find the Drones and their neighbors disturbingly like your own.

The new suburban slums, by concentrating young couples of similar background, income bracket, and outlook in rows of inadequate houses, have made a stultifying unnatural community. The frustrated residents, anchored to their tiny yards by their colossal mortgages, seek desperately for some form of self-expression.

They try to amuse themselves with the wonderful gadgets of our civilization, but the easy credit is hard to pay and their debt becomes ever more burdensome. Surrounded by friendly neighbors but no true friends, they attempt everything from handicrafts to neighborhood sex to relieve their boredom. But the only way out is to move and that's economically impossible.

Who is responsible for this situa-

(*Continued on Page* 38)

RESEARCH & DEVELOPMENT

(*Continued from Page 25*)

CARBON ANALYSIS OF STEEL

A new device, utilizing the elementary chemical fact that carbon and oxygen have a strong natural affinity for each other, is now being used at U. S. Steel's Research Center in Monroeville, Pennsylvania, to measure within 5/10,000 of a percent the carbon content of low-carbon steels.

The apparatus was designed and developed by research personnel of U. S. Steel in answer to the growing need for closer control of carbon in steels where this element is a decisive factor in quality and performance. For example, in high silicon steels for transformers or dynamos, carbon must be kept to a minimum. In enameling steels, certain quantities of carbon are necessary but must be controlled to very close specifications for best results.

The new equipment is used only in the analysis of steels where accuracy greater than that provided by standard equipment is required, usually in the range below 0.03 per cent carbon. The device consists principally of a force-pump together with a mercury diffusion pump to create avacuum in the system, an oxygen purifier, a combustion chamber, freezing chamber and a measuring system.

Absolutely pure oxygen is essential to accurate analysis. The gas is cleaned in a system consisting of two liquid-nitrogen traps, separated by a catalyst of asbestos on which palladium chloride has been dissolved and then baked. Oxygen from a tank is admitted into the catalyst chamber which is heated to about 400° centigrade. Here, any hydrocarbons contained in the oxygen are converted to carbon dioxide and water.

The oxygen is recirculated about three times by moving the liquid-nitrogen traps from one side of the catalyst to the other. At 195 degrees Centigrade, the liquid nitrogen freezes the oxygen. This creates a vacuum in front of the remaining gaseous oxygen and thus acts as a pump.

The steel samples to be analyzed consist of small chips and shavings. These are carefully weighed and then placed in a glass rack containing a number of pockets to hold several differenttypes of samples. The rack is sealed into the vacuum system and mounted directly over the combustion chamber. Samples are drawn into the combustion chamber by a magnet applied by the operator to the outside of the glass.

The combusion chamber is a platinum crucible lined with alumnum oxide. It is induction heated to about 1,700 degree Centigrade. At this temperature the steel sample is burned in the presence of a controlled amount of purified oxygen. The gas CO_2 is generated along with other gases.

These mixed gases then pass through another freezing trap containing dry ice and acetone to maintain a temperature of 80 degrees Centigrade. At this temperature, the CO_2 passes through as a gas, the interfering gases remain frozen in the trap. The CO_2 is then frozen out in liquid nitrogen and released into a pressure gage. Since the carbon dioxide formation depends entirely on the amount of carbon in the steel sample, the gas pressure can then be translated directly into amount of carbon originally contained in the steel being tested.

RCA ELECTRONIC AIR CONDITIONING SYSTEM

Radio Corporation of America has developed a revolutionary new electronic air conditioner which operates in complete silence, contains no moving parts, produces no heavy drafts, and can be used either to cool or to heat a room by the simple expedient of reversing the flow of direct electric current.

The noiseless electronic air conditioning system comprises large wall panels which become cold under the influence of direct electric current. With a reversal of the electric current, the same panels produce a heating effect. Employing new materials developed at RCA Laboratories, the system uses no motors, fans, pumps or other moving parts, but achieves room cooling or heating by both radiation and convection—the gentle circulation of air caused by differences in the air temperature. In the small room used for demonstrating the system, it is capable of maintaining a room temperature as much as 2 degrees cooler than the temperature outside. According to the RCA scientists, the system is capable of maintaining a room temperature considerably more than 2 degrees warmer than the temperature outside when used in reverse for room heating.

NEW ELECTRONIC REFRIGERATOR

The new electronic refrigerator operates on principles identical to those of the electronic air conditioning system. The refrigerator has a food compartment of 4 cubic feet, in which a temperature of 40 to 45 degrees is maintained, plus a 30-cubic-inch ice tray in which ice cubes can be produced. Like the air conditioner, the refrigerator is noiseless and has no moving parts.

SURFACE ROUGHNESS QUICKLY CHECKED WITH NEW TYPE HAND COMPARATOR

A completely new approach to the problem of judging surface roughness of mass-produced parts was announced by the Bausch & Lomb Optical Co., Rochester, N. Y.

The new principle is embodied in an inexpensive surface comparator which permits metal surfaces to be compared with a selected standard of roughness under 10-power magnification.

The comparator will speed up the work of set-up and production men and quality control inspectors who must constantly make judgments regarding surface roughness.

A pocket-sized, hand-held instrument, the surface comparator operates on a unique optical principle which greatly emphasizes surface irregularities. It illuminates both the known standard and the piece under study. When looking into the 10-power eyepiece, the user sees a cir-

(*Continued on Page 36*)

Highlights of your future with Honeywell

Campus-like Honeywell Research Center in Hopkins, Minneapolis suburb

Preview your career with a summer internship

Dr. Finn Larsen, Director of Honeywell's Research Center, M.A., Physics, 1941, Drake; Ph.D., Iowa State, 1948.

"Honeywell is now interviewing students for its summer intern program."

"We believe a man makes a much better choice in his career if his decision is based on actual work experience. And, at Honeywell, the experience can be matched exactly to his individual needs and interests.

"This is made possible by Honeywell's wide diversification in the field of controls. Honeywell makes more than 12,000 different systems and controls. They are precision products whose development and manufacture require extensive use of all kinds of engineering skills. And they are used in virtually *every industry known today*. Thus, the man who enters Honeywell's summer program gets a real working knowledge, not only of controls, but of many related industries.

"Many of Honeywell's 14 separate divisions will offer assignments under the summer internship program. The location and name of each division and activity is listed at the bottom of this ad."

Terms of program

Honeywell's program is geared to students one year from graduation in any branch of engineering, chemistry, mathematics, physics, business administration or accounting.

Assignments will be made in Design and Development, Industrial Engineering, Quality Control, Quality Analysis, Production Coordination, Personnel Administration, Financial Control, Marketing and Market Analysis.

There are also special assignments in the Honeywell Research Center for graduate students in Physics, Chemistry or Engineering who are one year from completion of their work.

If you are enrolled in this program you will work at Honeywell from mid June to early September, approximately 12 weeks. Included in the weekly schedule will be discussions and meetings, as well as practical work assignments.

Applications being accepted now!

In order to give maximum benefit to the members of this program, Honeywell must limit the number enrolled. If you wish to apply for an assignment, send your name, address, school, the course in which you are enrolled, plus the number of years completed to:

Dr. A. Lachlan Reed
Director, Industry Education Relations
Minneapolis-Honeywell Regulator Company
Dept. TC29A
Minneapolis 8, Minnesota

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Residential Controls: **Minneapolis, Minn.** and **Wabash, Ind.** Industrial Instruments: **Philadelphia, Pa.** Commercial Controls: **Minneapolis, Minn., Chicago, Ill.** and **Wabash, Ind.** Aeronautical Controls: **Minneapolis, Minn., Los Angeles, Calif.** and **St. Petersburg, Fla.** Valves: **Philadelphia, Pa.** Micro Switches: **Freeport** and **Warren, Ill.** and **Independence, Ia.** Appliance Controls: **Los Angeles, Calif.** Ordnance: **Minneapolis, Minn., Wabash, Ind., Seattle, Wash.** and **Monrovia, Calif.** Transistors and Servo Components: **Boston, Mass.** Home Products: **Minneapolis, Minn.** Photographic and Oscillograph Equipment: **Denver, Colo.** Industrial Tape Recorders and Reproducers: **Beltsville, Md.** Research: **Minneapolis, Minn.** Sales: 112 offices throughout the country.

RESEARCH & DEVELOPMENT

(*Continued from Page* 34)

cular image, one half of which is the standard, the other half, the sample being checked. A comparison can thus be made quickly using commercial roughness standard strips, or samples of satisfactory work.

According to B&L research, the instrument fills a long standing need for a handy, inexpensive tool to examine surfaces after milling, turning, grinding, planing, buffing, polishing, plating, painting, and lacquering.

Previously, production workers usually judged a metal surface for roughness by testing it with a fingernail, and then testing a standard block or roughness strip for comparison.

NEW RESEARCH TECHNIQUE IN METALLURGY

"Point probe microanalysis," a new metallurgical research technique, permits analysis of steel-specimen areas 10,000 times smaller than is possible by any other method. The new technique was conceived in France about six years ago and is now being developed and refined by scientists at U. S. Steel's Research Center in Monroeville, Pennsylvania.

The point probe method of analysis involves the use of an electron microscope containing a focused electron beam to excite X-ray emission from a region as small as a few microns in diameter. The characteristic X-rays emitted are then analyzed by a crystal spectrometer.

This method has wide application in metallurgy for study of intergranular corrosion, analysis of segregation of alloying elements among the metallic phases and along metallic grain boundaries, measurement of inter-diffusion during welding and plating, and for determining the composition of fine precipitate particles.

The basic instrument being studied and modified at U. S. Steel's Fundamental Research Laboratory is a vertical, 7 1/2-foot electron microscope with a 4-foot electron column.

The steel samples to be studied are placed in a specimen chamber through a door in the base of the column. A vacuum is then created by a standard oil-diffusion pump. An optical binocular microscope and mechanical stage motion permits the operator to make a visual adjustment of the specimen under the beam.

The beam is generated by an electron gun which accelerates electrons through approximately 30,000 volts. The beam is focused by three electrical lenses. The electron-beam cross-over point formed by the objective lens is focused by the repeater lens on the surface of the steel sample.

The focused beam strikes a selected area of the specimen's surface, causing X-ray emission. The X-ray beam is then analyzed to determine its component wave lengths by reflection from a lithium-fluoride crystal. Each chemical element in the sample emits an X-ray of characteristic wave length. The concentration of the element determines the intensity of that wave length component. At present the instrument is able to detect all elements with atomic number equal to 22 (titanium) or higher.

The X-ray intensity at each wave length is measured by a geiger or proportional counter. The signal is amplified through a vacuum tube arrangement to activate a pen on a graph. The X-axis of the graph indicates the wave length and the Y-axis charts intensity The technician can analyze these data into a quantitive analysis.

"Point Probe Microanalysis" utilizes X-ray emission.

Pocket-size pound of pleasure!

New RCA Transistor Radio

Drop a gentle hint (like enclosing this ad in your next letter home), and come graduation time you could be getting this amazingly ingenious radio.

It's a new RCA Victor Transistor Six, and this one you can really take along anywhere. It's smaller and lighter than the average textbook – and lots more fun.

You can carry it easily in pocket or purse. It weighs a mere 16 ounces, yet delivers a roomful of sound anytime you wish.

The RCA Victor Transistor Six is battery-powered and uses six long-lasting transistors. The cabinet is long-lasting, too. It's the fabulous, *guaranteed nonbreakable* "IMPAC" case. Cabinet colors include antique white, charcoal and spruce green.

And note the price—now just $49.95!

This beautiful little bargain is typical of the extra value engineered into every product of RCA. For, almost without exception, these achievements in electronics begin at the David Sarnoff Research Center in Princeton, New Jersey. Here the scientists and engineers of RCA continually seek—and very often find—practical and dramatic new ways to bring you ever-better "Electronics for Living." Tmk(s)®

Where to, Mr. Engineer?

RCA offers careers in research, development, design and manufacturing for engineers with Bachelor or advanced degrees in E.E., M.E. or Physics. For full information, write to: Mr. Robert Haklisch, Manager, College Relations, Radio Corporation of America, Camden 2, N. J.

RADIO CORPORATION OF AMERICA

Electronics for Living

LIBRARY NOTES

(*Continued from Page 32*)

tion? The builders, whose most useful tool is the chisel? The bankers, who are getting the frosting from this miracle-mix cake? The federal government, who by guaranteeing veterans' mortgages has put a solid base under the whole shaky construction? The local communities, whose lack of zoning laws has permitted these excrescences? The suckers who have bought the houses?

Keats discusses every aspect of life in a development. His account is supported by solid facts and figures but it is presented in personal terms to show you an existence that combines all of the worst aspects and none of the advantages of suburban living. If you ever wondered what goes on under those regimented roofs, this book will tell you. And if you already know, it will make you want to get up and break something. Fortunately the book also tells you how to put the pieces back together.

Autumn Across America, by Edwin Way Teale

Come for a twenty-thousand mile journey through the bright colored autumn! From Cape Cod to California, watching the changes of fall, seeing all the beauty that makes the American autumn world-famous, the author carries his readers along on this new adventure with a season.

This time the direction of travel is across the advancing front of the season, revealing it is a cross-section from coast to coast. The reader, in a leisurely westward journey, pokes into out-of-the-way places, encounters interesting people, discovers fascinating mysteries of nature, and travels through the infinitely varied autumns of the land, in mountains, deserts, rain forests, by the sea. And here again are adventures along the way: flying down ridges with the migrating hawks, descending into submarine jungles of the eel-grass, following the trial of a pioneer naturalist along a warbler river, spending a day with fern gatherers in a forest of giants. All wild things are in the province of this book. All aspects of autumn and the dramatic changes of autumn are within its range.

It is formed of first-hand, on-the-spot impressions. You go walking with the author and with him see the birds, the flowers, the butterflies, the trees, the stars, the wide-open, sweet-smelling land. Here is a companion who is endlessly the enricher, amuser and informant. There is a freshness about Teale that is unique. What characterizes him most of all is the great satisfaction and inspiration which he gets from his love of natural things, and so infectious is his enjoyment that he takes every reader with him. His interest extends over the whole of nature, interrelating it all.

Here is the warm and mellow record of a roving pilgrimage across twenty-six states, from coast to coast, all through the autumn. It is a travel book that reveals the interest and beauty of America from a new angle. Its pages are packed with vivid scenes and odd and engrossing facts of natural history. It is a great cornucopia of a book, overflowing with the autumnal harvest of a lifetime of nature living and nature loving. And it is generously illustrated with fascinating photographs taken by the author on his unique journey.

The Age of Reform, by Richard Hofstadter

This book is a landmark in American political thought. It examines the passion for progress and reform that colored the entire period from 1890 to 1940—with startling and stimulating results. While it is sympathetic to the ideals of the reformers, it dismisses any notion, conservative or liberal, of returning to their world—a world that never was. It does not review old issues and forgotten political planks, but searches out the emotional drives of the reformers, their social and psychological motives, the myths and dreams in which they believed, and the realities with which they had to compromise.

The book begins in an era when, though Americans fondly believed that security and prosperity were the rewards of good character, individualistic enterprise, and freedom, these actually were becoming the rewards of social and industrial organization. Americans were looking backward to an old dream at the same time that they were moving forward to what Mr. Hofstadter calls a status revolution. Among many other things, this status revolution changed the farmer from an individualistic yeoman to a businessman in agriculture; it reduced the prestige of lawyers as they became corporation functionaries; it altered the secure outlook of the middle class, which was now overshadowed by a large number of new millionaires, to one of great anxiety.

The emotional shocks of the status revolution sometimes abetted isolationism; hatred of Europe; racial, religious, and nativist phobias; and resentment of big business, trade-unionism, intellectuals, the Eastern seaboard and its culture. All these have been found not only in opposition to reform, but at times oddly combined with it. "But populism, for all its zany fringes, was not a forerunner of modern authoritarian movements; nor was Progressivism . . . a harbinger of our most troublesome contemporary delusions."

The last chapter offers a completely fresh analysis of the New Deal. "Roosevelt and his supporters were attempting to deal with the problems of the American economy within the distinctive framework of American political methods. . . . (But) the beginning of the war meant that Americans, with terrible finality, had been torn from the habitual security of their domestic life. . . . With this change came the final involvement of the nation in all it had sought to avoid, for it was not only mechanized and urbanized and bureaucratic, but internationalized as well. Much of America still longs for—indeed expects to see—a return of the older individualism and the older isolation, and grows frantic when it finds that even our conservative leaders are unable to restore such conditions." Thus ends Mr. Hofstadter's highly stimulating and original analysis of an important aspect of American life.

To the *creative* engineer...

AiResearch two stage lightweight gas turbine compressor provides pneumatic power for aircraft main engine starting and serves as auxiliary power source for a variety of ground and in-flight services.

The rapid scientific advance of our modern civilization is the result of new ideas from creative minds that are focused on the future. Our engineers not only have ideas but have the ability to engineer them into products.

That's why The Garrett Corporation has grown in both size and reputation to leadership in its areas of operation. That's why we are seeking more creative engineers to help us maintain and extend our leadership. If you fall in that category, you'll find working with us fulfilling in stimulation, achievement and financial rewards. In addition, financial assistance and encouragement will help you continue your education in the graduate schools of fine neighboring universities.

All modern U.S. and many foreign aircraft are Garrett equipped. We have pioneered such fields as refrigeration systems, pneumatic valves and controls, temperature controls, cabin air compressors, turbine motors, gas turbine engines, cabin pressure controls, heat transfer, electro-mechanical equipment, electronic computers and controls.

We are seeking engineers in all categories to help us advance our knowledge in these and other fields. Send resume of education and experience today to: Mr. G. D. Bradley

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AIRESEARCH INDUSTRIAL • REX • AERO ENGINEERING • AIR CRUISERS • AIRESEARCH AVIATION SERVICE

(*Continued from Page* 26)

were ready for posting, they were converted to the proper format for DYSEAC, transmitted, and checked by DYSEAC to see whether there had been garbling in transmission. The receipt of data simulating a detail item resulted in a tally count for the appropriate master item in the file section.

If the switch settings that are controlled by the d-c voltages from the external device indicate that the device is ready, DYSEAC will then carryoue the indicated operation, such as direct loading of one or more memory locations, and select its next instruction from the location specified by the address-storage register. The instruction selected in this manner then indicates in its program-control digits which of the two counters is to be used next. In this way, it can either return DYSEAC to a program that has been discontinued during the interruption or initiate an entirely new sequense of operations.

For the DYSEAC-SEAC interconnection, monitor switch settings were arranged so that upon receipt of the preparatory signal from SEAC, DYSEAC at its next breakpoint read in one information word to a predetermined memory address and took its next instruction from the location indicated in the address storage register. This next instruction was a "file" order which recorded both counter settings, reset the proper counter to the initiation of the routine for the processing of the data from SEAC and transferred control to that counter. Upon completion of the processing of any one set of data from SEAC, DYSEAC would return to the sequence of operations it had been performing immediately prior to each interruption.

When the coordinated programs had been read into both machines, each file section in a scheduled order they were transferred to DYSEAC for posting there. In addition, after

(*Continued on Page* 54)

One of many pilot plants at Standard's Whiting Laboratories. Scientists and engineers frequently take new processes from the "bench-scale" all the way to final field application.

Like to try on this man's shoes?

DONALD PLAUTZ belongs to the group of engineers at Standard Oil's Whiting, Indiana, Research and Engineering Laboratories who are fitted by training and talent for a process engineering career. His fraternal affiliations include Phi Eta Sigma, Tau Beta Pi, Phi Lambda Upsilon and Theta Tau.

B.S. (University of Wisconsin); M.S. (Ohio State); Ph. D. (University of Illinois), all in chemical engineering, Dr. Plautz has utilized this training in carrying out varied responsibilities on development of the Ultraforming process. He has operated pilot plants, correlated data, prepared process manuals, and assisted in the initial operation of new Ultraforming units.

Ultraforming is an intricate refining process which Standard invented, patented and makes available to other refiners, as licensees, to provide increased yields of high octane gasoline.

Perhaps you're not ready to try on this man's shoes yet, but Standard Oil offers outstanding career opportunities to college men in almost all fields of science and engineering.

Standard Oil Company

910 South Michigan Avenue, Chicago 80, Illinois

STANDARD

LIQUID METAL PUMP

(*Continued from Page* 11)

THE WESTINGHOUSE PUMP

POWER SUPPLY

It was determined that the current requirements for the pump would be almost 16,000 amperes at ½ volt, and that the best way to obtain this current was to use a unpolar generator driven by an a.c. motor. Conventional unipolar generators are high current, low voltage machines; with conventional carbon brushes they are enormous in size. This particular generator is an offshoot from conventional design in that a liquid sodium potassium alloy is used in place of the carbon brushes. This greatly reduces the physical size of the generator.

The generator consists essentially of an iron cored, motor driven, rotor surrounded by a cylindrical shell of copper, and an iron stator which contains d.c. field coils. The flux produced by the coils passes radially through the copper of the rotor. When the rotor is turned by the motor, the elements of copper cut the flux, and this causes an emf to be developed axially along the copper. The copper shell acts as a very heavy coil of one turn, in which there is a very small voltage and a very high current induced. Each end of the copper is immersed in a bath of liquid sodium metal through which the current is conducted to buss-bars.

THE PUMP

This particular pump, a good example of a large installation, is designed to pump NaK at a rate of 120 gallons per minute at a pressure of 30 pounds per square inch. At rated output the electrical requirements are 15,900 amperes at 0.48 volts at the end of the buss bars.

As has been explained before the pump operates on the principle that a current-carrying conductor in a magnetic field has a force exerted on it. In the pump the current carrying conductor is the liquid metal in the pump chamber. A permanent magnet produces a flux field in the pump chamber, and the current flows through the chamber at right angles to the flux field from one copper electrode to the other. The resulting force acts on the liquid metal and forces it through the chamber at a rate determined by the force and the reluctance of the hydraulic path.

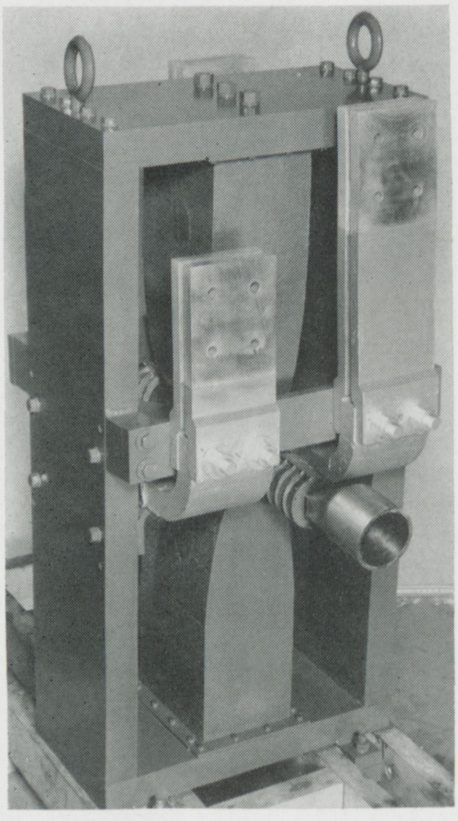
MAGNETIC STRUCTURE

The pump's magnetic circuit consists of a soft iron rectangular frame and a central leg made up of two Alnico 5 permanent magnets, two tapered soft iron pole pieces, and an air gap between the two pole pieces. The magnets produce an average flux density of 5300 gauss in the air gap.

The magnetic structure is 40 inches high and weighs about 1000 pounds. The weight of the pump without buss bars is about 1300 pounds.

ELECTRICAL SYSTEM

The current required by the pump enters from the supply buss bars through two sets of risers, one on each side of the pump. The risers are brazed to a copper electrode which is brazed to one side of the pump's chamber. The current flows from the electrode, through the pump chamber to an electrode brazed to the other side of the chamber and flows back to the return supply buss bars by another set of risers.



The D.C. Conduction Pump, showing buss bars, magnetic poles, and Na K discharge pipe.

The electrodes, risers, and buss bars are all nickel plated to prevent oxidation of the copper at the high operation temperature.

Thermal insulation between the magnet and the pump chamber is provided by two sheets of mica separated by a grooved stainless steel wedge. The grooves reduce the contact area and, thereby, reduce heat flow from the pump chamber to the magnet.

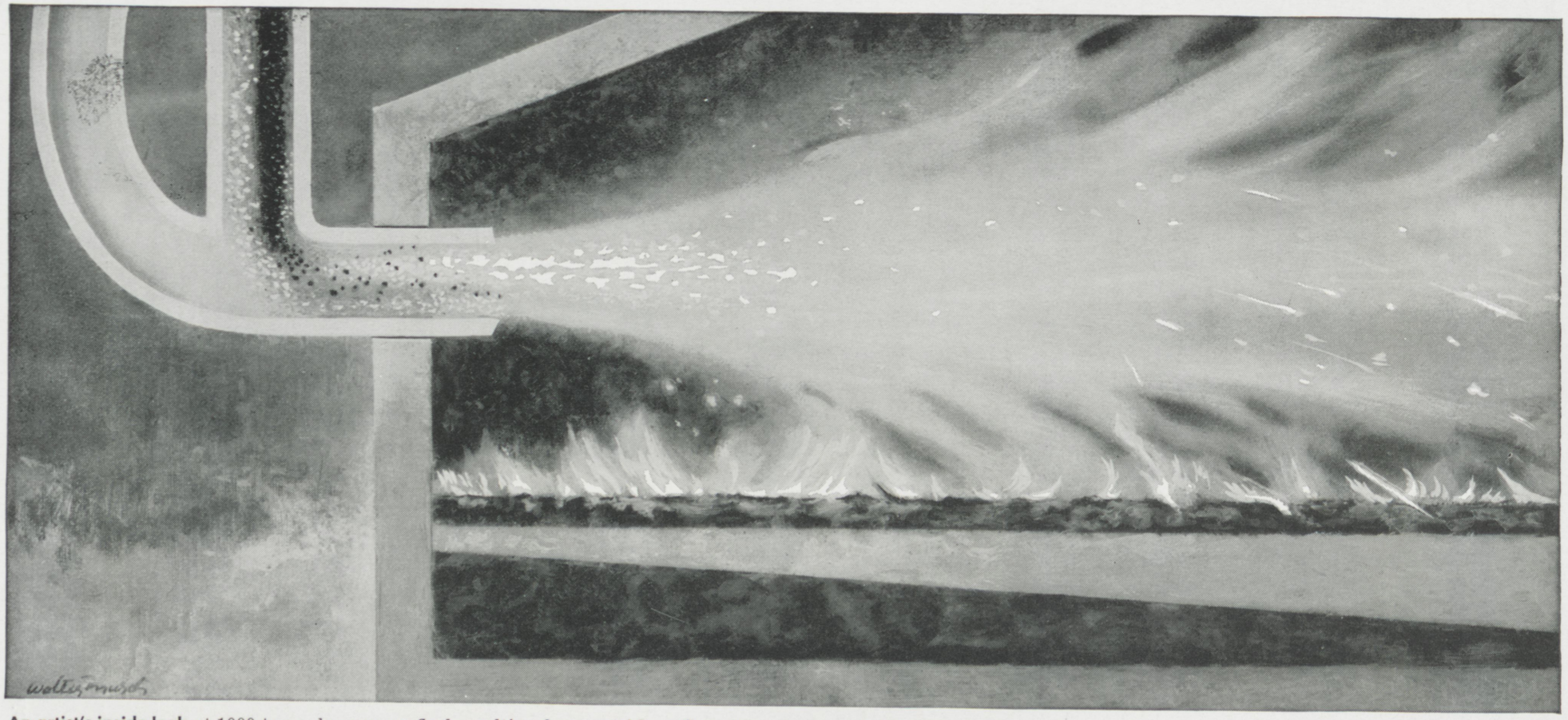
THE PUMP CHAMBER

The pump chamber is a rectangular tube made by welding two stainless steel channels together. The cross sectional area is 1¼ square inches. An adapter is welded to each end of the tube to permit connecting the pump to a 3 inch pipe.

Before the pump was shipped from the Special Products Division of Westinghouse the theoretical efficiency was calculated. The result of these calculations was 21½% for the overall system. In actual tests run at the installation sight, the maximum efficiency was 7.33%.

The future use of these pumps looks bright in spite of the rather low efficiency just mentioned. The increasing use of liquid metals as heat transfer media indicates a rising demand for development of conduction type pumps.

As the reader can no doubt see for himself, the main object of this article is a general discussion of the subject material. It in no way pretends to be either all inclusive or deeply technical. The author would like to express his thanks to Messers E. W. Frantti and F. J. Rau of the Westinghouse Electric Corporation for their invaluable aid in the preparation of this article.



An artist's inside look at 1000-ton-a-day oxygen flash smelting furnace of Inco-Canada at Copper Cliff, Canada.

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Oxygen flash smelting is another advance in extractive metallurgy. It's part of a continuing program *to step up production, to keep costs down, through maximum utilization of ores.*

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CAMPUS SURVEY

(*Continued from Page* 16)

is whether or not he will join a fraternity. If so, which one should he choose?

At Rose we have the delayed system of rushing where a freshman, or transfer student, has at least one semester to decide which fraternity, if any, he might like best. This not only gives the incoming student a chance to get adjusted before he is rushed, it also gives the men and the fraternity a chance to meet without the pressure that might otherwise be present.

This year, rush parties were held from 12:30 to 2:30 and from 4:00 to 6:00 on Saturday, March 2nd, and from 2:00 to 4:00 and 6:00 to 8:00 on Sunday, March 3rd. Interested freshmen attended four parties, each lasting two hours, and got a chance to become formally acquainted with the fraternity and its policies.

On the following Monday, March 4th, cards were filled out by the freshmen in order of their preference and simultaneously, each fraternity submitted a list of the men it wanted. If both fraternity and student preference agreed, the man was pledged.

If desired, a student could wait until a later date to make his decision, which is sometimes wise if he isn't completely sure of his choice.

ENGINEER'S DAY AND PARENT'S DAY

At the Request of the Blue Key Fraternity, Engineer's Day will not be held this Spring. It is planned to hold the event in November, about the 16th, or to arrange through Blue Key, small group visits of interested High School students on several weekends throughout the year.

Parent's Day will be held on May 11 repeating the program of classroom visits inaugurated last year.

SAINT PATRICK'S DAY

It seems, like all males, the students of Rose have a desire to prove their masculinity. The predominance of great hairy monsters around the campus points out this hidden (usually) desire for social acceptance. Anyway, who says the cave men had it so bad?

As in most contests, the competition can be quite keen as is seen by the gradually diminishing number of these creatures. This year was no exception. To some the Beard Growing Contest is merely a joke but to the stout-hearted it is a challenge rewarded by a nice prize if taken seriously enough.

The contest, open to the students (male only), comes to a close on March 15th, the annual St. Pat's Dance. Three judges, this year from the Orphium Barber Shop, present a first, second, and "most unusual" award during the dance.

The dance, from 9:00 to 12:00 was informal to semi-formal meaning suits for the men and party dresses for girls. Leo Baxter and his musicians furnished the music.

DANCES

While on the subject of dances, the Junior Prom will be held on April 6th this year in the Mayflower Room of the Terre Haute House. The Prom, highlight of the year, is open to all students and there are rumors that a big-name band will be featured this year. The dress is semi-formal. Also along the dance line, the annual Inter-Fraternity dance will be on May 18. This social function, open to all frat men will also be one of the important events this year.

RIFLE CLUB

The Rose Poly Rifle Team has been following a busy schedule these past few months. The 5th Army match, carried on during February, involved the ROTC Rifle Team and was open to any ROTC student.

Also in February, the Rifle Team traveled to the University of Louisville.

Our Rifle Club, directed by Master Sergeant William Golden is open to any student of Rose and even though the semester is nearly half over, the Club can still use new members. Usually they have one postal match per week which permits plenty of firing. Last year, the team won twelve of fourteen matches.

The officers presently are Paul Harter, Jay Stephens and Ken Denny.

Another point of interest, the range is being remodeled and relighted for future use.

RELIGION

The students of Rose are invited to join with the Reverend Leroy Brown, our chaplain, in a discussion of any social, religious or moral problems they might have or would like to talk about. Chaplain Brown, if response warrants, would be glad to meet with a group some hour of each week and is always glad to help out with any personal problems at any time.

He can be found in room 20-C on Monday from 10:00 to 12:00, Tuesday 4:00 to 5:00, Wednesday 2:00 to 4:00, and on Friday from 10:00 to 12:00.

We are really quite fortunate to have Chaplain Brown and students are invited to feel free to discuss their problems with him.

GLEE CLUB

Election of officers was held recently in the Glee Club. Those elected were Mick Adams, John Jardine, and Tom Reed to the officers of president, publicity manager, and business manager, respectively.

AUTO CLUB?

Several individuals have initiated an idea recently which, although nothing definite has been recorded, seems to be very sound.

The idea, to start some kind of Automobile Club here on the campus, has definite possibilities and would probably never suffer from lack of interest.

The organization should in some way be exclusive, if possible, and should have officers, a constitution and definitely have rules outlawing such things as mud flaps, excess chrome, and cowboying. The organization's purpose would be to work on automobiles, have reliability runs, etc., and in general encourage true customizing to give the club prestige.

The club, if organized properly, would have school support and should draw considerable interest.

Perhaps sometime in the near future such an organization could be formed.

IMPORTANT ON-CAMPUS INTERVIEWS FOR POSITIONS AT

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POWER FOR AUTOMATION

(*Continued from Page* 15)

range. With a tension buildup, of course, there is always the possibility of material failure. However, with d-c's precise control, it is possible to handle material as tough as steel wire or as delicate as yarn and soft paper with equal ease.

Feedback is the secret. Since tension on the material directly affects the current the motor armature draws (as d-c motor torque increases, the armature draws current in proportion to it), tension is effectively measured by measuring that current- draw and sending the signal to the comparator. If there is any deviation from the standard, the differential current is used to apply corrective voltages to the motor. The point to be made is that by utilizing the d-c method of power supply, precise and continuous control is affected and material quality can be maintained at high operating speeds in a tension sensitive process.

D-c's tension-control capabilities are characterized by an application in a Southern paper mill. Here, sheets ranging from 30-pound paper to 90-pound board 220 inches wide are wound at a top speed of 5000 feet per minute. Tensions for the various sheet weights are adjustable from 1½ to 12 pounds per inch width of material. In this system, motor speed is controlled by voltage regulation and tension maintained constant by current control. In addition, the system has an emergency stop time of 20 seconds using the regenerative braking advantages of the d-c motor.

In certain types of continuous processing, it may be advantageous, if not essential, that the product be fed through a series of machines at a different rate of speed for each machine. Such a process might be the flattening of wire, in which each successive flattening operation must proceed at a faster rate than that before in order to compensate for the increase in wire length at each machine.

Without accurate speed-matching, to attempt such a continuous process might lead to machine damage, product damage, or production snarls. However, with a d-c drive, such a process can be controlled to a fine degree of accuracy by having the drive motors run in a ratio of speeds, with the speeds automatically controlled by the feedback principle. In addition, should the need arise, it is also possible to alter the system such that the motors may run in changing ratios of speeds to suit different materials or products. Thus, d-c drive offers a flexibility never before possible that allows the system the capability of turning out a variety of products with no expensive investment in additional equipment.

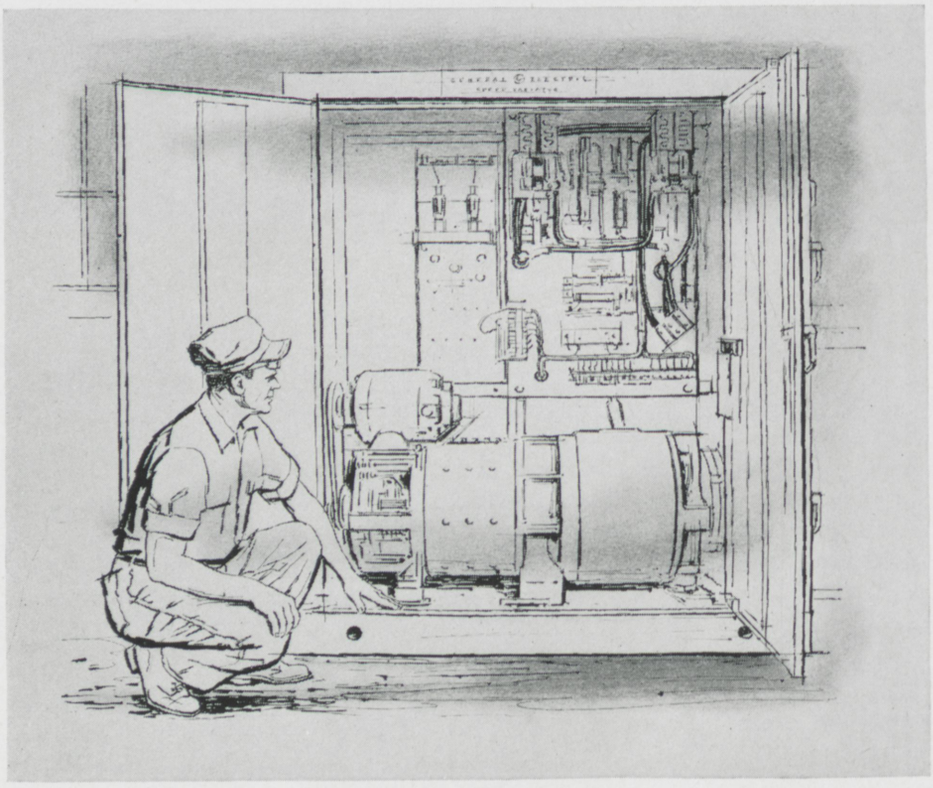
A related utility of the d-c drive system is its peculiar adaptability to proportionate mixing. Here, d-c drives with rheostat adjusted motor speeds can mix various fluids or solids in any ratio desired by simply adjusting the motor speeds with the rheostat.

In the field of steel-rolling, there is an excellent example of the d-c drive's usefulness. One cold-strip mill producing light-gage sheet for cans feeds a 15 ton coil of strip steel, 2/3 of a mile long and 1/11 of an inch thick, into the first machine at several hundred feet per minute. As the strip passes through the five sets of d-c driven rolls, its speed is increased in a ratio until it leaves the mill at 70 miles per hour as a sheet six miles long and 1/100 of an inch thick. The surprising thing is that the entire operation, powered by d-c motors, is controlled by a single rheostat. D-C drive's simplicity, ability for speed-matching, and precise control speak for themselves.

For a process or operation which requires factors of rapid acceleration and deceleration, or merely frequent starting and stopping, or a combination of them, d-c drive's inherent characteristics make it stand far ahead of any other power for automation. These factors are necessary in such operations as powering elevators, hoists, steel reversing-mills, automatic broaching machines, indeed, in any operation where the tool or object powered must accelerate rapidly, decelerate and stop accurately positioned, only to start again.

The very nature of the design and

(*Continued on Page* 53)



D-C Motor-Generator set.

James B. Walker *received his B.S. in mechanical engineering from North Carolina State College in June, 1954, and was working toward his M.S. in the same field when he was called for military service.*

Jim Walker asks:

Can a mechanical engineer make real progress in a chemical firm?

"Pick" Pickering answers:

You might call that a leading question, Jim, but the answer leads right into my bailiwick. I came to Du Pont in 1940, after taking a combined mechanical and electrical engineering course. So I had what you might call a double reason for wondering about my future with a chemical firm.

I soon learned that the success of a large-scale chemical process hinges importantly on mechanical equipment. And the success of this equipment—especially for a new process—depends on (1) Research, (2) Development, (3) Plant Engineering, and (4) Close Supervision. The net result is that a mechanical engineer at Du Pont can progress along any one of these four broad highways to a top-level position.

My own Du Pont experience includes mechanical engineering work in fields as varied as atomic energy, fabrics and finishes, and nylon manufacture. Every one of these brought with it a new set of challenging problems in construction, instrumentation and power supply. And every one provided the sort of opportunities a man gets in a pioneering industry.

So, to answer your question, Jim, a mechanical engineer certainly has plenty of chances to get somewhere with a chemical company like Du Pont.

H. M. Pickering, Jr., *received a B.S. in M.E. and E.E. from the University of Minnesota in 1940. He gained valuable technical experience at Hanford Works, in Richland, Wash., and in Du Pont's Fabrics and Finishes Plant at Parlin, N. J. Today, he is Assistant Plant Manager at Du Pont's Seaford, Del., plant, where nylon is made.*

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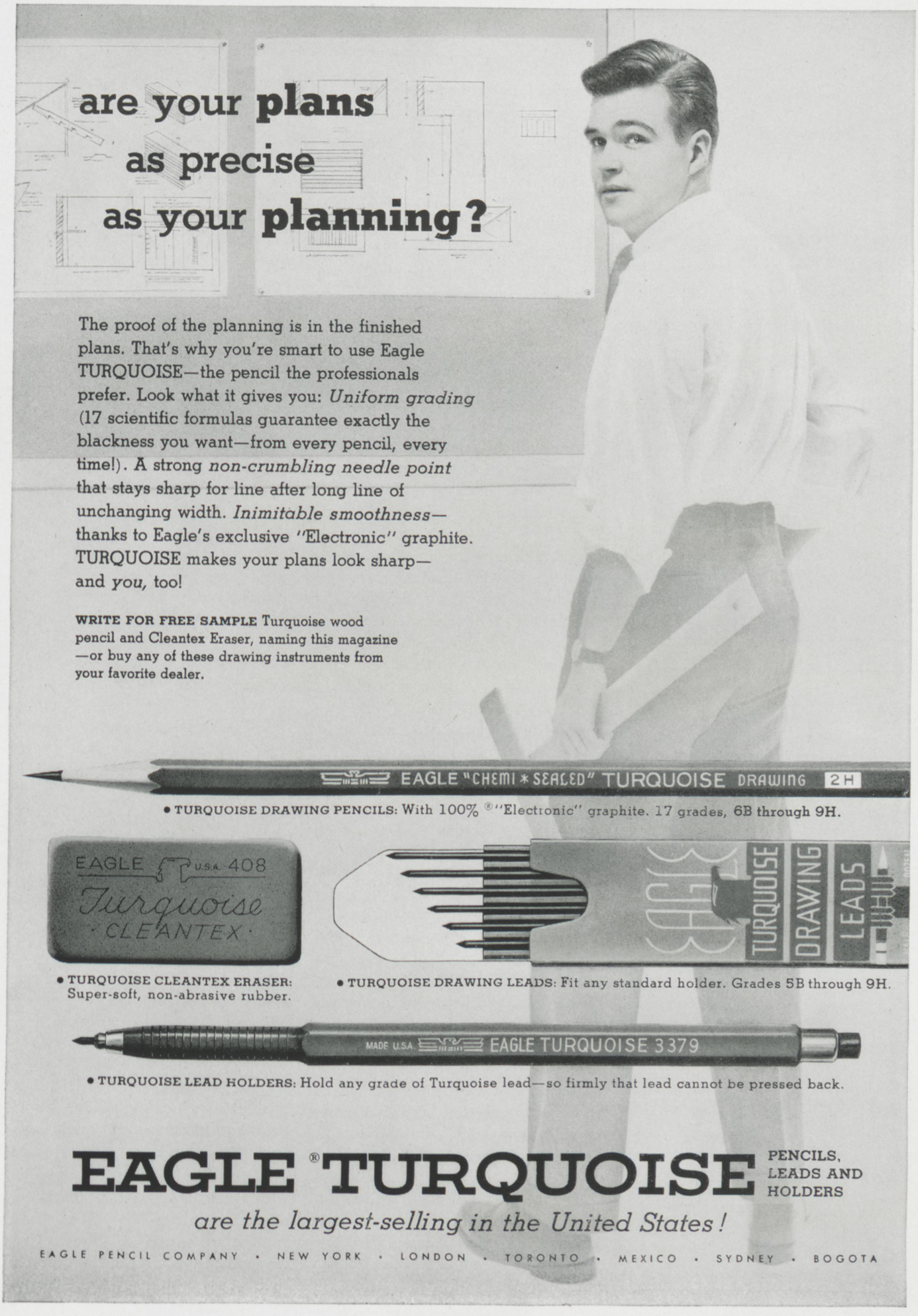
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MODULUS

(*Continued from Page* 12)

order, he found that some of the lists started with a man in the middle and went both ways. It is perhaps not in the best interests of the Institute to mention any direct quotations of Messrs. Williams and Burtner regarding the incident.

Trying to make the story of a year at an engineering school lively and entertaining is sometimes a perplexing job. Other schools have girls on campus to take pictures of. Certainly if the Modulus Staff had material like this to use in the book, it would be more attractive. But until some unheard of revolution occurs around here, we must continue to use our ingenuity to present the annual story of Rose—our classes, athletics, and recreations—as best we can. We believe that this story of a year at Rose is an interesting one and can be made very entertaining if it is well presented. Believe it or not, the Modulus Staff has found that there can be many dramatic human interest stories to tell about in the course of a year. We are doing our best to make the 1957 Modulus the true story of what goes on around here.

Financially speaking, the Modulus until last year finished in the red as a matter of tradition. To reduce expenses, the 1956 book was lithographed, which was less expensive than the standard process of offset printing. The money saved not only brought the Modulus out of the red, but provided a staff banquet and new equipment as well. Hopes are high that with the 1957 Modulus, we can set up an operating balance for the future. However the Modulus Staff is disappointed by the way sales have been lagging. We feel that the 1957 Modulus will be the best yearbook in Rose history, and that many more students will want this record of their college activities. Members of the sales staff anxious to sell you a 1957 Modulus are Jack McDonald, Vern Fellows, Paul Harder, Milt Sanders, and Bob Doom. We hope all of you will see one of these fellows right away.

FRATERNITY NOTES

(*Continued from Page* 13)

terrible. This will improve to the point of perfection though by the contest date.

Our house improvement committee is still looking for work to be done—quite a list has been made. Sometimes it seems simpler to build a new house. Gerry Rose who rewired our basement; Barlow Brooks, Dan Mook, and John Kennedy who were the "chief" in repaneling and receiling our basement; and Larry Kirts, Cookie, and Jim Oaks who fixed the kitchen will all agree. Really most of the house helped in these improvements headed by House Manager Rick Resseler and aided by painter Red Newgent and carpenter Bill Payne.

J. Bizal

SIGMA NU

Sigma Nu has extended its winning streak to five in a row in the interfraternity basketball league to give us a record of seven wins and one loss. We beat Lambda Chi Alpha last week 58-49 and we play TX this week. On March 9, we had the first half of our State Day which was the basketball games. We played the Sigma Nu's from Purdue and we lost a heartbreaker in the last minute.

On March 23, the Sigma Nu fraternities in Indiana had their second half of State Day at Butler which consists of the dance. It was held at the Antlers Hotel and all of the members had a good time.

Dave Williams "the wedge," who retired as Santa Claus at Roots this month, is getting himself in condition for next years job. Dave is filling himself out very well in certain places with mom's good cooking.

Also, it is rumored that Dick Light is planning on a date before the year is over. If true, this will be his first since a freshman and a celebration will be due.

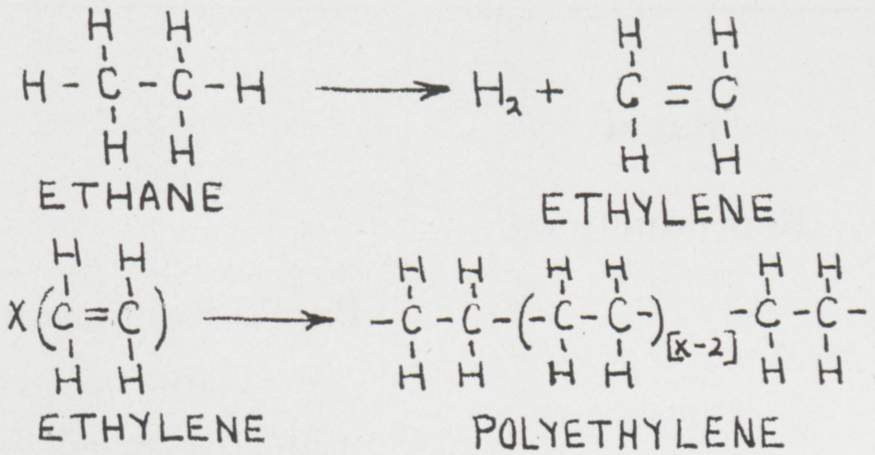
Congratulations to Don Slack who became engaged to Miss Marcia Huebschman and to Chuck Crum who pinned Miss Louise Van Buskirk.

Kent Sharp

POLYETHYLENE

New poly toys are becoming popular because they are both safe and able to withstand juvenile punishment. Now junior can safely bounce his beach pail off sister's head, and baby can toss his poly blocks at the window without disastrous results.

The atomic industry may provide a future use. Because of its chemical inertness, polyethylene containers may be able to carry away radioactive waste and uranium liquor that will be by-products of atomic-powered electric plants.



Equation for the polymerization of ethane gas, showing first the removal of a hydrogen molecule, then the high pressure polymerization to polyethylene.

Super Polyethylene

In 1955 it was announced that a radically simplified method of making polyethylene had been developed in Germany. This became known as the low-pressure method because by using a special catalyst only atmospheric pressure is required to bring about the polymerization of ethylene.

The product, super polyethylene, has somewhat different properties from ordinary poly and, therefore, will be only partially competitive. For example, the new plastic is not flexible enough to contend for the squeeze bottle market. However, super poly is stronger at low temperatures, which makes it useful in refrigeration equipment and high-altitude aircraft. An ordinary polyethylene tumbler may lose its shape in the hotter water and steam of an automatic dishwasher, but super poly can take temperatures up to 250°F without softening or deforming.

The new plastic has a tensile strength of 4,500 pounds per square inch, compared with 2,000 psi for ordinary poly. It is also more resistant to chemical attack. Super Dylan, produced by the Koppers Co., is unaffected even by hydrofluoric acid, which dissolves glass.

FUEL INJECTION

(*Continued from Page* 18)

The main drawback to the use of an injector system on passenger cars is the cost of manufacturing the pump for the injectors. The pump is expensive because it is small and many parts must be held to a very close tolerance. It must be capable of delivering as many as twenty or more injections per second. One injection may be only 1/1000 of a cubic inch. With mass production, it has been estimated that these pumps can be produced at almost the same cost as a four barrel carburetor. This would be quite expensive with one pump being required for each injector.

After much research, pump maufacturers have hit upon a basic design that may make fuel injection practical for passenger cars. This pump utilizes only one plunger, which makes six or eight times as many strokes per minute. Each measured shot of fuel is distributed to the proper injector head vit a "distributor head." The distribution principle is similar to that used in the ignition system of a present day car.

Chevrolet seems to be the pioneer in the American passenger car line. Rochester Products Division of General Motors, which developed the Chevrolet system, has been working on two types: the direct fuel injection, in which the fuel is forced under high pressure into the combustion chamber, where it mixes with air and is ignited; the indirect type, in which the fuel is injected just ahead of the intake port, where it is mixed with air, and then the mixture is fed into the cylinder. The indirect type allows easier conversion from the carburetor feed to fuel injection, making it possible to equip the standard family car with either system desired.

Fuel injection, which will provide greater acceleration and power, along with lowering fuel consumption, seems to be the most probable major change to be made in the modern gasoline engine.

POWER FOR AUTOMATION

(*Continued from Page 46*)

functioning of a d-c motor are such as to uniquely provide it with the ability to perform such taxing operations with ease. For instance, the speed of a d-c motor is proportional to the voltage applied to the motor's armature. Thus, the simplest way to control the motor speed is by varying the output strength of the generator supplying the power. This is best accomplished by using a rheostat to control excitation at the generator fields.

In addition, a "free-wheeling" d-c motor has the ability to operate as a generator, a factor which allows it to decelerate quite rapidly due to a resistive torque set up in it while functioning as a generator. By regulating its output current with variable resistors, precise decelerating control can be accomplished, the current either being dissipated as heat (dynamic braking) or fed back into the plant's power lines for use elsewhere (regenerative braking).

Lastly, where a motor must start and stop frequently, the d-c drive is more efficient than an a-c unit. A-C motors often draw large amounts of current on starting, and, consequently, produce excessive amounts of heat internally. D-C, on the other hand, is started by increasing the voltage, a factor which assures that its accelerating losses will be the lower of the two and that it may be started and stopped as often as desired with no resulting damage.

Although d-c power has numerous advantages over a-c for modern automated processes, it is seldom that an industry is able to purchase d-c power directly from a public utility. It is essential, therefore, that a cheap means of d-c production be found in order to reap the profits obtainable from direct current powered automatic machinery.

Several efficient and economical means of conversion are available for on-the-spot location. The most widely used method is the motor-generator set. Here, an a-c motor driving a d-c generator through a mechanical coupling, and suitable output control devices, safety devices, and ventilation equipment are all contained in a compact housing ready for installation near the machinery being powered. M-G sets can be had for any a-c voltage, frequency, or number of phases; and with their use, the advantages of regenerative braking become available. On the other hand, there are various electronic and metallic rectifier units available for use where blocks of d-c power are needed, and adjustable voltage control and regenerative braking are not particularly desired. Thus, the advantages of d-c powered machinery need be only as far away as the nearest packaged convertor unit.

How often do we find exactly what we need at a price we can afford to pay? It seems that in the realm of modern automation we have found, in d-c power, the unique ability to supply our needs efficiently, economically, and lastingly.

ADVERTISING INDEX

(*Continued from Page 40*)

each complete set of detail items for a particular file section had been processed, SEAC transmitted a special end-of-set flag to DYSEAC. The coordinated DYSEAC program called for (1) responding to the SEAC transmitted signal, (2) reading-in the message from SEAC, (3) determining whether the message was a detail item or an end-of-flag and (4) either tallying the appropriate master file item in the first case, or reading in the next in the case of the flag.

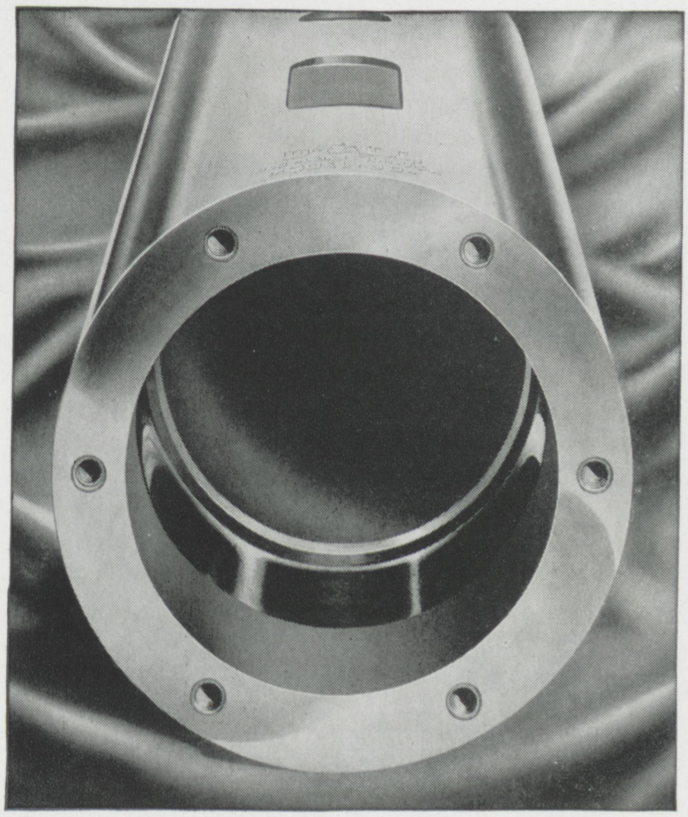
A cable between the SEAC building and the trailer van housing DYSEAC provided interconnection through a regular input-output terminal of each machine. Information transfers were initiated and terminated by transmission of control signals between the two machines. Whenever a SEAC output instruction called for selection of the particular output used for transmission to DYSEAC, a 62-volt preparatory signal was sent from the SEAC external selector unit to DYSEAC. This signal activated appropriate monitor operations in DYSEAC. As soon as DYSEAC was ready to accept the data, it transmitted a 63-volt signal to SEAC. Only upon receipt of this signal was SEAC able to proceed with its next instruction. In effect, SEAC continued trying to complete this output instruction until DYSEAC signalled readiness to accept the transfer.

This dual machine interconnection utilized both the special program control and the manual-monitor features of DYSEAC. In terms of program control, DYSEAC is a three-address automatically sequenced machine; choice between one of two counters as the source of the address of the actual next instruction is determined by control-code digits in the instruction being executed at any operating time. In addition, a special address-storage register can serve to locate the next instruction when new information or new instructions are to be interpolated into a program that is being processed, as in the case of manual-monitor operations.

Only a limited form of master-slave relationship was demonstrated. Only one of the two machines, DYSEAC, had the flexible system design features that provide for multiple machine processing and interruptibility necessary in the interdependent system. However, this limited experiment did demonstrate the significant fact that two machines need not have identical capabilities and characteristics in order to share a common data-processing program, provided that one machine has the necessary flexibility. The one machine that is capable of multiple-program processing with interruptibility can receive and process data fed directly to it form one or more external sources and can therefore share its high-speed memory, computing ability, and output facilities with remotely located external devices, including other computers with different characteristics.

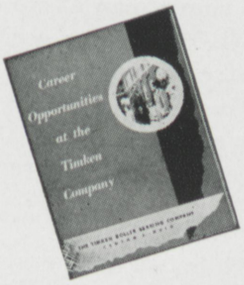
Another page for **YOUR STEEL NOTEBOOK**

Steel that lowered housing costs 26%



THIS part is a housing that must accurately position the spindle of a grinding machine that operates at high speeds. Dimensional stability is of prime importance. The manufacturer machined the part from bar stock. That meant drilling the hole—a costly step. Other factors raised costs even more. The manufacturer couldn't maintain the precise tolerances required and reduce production costs, too.

After studying the problem, Timken Company metallurgists recommended a switch from the bar stock previously used to Timken® seamless steel tubing. Immediate savings resulted. No drilling was required—the hole was already there. Scrap loss was reduced. More parts were produced per ton of steel. One of the annealing operations required with bar stock was eliminated. Stress-relieving operations were devised to insure complete stability of the finished part. Tolerances were held. And final reports showed that the switch to Timken seamless steel tubing cut production cost per housing 26%.



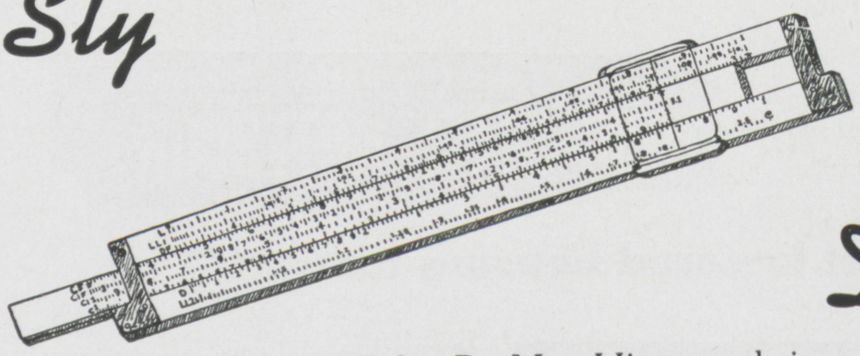
Want to learn more about steel or job opportunities?

Some of the engineering problems you'll face after graduation will involve steel. "The Story of Timken Alloy Steel Quality" will help you learn more about steel. And you might be interested, too, in the excellent job opportunities described in "Career Opportunities at the Timken Company". Drop us a card, ask for one or both booklets. The Timken Roller Bearing Company, Canton 6, Ohio.

TIMKEN *Fine Alloy* STEEL

TRADE-MARK REG. U.S. PAT. OFF.

SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS STEEL TUBING

Sly  Droolings

Stolen By Max Hippensteel, jr. e.e.

The young, inexperienced druggist was asked by a young lady for some cough medicine. Looking on the shelf he could find none.

"Please — cough cough — you've got to do something — cough cough — for — cough — me."

So he gave her his own idea of a remedy. Soon the owner returned and asked how business was. He reported that he had just cured a woman's cough. "I gave her a malted with 4 ozs. of mineral oil and 5 ozs. of castor oil. She doesn't dare cough."

* * *

A farmer who had earlier given two tramps a job chopping wood decided to check on how they were doing. He found one tramp leaning on his ax, watching the other execute a series of flip-flops and somersaults.

"Gosh," said the farmer, "I didn't know your friend was an acrobat."

"Neither did I," admitted the tramp, "till I cracked him on the shin with this ax.

* * *

The guy was walking down the street dressed only in a barrel when a cop stopped him.

"Are you a poker player?" asked the law.

"Not me," replied the character, "but I just left a couple of guys who are."

* * *

Soph: I failed my Physics exam.

Jr: But I thought you had the answers written on your cuff.

Soph: Yeah, but by mistake I put on my Calculus shirt.

The barber had a reputation for heavy drinking, and on a particular Monday morning there was a decided odor of whiskey on his breath. Suddenly the razor slipped and cut a nick in the customer's face.

"Now, Sam, you see what comes from too much drinking," the customer teased.

"Yessir," replied the barber as he wiped the blood from the blade. "Drinking sure does make the face tender."

* * *

A castaway on a desert island, following another shipwreck, pulled ashore a girl clinging to a barrel.

"How long have you been here?" asked the girl.

"Thirteen years" replied the castaway.

"All alone—then you're going to have something you haven't had for thirteen years," said the girl.

"You don't mean to tell me that barrel is full of beer."

* * *

Veteran of the South Seas: "While in the Marshalls I saw the screwiest bird. It lays square eggs and talks."

Prof: "Oh, yea! What does it say?"

Vet: "Ouch!"

* * *

C.E. "I suppose you dance?"

Coed: "Oh, yes, I love to."

C.E. "Great, that's better than dancing."

A conscience doesn't keep a man from doing anything wrong—it just prevents him from enjoying it.

* * *

Senior Engineer: We're coming to a tunnel. Are you afraid?"

Co-ed: "Not if you take that cigar out of your mouth."

* * *

C.E.: "I have here the one and only cure for dandruff."

Date: "Really, how does it work?"

C.E.: "Oh, it's really simple—it's a mixture of alcohol and sand."

Date: "But how does it cure dandruff?"

C.E.: "Well, you just rub the mixture on your hair; then the bugs get drunk and kill each other in a rock fight."

* * *

A young man (hard of hearing): "Well, Miss Grace, were you in the theatre last night?"

Miss Grace: "No, I was in bed very early . . ."

Youth: "Was it crowded?"

* * *

While two brothers were discussing their family, the younger asked, "Why does Grandpa spend so much time reading the Bible?"

"I think he's cramming for his finals." said the other.

* * *

Senior: Is this ice cream pure?

Waiter: As pure as the girl of your dreams.

Senior: Gimme a pack of cigarettes.

Illustration shows test of aircraft compass at United States Gauge, division of American Machine and Metals, Inc. A magnetic force, developed by the loops, pulls the compass card 30° off its normal heading. Then the force is released. The instant of release and the moment the compass recovers by 5° are both recorded on the film—become positive evidence of proper performance.

Wanted: an inspector with a split-second eye —*photography got the job*

A difference of 2/10ths of a second means the compass passes or fails. So the maker pits it against a stop watch—gets definite proof of performance with movies.

Uncle Sam said this aircraft compass must respond by 5 degrees in not less than 1 second or more than 1.2 seconds. That's only 2/10ths of a second leeway—far too little for human hands and eyes to catch the action accurately.

So, side-by-side, the stop watch and compass act their parts before the movie camera. Then individual frames along the film show the precise instant that the 5-degree mark is reached.

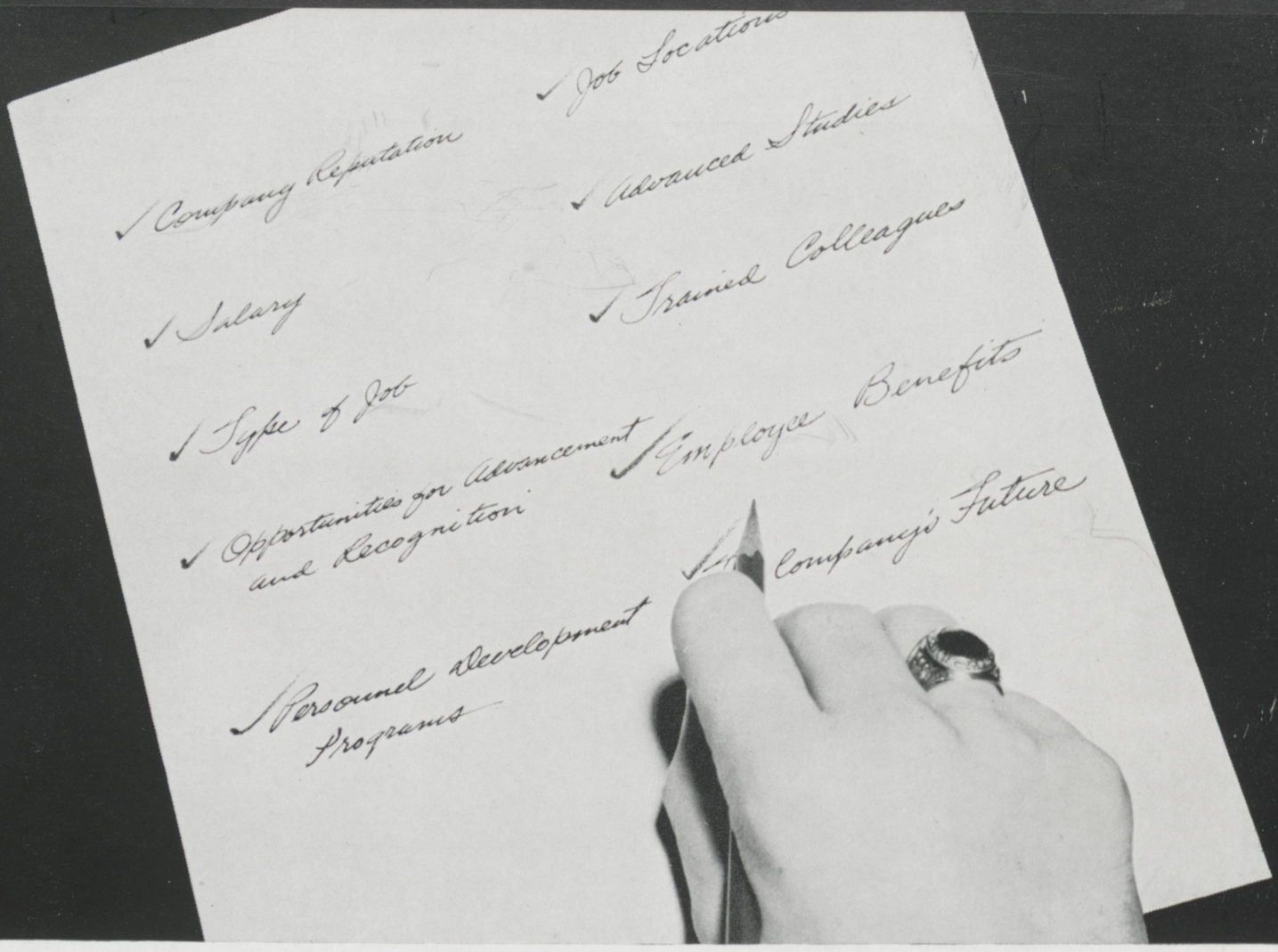
Product testing and quality control are naturals for photography. They are typical examples of the many ways photography works for businesses, large and small. It is improving production, saving time, reducing error, cutting costs.

CAREERS WITH KODAK

With photography and photographic processes becoming increasingly important in the business and industry of tomorrow, there are new and challenging opportunities at Kodak in research, engineering, electronics, design and production.

If you are looking for such an interesting opportunity, write for information about careers with Kodak. Address: Business and Technical Personnel Dept., Eastman Kodak Company, Rochester 4, N. Y.

Eastman Kodak Company, Rochester 4, N. Y.



How General Electric stacks up on your job check list

● **COMPANY REPUTATION**—As an engineer, the names of Thomas Edison and Charles Steinmetz should be known to you. These men, who so greatly influenced the industrial surge of our country since the 19th century, are symbolic of General Electric's past and present technological leadership.

● **SALARY**—General Electric's salary program is planned with a long-range view for your career; a well-considered starting salary and merit increases based on your contributions. Through regular counseling by your supervisor you know just "how you are progressing".

● **OPPORTUNITIES FOR ADVANCEMENT**—Through the Company's Personnel Registers, and individual appraisal of your qualifications and preferences, you are considered for all new or related jobs and promotions throughout the Company.

● **TYPE OF JOB**—Based on your personal preferences and abilities, you will work in various marketing, manufacturing or engineering fields. Your technical or managerial experiences may be in any of nearly 100 product departments where you contribute to the engineering, manufacturing or marketing of some of the more than 200,000 G-E products.

● **PERSONNEL DEVELOPMENT PROGRAMS**—General Electric, a pioneer in industrial training programs, hastens your professional development through classroom and on-the-job assignments as a part of the Company's marketing, manufacturing and engineering programs. Specific position placement is also available if your interests are already formulated.

● **JOB LOCATION**—There are opportunities for you as a G-E engineer in 150 cities in 45 states, plus many foreign countries.

● **ADVANCED STUDIES**—General Electric offers to technical graduates the Tuition Refund Program and Honors Program for Graduate Study wherein you may take graduate courses at nearby universities. In addition, G.E. sponsors graduate-level Company courses where top professional men teach in their respective fields.

● **TRAINED COLLEAGUES**—As a G-E engineer, you may be working with outstanding men who are responsible for the envisioning, production, and distribution of such new products as man-made diamonds, high-speed rocket and jet engines, the new heat pump, commercial atomic power reactors and electronic ovens.

● **EMPLOYEE BENEFITS**—General Electric's outstanding benefit program for you and your family includes all the usual life, accident and illness insurance and pension plans, plus a Savings and Stock Bonus Plan and discounts on G-E home appliances.

● **THE COMPANY'S FUTURE**—General Electric's investment in research can mean much to you. Forty-two major Company laboratories, dedicated to invention and innovation, will play a major role in doubling the Company's sales during the next eight years. Only through research is a company assured of future growth. For you, this growth at General Electric means new and challenging technical and managerial positions. General Electric Company, Section 959-3, Schenectady 5, N. Y.

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